Employment Opportunities

Technical Manual

Introduction

Finding the perfect job… the career that's just right for you is an elusive creature. It's something that every workingman and women wants but seldom finds – at least right away. It may take a decade or more to gather the right credentials and find your self in the right set of circumstances to capture the ideal job. However, nothing's going to happen unless you go out into the job market and hunt for what you want. Fortunately, employers have the same problem. They're looking for the perfect employee. They too are actively searching for the right person not only fill a position, but become an valuable asset to their company.

This guide will help you in your job search. It's full of sound advice on finding an entry-level position in the Information Technology industry. We'll explore required skills, educational and experiential employment requirements, as well as industry-recognized certification. You'll also complete laboratory experiments in which you will actually look for a job as an entry-level technician with A+ Certification.

Words and Terms You Should Know:

Employability Skills
Interpersonal Relationship Skills
Employability Skills
Information Technology (IT)
Industry Accepted Certification
CompTIA
Resume
Letter of Application
Letter of Acceptance
Letter of Rejection
Headhunter

The Job Hunt

The process of finding a job is filled with a language that's likened more to hunting big game than anything else. Hunting for a job, having a job in your sites, and landing a job are all phrases frequently used to describe searching for employment. Why? Because looking for the job you really want has all the trepidation, anticipation, and exhilaration of an African safari. As with the big game hunt, you'll need to bring along the proper provisions to be successful.

Often, it's not enough to have a specific technical skill to look attractive to a perspective employer. In fact, most employers value general employability and interpersonal relationship skills above specific vocation skills in entry-level employees. They've realized that it's much easier to teach technical skills to new workers with a strong work ethic than it is to instill employability and interpersonal relationship skills in employees with weaker work ethics.

So… You think you have skills?

Over a decade ago, the Secretary of Labor appointed a commission to determine what skills our young people need to succeed in the world of work. This body produced a report, "The Secretaries Commission on Acquiring Needed Skills" or the SCANS report. The commission's purpose was to encourage the developing high-performance economy as characterized by high-skill, high-wage employment. Although the commission completed its work in 1992, its findings and recommendations continue to be a pertinent to today's job market. In concert with employers and educations, the commission identified a list of fundamental skills that all entry-level employees should posses. These skills were divided into two groups; General Employability and Interpersonal Relationship skills.

Frank C. Pendzich © 16 July, 2002

GENERAL EMPLOYIBILITY COMPETENCIES

- **INFORMATION PROCESSING -** The student identifies the purpose for an Information search and develops an effective plan for the collection of relevant information using appropriate sources. The student locates, selects, and evaluates information in an organized manner in order to create clear and concise oral, visual, or written communication.

- **COMPUTER USAGE -** The student demonstrates proficiency in the use of computer technology by selecting appropriate programs to fit the needs of the desired outcome. The student responsibly operates, manipulates, and integrates word processing, graphics, spreadsheet, database, internet, and email software programs for written communication and graphic representation.

- **TECHNOLOGY USAGE -** The student selects, sets up, and uses a variety of technological tools. The student identifies and analyzes situations to circumvent, troubleshoot, and solve problems in the respective technologies used.

- **RESOURCING -** The student plans and utilizes time, money, materials, facilities, and human resources. The student selects appropriate resources and uses them efficiently to complete the task or project.

- **ORAL COMMUNICATION -** The student organizes ideas and communicates with clarity oral messages matched to the audience and situation. The student demonstrates listening with clear feedback to verbal and nonverbal messages.

- **WRITTEN COMMUNICATION -** The student employs the writing process to produce effective written communication for an intended audience. The student composes, creates, and records information completely and accurately in order to communicate thoughts, information, and messages.

- **READING -** The student interprets the meaning of written communication, identifies and explains the main idea and relevant details, ascertains the meaning of unknown vocabulary, and judges the accuracy, appropriateness, and plausibility of written communication.

- **MATHEMATICS USAGE -** The student approaches practical problems by choosing appropriately from a variety of mathematical techniques and uses data to construct logical explanations for real world situations. The student expresses math concepts orally and in writing and understands the role of chance in the occurrence and prediction of events.

- **SYSTEMS USAGE -** The student explains how current social, organizational, and technological systems work and operates effectively within them. The student explains how a system's structures relate to goals, respond to the demands of the system, and functions within the formal and informal social and organizational systems.

INTERPERSONAL COMPETENCIES

- **LEADERSHIP -** The student demonstrates competencies through the organization and coordination of group and individual tasks. The student can employ effective communication and listening skills to persuade and motivate others to accomplish goals. The student demonstrates sensitivity toward individual ideas and beliefs and will generate credibility through competence and integrity.

- **GROUP DYNAMICS -** The student organizes tasks and assumes different responsibilities as a contributing group member. Through positive interaction with respect for group diversity, the student negotiates, compromises, and reaches consensus when working toward a common goal.

- **PROBLEM SOLVING -**The student recognizes and defines the problem, generates alternative solutions, chooses the best alternative, and implements a plan of action. The student considers the consequences of these actions and makes informed decisions.

- **RESPONSIBILITY -** The student initiates and/or completes tasks consistently, exhibits regular and timely attendance, and is prepared to work and learn. The student demonstrates a high level of effort and perseverance towards reaching goals. The student takes care of materials and equipment, respects the property of others, and completes tasks on time.

- **SELF CONFIDENCE -** The student believes in own self worth and maintains a positive view of self. The student demonstrates knowledge of their own personal strengths and limitations, displays initiative, is aware of their impact on others, and responds to constructive criticism.
- **SELF MANAGEMENT -** The student sets realistic goals, organizes resources, prioritizes, and monitors own progress. The student evaluates information and motivates self in assessing progress toward completion of goals.

- **SOCIABILITY -** The student demonstrates understanding, friendliness, adaptability, empathy, and politeness in new and on-going group settings, and responds as the situation requires. The student cooperates as a team member, negotiates to arrive at a decision, demonstrates positive ways of solving conflicts, and relates to diverse groups.

- **COMMUNITY SERVICE -** The student will complete 60 to 100 hours of community service in one or several projects as authorized by school administration and as verified by the system designed by local schools and communities.

- **PERSONAL IDENTIFICATION -** The student produces a personal portfolio of major achievements and accomplishments and successfully produces a resume for employment purposes.

How many of these skills have you mastered? That's an important question because these are the specific skills that today's employers are looking for. Unfortunately they're not finding them among American applicants. Employers are forced to look into foreign job markets to find applicants that have the necessary general employability and interpersonal relationship skills to do the job.

IT?

The growing number of careers in the Information Technology (IT) profession changes daily. This is especially true since nearly everyone interacts with some sort of computer on a daily basis. From household appliances to the automobile, computer technology has crept into all aspects of our everyday existence. The people who create, construct, program, service, and support this technology are in themselves component parts of the IT profession. Here are but a few of the careers available in the Information Technology profession.

Computer Hardware Engineer

Computer hardware engineers research, design, develop, and test computer hardware and supervise its manufacture and installation. Hardware refers to computer chips, circuit boards, computer systems, and related equipment such as keyboards, modems, and printers. (Computer software engineers—often simply called computer engineers—design and develop the software systems that control computers.) The work of computer hardware engineers is very similar to that of electronics engineers, but unlike electronics engineers, computer hardware engineers work with computers and computer-related equipment exclusively. In addition to design and development, computer hardware engineers may supervise the manufacturing and installation of computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of computer hardware engineers. To keep up with technology change, these engineers must continually update their knowledge.

Computer Software Engineer

The explosive impact of computers and information technology on our everyday lives has generated a need to design and develop new computer software systems and to incorporate new technologies in a rapidly growing range of applications. The tasks performed by workers known as computer software engineers evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers. Computer software engineers apply the principles and techniques of computer science, engineering, and mathematical analysis to the design, development, testing, and evaluation of the software and systems that enable computers to perform their many applications. Software engineers working in applications or systems development analyze users' needs and design, create, and modify general computer applications software or systems.

Computer Support Specialist and Systems Administrator

This group includes technical support specialists and help-desk technicians. These troubleshooters interpret problems and provide technical support for hardware, software, and systems. They answer phone calls, analyze problems using automated diagnostic programs, and resolve recurrent difficulties. Support specialists may work either within a company that uses computer systems or directly for a computer hardware or software vendor.

Computer Operator

Computer operators oversee the operation of computer hardware systems, ensuring that these machines are used as efficiently as possible. They may work with mainframes, minicomputers, or networks of personal computers. Computer operators must anticipate problems and take preventive action, as well as solve problems that occur during operations.

The duties of computer operators vary with the size of the installation, the type of equipment used, and the policies of the employer. Generally, operators control the console of either a mainframe digital computer or a group of minicomputers. Working from operating instructions prepared by programmers, users, or operations managers, computer operators set controls on the computer and on peripheral devices required to run a particular job.

Systems Analysts, Computer Scientists, and Database Administrator

Systems analysts solve computer problems and enable computer technology to meet individual needs of an organization. They help an organization realize the maximum benefit from its investment in equipment, personnel, and business processes. This process may include planning and developing new computer systems or devising ways to apply existing systems' resources to additional operations. Systems analysts may design new systems, including both hardware and software, or add a new software application to harness more of the computer's power. Most systems analysts work with a specific type of system that varies with the type of organization they work for-for example, business, accounting, or financial systems, or scientific and engineering systems. Some systems analysts also are referred to as systems developers or systems architects.

Computer and Information Systems Manager

Computer and information systems managers direct the work of systems analysts, computer programmers, support specialists, and other computer-related workers. These managers plan and coordinate activities such as the installation and upgrading of hardware and software, programming and systems design, the development of computer networks, and the implementation of Internet and intranet sites. They are increasingly involved with the upkeep and maintenance of networks. They analyze the computer and information needs of their organization and determine personnel and equipment requirements. They assign and review the work of their subordinates, and stay abreast of the latest technology in order to purchase necessary equipment.

Computer Programmer

Computer programmers write, test, and maintain the detailed instructions, called programs, that computers must follow to perform their functions. They also conceive, design, and test logical structures for solving problems by computer. Many technical innovations in programming-advanced computing technologies and sophisticated new languages and programming tools-have redefined the role of a programmer and elevated much of the programming work done today. Job titles and descriptions may vary, depending on the organization. In this occupational statement, computer programmer refers to individuals whose main job function is programming; this group has a wide range of responsibilities and educational backgrounds.

You can find a complete job brief for each of these career choices in Appendix A of this document. The job briefs include detailed information regarding Significant Points, The Nature of the Work, Working Conditions, Employment, Training, Other Qualifications, and Advancement, Job Outlook, Earnings, and Related Occupations.

Without that sheepskin… You're going nowhere baby.

Most jobs in IT require a college degree… some do not. If you go to a 4-year college or university to prepare for an IT profession you can expect to major in one of two areas: ***Computer Science*** or ***Computer Science and Engineering***. You'll find sample requirements for Bachelor's degree in both of these disciplines in Appendix B of this document. Community and Junior colleges offer a 2-year version of an IT curriculum often called ***Computer and Information Sciences***. Upon complete of this program, graduates would be presented with an Associates degree.

Before you decide what college to attend, here are some interesting facts about the growing trends in the job market that might startle you.

- June 2002 high school students will change careers seven to nine times in their working lifetime.
- 65% percent of 1999 high school freshmen will be employed in careers that do not exist today.
- 90% of today's jobs require the use of technology.
- Automobile manufactures since 1992 have more technology onboard that did the Apollo 13.
- Technical repair manuals of today's automotive technicians have a reading level of grade 16.
- 90% of today's jobs require post secondary education and/or training, but not necessarily four years of college. Additional post secondary options include technical school, community college, apprenticeship programs, internships, on-the-job training, and the military.

Industry Recognized Computer Certification

Surveys show that information technology (IT) professionals are in high demand and their skills earn good money. Surveys also show that certified IT professionals make more money than most who are not certified. Companies have discovered the benefits and productivity gains realized through IT certification, creating higher demand and salaries for certified computer professionals.

A four-year, computer science degree is still nice to have, but no longer required to land a good-paying IT job. If you don't have the time or resources for a four-year degree, computer certification is the way to go. One, well-chosen certification course is all it takes to get the ball rolling.

Here are four popular computer certifications encompassing hardware, software, networking, and internetworking for balance. Of the four, some call Cisco, Microsoft and Novell certifications the "Big Three."

A+ Certification

This widely-acknowledged, general certification is for computer service technicians. It is sponsored by The Computing Technology Industry Association (CompTIA) and leans heavily toward hardware. But naturally, to install and repair computers, technicians must know something about networks, operating systems and customer relations, too. The exam assesses basic computer service and repair skills, by covering a broad range of these topics.

Courses are available at several authorized training centers, including those with online facilities. Prometric and Virtual University Enterprises administer the exam. You must pass two parts: the Core plus the Microsoft DOS/Windows module.

Cisco Certifications
Thanks to the Internet, Cisco Systems has grown by leaps and bounds in just a few years. They have a huge campus in Silicon Valley and job opportunities throughout the world. Some say that Cisco is the Internet. Accordingly, Cisco certifications are quite valuable.

Cisco Career Certifications are highly specialized for network professionals, and indicate three levels of technical proficiency: Associate (CCNA), Professional and Expert. The Cisco Certified Internet work Expert (CCIE) certification is at the top of the training pyramid for network support. The Cisco Certified Design Professional (CCDP) certification is at the top of the training pyramid for network design. Each allows you to specialize in routing & switching, WAN switching or other specialties such as security, a growing field. All other certifications are beginning or intermediate steps toward the top of the two pyramids, but are valuable on their own.

Cisco Training Partners offer the courses, while Prometric and Virtual University Enterprises administer the exams.

Microsoft Certified Professional
Microsoft Certified Professional (MCP) is a broad term for several types of certification credentials offered by Microsoft Corporation. You may earn "power user" certification by passing one or more exams for applications in the Microsoft Office suite. If you wish to be recognized as an IT professional, you may take it step farther by going for the master credentials.

Microsoft Certified Technical Education Centers (CTEC) offer the courses, while Prometric and Virtual University Enterprises administer the exams. The courses and exams aren't cheap, especially if you go for one of the master credentials. But you can usually get financial assistance from the CTECs.
Microsoft computer certifications are among the most prestigious. They're very hot and command comparatively higher salaries, typically with MCSE at or very near the top of the list, depending on employer demand.

Novell Professional Certifications
Novell's certifications are for network professionals and set the standard for IT training over ten years ago. They are among the prestigious on their own, but add a Novell Certification to Microsoft's, and you've got a super combination of skill sets for jobs in many, management information systems (MIS) and IT departments. That's because many companies have Microsoft Windows NT servers on Novell intranets. A nice plus is that Microsoft will give you credit for certain Novell Professional Certifications.
Novell's authorized training partners offer courses, self-study materials and financial assistance. Prometric and Virtual University Enterprises administer the exams.

Waging a Successful Job Campaign
Getting the job you want is not an easy-going, matter-of-fact task. Gone are the days when someone could present themselves to a company interviewer and say, “Here I am… Take me.” There are hundreds, if not thousands of qualified applicants in the job pool. Because of the keen competition for fewer and fewer good jobs, you must make special efforts to convince employers that you are just the right person for the job. No matter how qualified you think you are, you have competitors that are just as qualified… if not more.

Your edge comes in how well you can communicate your job credentials. When you are ready to apply for jobs, your ability to persuade prospective employers through your written and oral communications will make you victorious in the job hunt.

In many cases, your first contact with a firm will be in writing. For example, to follow up on an advertised job announcement, you must first send the firm a copy of your job resume and a letter of introduction (application letter). The long-range goal of this document packet is to land the job. However, the immediate goal is to win a face-to-face interview with a company representative.

Most applicants are screened out by companies on the sole basis of their resumes and letters. Many applicants never get the opportunity to sell themselves in person during interviews because their resumes didn't make the cut. This may seem somewhat unfair, especially for those who make a great personal impression and speak well but write poorly. From the company's point of view, the job screen is highly practical. In the current job market, very few jobs are available for many highly qualified job seekers and the hundreds of applicants who apply in response to and advertised job opening must be evaluated by limited screening recourses of personnel and time.

Review:

Finding the job you want requires a well planned and systematic approach if you are to be successful. The key to the entire process is collecting and the effectively presenting valued credentials to a prospective employer with the immediate goal of winning a face-to-face interview. Credentials verify your skills and experience and can include the SCANS Competency Certificate, Completed Coursework, Professional Degree, or IT Certification.

All jobs in the IT profession require some form of postsecondary education or training. There are IT preparatory programs in both 4-year and 2-year colleges, as well as, trade schools and the military. You might also consider IT Certification from CompTIA, Microsoft, Cisco, or Novell depending on your individual skills and needs.

Once you've identified a prospective employer, you'll then present yourself and your credentials though an expertly written resume and application letter. The whole idea is to "get your foot in the door" and land a job interview. From that point on, it's your primary goal to wow your interviewer with your appearance, personality, and oral communication skills. If you don't have the right credentials or your resume and application letter misses the mark… you'll have to start the job hunt all over again.

Appendix A
IT Job Briefs

Computer Hardware Engineers

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Nature of the Work

Computer hardware engineers research, design, develop, and test computer hardware and supervise its manufacture and installation. Hardware refers to computer chips, circuit boards, computer systems, and related equipment such as keyboards, modems, and printers. (Computer software engineers—often simply called computer engineers—design and develop the software systems that control computers.) The work of computer hardware engineers is very similar to that of electronics engineers, but unlike electronics engineers, computer hardware engineers work with computers and computer-related equipment exclusively. In addition to design and development, computer hardware engineers may supervise the manufacturing and installation of computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of computer hardware engineers. To keep up with technology change, these engineers must continually update their knowledge.

Employment

The number of computer hardware engineers is relatively small compared with the number of other computer-related workers who work with software or computer applications. Computer hardware engineers held about 60,000 jobs in 2000. About 25 percent were employed in computer and data processing services. About 1 out of 10 worked in computer and office equipment manufacturing, but many also are employed in communications industries and engineering consulting firms.

Job Outlook

Computer hardware engineers are expected to have favorable job opportunities. Employment of computer hardware engineers is projected to increase faster than the average for all occupations through 2010, reflecting rapid employment growth in the computer and office equipment industry, which employs the greatest number of computer engineers. Consulting opportunities for computer hardware engineers should grow as businesses need help managing, upgrading, and customizing increasingly complex systems. Growth in embedded systems, a technology that uses computers to control other devices such as appliances or cell phones, also will increase the demand for computer hardware engineers. In addition to job openings arising from employment growth, other vacancies will result from the need to replace workers who move into managerial positions, transfer to other occupations, or leave the labor force.

Earnings

Median annual earnings of computer hardware engineers were $67,300 in 2000. The middle 50 percent earned between $52,960 and $86,280. The lowest 10 percent earned less than $42,620, and the highest 10 percent earned more than $107,360. Median annual earnings in the industries employing the largest numbers of computer hardware engineers in 2000 were:

Computer and office equipment	$75,730
Computer and data processing services	$69,490
Electronic components and accessories	$67,800
Telephone communication	$59,160

Starting salaries for computer engineers with a bachelor's degree can be significantly higher than salaries of bachelor's degree graduates in many other fields. According to the National Association of Colleges and Employers, starting salary offers in 2001 for bachelor's degree candidates in computer engineering averaged $53,924 a year; master's degree candidates averaged $58,026; and Ph.D. candidates averaged $70,140.

Computer Software Engineers

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- Computer software engineers are projected to be the fastest growing occupation over the 2000 – 10 period.
- Very favorable opportunities are expected for college graduates with at least a bachelor's degree in computer engineering or computer science and practical experience working with computers.
- Computer software engineers must continually strive to acquire new skills as computer technology changes rapidly.

Nature of the Work

The explosive impact of computers and information technology on our everyday lives has generated a need to design and develop new computer software systems and to incorporate new technologies in a rapidly growing range of applications. The tasks performed by workers known as computer software engineers evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers. Computer software engineers apply the principles and techniques of computer science, engineering, and mathematical analysis to the design, development, testing, and evaluation of the software and systems that enable computers to perform their many applications. Software engineers working in applications or systems development analyze users' needs and design, create, and modify general computer applications software or systems.

Software engineers can be involved in the design and development of many types of software including software for operating systems, network distribution, and compilers, which convert programs for faster processing. In programming, or coding, software engineers instruct a computer, line by line, how to perform a function. They also solve technical problems that arise. Software engineers must possess strong programming skills, but are more concerned with developing algorithms and analyzing and solving programming problems than with actually writing code.

Computer applications software engineers analyze users' needs and design, create, and modify general computer applications software or specialized utility programs. Different programming languages are used, 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 and maintenance of a company's computer systems, and plan their future growth. Working with a company, they coordinate each department's computer needs-ordering, inventory, billing, and payroll record keeping, for example-and make suggestions about its technical direction. They also might set up the company's intranets, networks that link computers within the organization and ease communication.

Systems software engineers work for companies that configure, implement, and install complete computer systems. They may be members of the marketing or sales staff, where they serve as the primary technical resource for sales workers and customers. They also may be involved in product sales and in providing their customers with continuing technical support. 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 until the product is released.

Working Conditions

Computer software engineers normally work in well-lighted and comfortable offices or computer laboratories in which computer equipment is located. Most software engineers work at least 40 hours a week; however, due to the project-oriented nature of the work, they also may have to work evenings or weekends to meet deadlines or solve unexpected technical problems. And like other workers who sit for hours at a computer typing on a keyboard, software engineers are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome.

Many computer software engineers interact with customers and coworkers as they strive to improve software for users. Those employed by software vendors and consulting firms, for example, spend much of their time away from their offices, frequently traveling overnight, to meet with customers. They call on customers in businesses ranging from manufacturing plants to financial institutions.

As networks expand, software engineers may be able to use modems, laptops, e-mail, and the Internet to provide more technical support and other services from their main office, connecting to a customer's computer remotely to identify and correct developing problems.

Employment

Computer software engineers held about 697,000 jobs in 2000. About 380,000 were computer software engineers, applications, and about 317,000 were computer software engineers, systems software. Although they are employed in most industries, the largest concentration of computer software engineers, almost 46 percent, is in the computer and data processing services industry. This industry includes firms that develop and produce prepackaged software and firms that provide contractual computer services such as computer programming, systems integration, and information retrieval, including online databases and Internet services. Many computer software engineers also work for establishments in other industries, such as government agencies, manufacturers of computers and related electronic equipment, and colleges and universities.

Employers of computer software engineers range from startup companies to established industry leaders. The proliferation of Internet, e-mail, and other communications systems expands electronics to engineering firms traditionally associated with unrelated disciplines. Engineering firms specializing in building bridges and power plants, for example, hire computer software engineers to design and develop new geographic data systems and automated drafting capabilities. Communications firms need computer software engineers to tap into growth in the personal communications market. Major communications companies have many job openings for both computer software applications and systems engineers.

An increasing number of computer software engineers are employed on a temporary or contract basis-many of whom are self-employed, working independently as consultants. Some consultants work for firms that specialize in developing and maintaining client companies' websites and intranets. Consulting opportunities for software engineers should grow as businesses need help managing, upgrading, and customizing increasingly complex computer systems. About 49,000 computer software engineers were self-employed in 2000.

Training, Other Qualifications, and Advancement

Most employers prefer to hire persons who have at least a bachelor's degree and broad knowledge and experience with computer systems and technologies. Usual degree concentrations for applications software engineers are computer science or software engineering; for systems software engineers, usual concentrations are computer science or computer information systems. Graduate degrees are preferred for some of the more complex jobs.

Academic programs in software engineering emphasize software and may be offered as a degree option or in conjunction with computer science degrees. Students seeking software engineering jobs enhance their employment opportunities by participating in internship or co-op programs offered through their schools. These experiences provide students with broad knowledge and experience, making them more attractive candidates to employers. Inexperienced college graduates may be hired by large computer and consulting firms that train new hires in intensive, company-based programs. In many firms, mentoring has become part of the evaluation process for new employees.

For systems software engineering jobs that require workers who have a college degree, a bachelor's in computer science or computer information systems is typical. For systems engineering jobs that place less emphasis on workers having a computer-related degree, computer training programs are offered by systems software vendors, including Microsoft, Novell, and Oracle. These training programs usually last from 1 to 4 weeks but are not required in order to sit for a certification exam; several study guides also are available to help prepare for the exams. However, many training authorities feel that program certification alone is not sufficient for most software engineering jobs.

Professional certification is offered by the Institute for Certification of Computing Professionals. This voluntary certification is available to those who have a college degree and at least 2 years of experience. Candidates must pass an examination covering general knowledge and two specialty areas or one specialty area and two computer programming languages. In addition, the Institute of Electrical and Electronics Engineers Computer Society recently announced plans to certify software engineers who pass an examination. Persons 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. And because they often deal with a number of tasks simultaneously, they must be able to concentrate and pay close attention to detail.

As is the case with most occupations, advancement opportunities for computer software engineers increase with experience. Entry-level computer software engineers are likely to test and verify ongoing designs. As they become more experienced, computer software engineers may be involved in designing and developing software. They eventually may advance to become a project manager, manager of information systems, or chief information officer. Some computer software engineers with several years of experience or expertise find lucrative opportunities working as systems designers or independent consultants or starting their own computer consulting firms.

As technological advances in the computer field continue, employers demand new skills. Computer software engineers must continually strive to acquire new skills if they wish to remain in this extremely dynamic field. To help them keep up with the changing technology, continuing education and professional development seminars are offered by employers and software vendors, colleges and universities, private training institutions, and professional computing societies.

Job Outlook

Computer software engineers are projected to be the fastest growing occupation from 2000 to 2010. Very rapid employment growth in the computer and data processing services industry, which employs the greatest numbers of computer software engineers, should result in very favorable opportunities for those college graduates with at least a bachelor's degree in computer engineering or computer science and practical experience working with computers. Employers will continue to seek computer professionals with strong programming, systems analysis, interpersonal, and business skills.

Employment of computer software engineers is expected to increase much faster than the average for all occupations as businesses and other organizations continue to adopt and integrate new technologies and seek to maximize the efficiency of their computer systems. Competition among businesses will continue to create an incentive for increasingly sophisticated technological innovations, and organizations will need more computer software engineers to implement these new technological changes. In addition to employment growth, many job openings will result annually from the need to replace workers who move into managerial positions, transfer to other occupations, or who leave the labor force.

Demand for computer software engineers will increase as computer networking continues to grow. For example, the expanding integration of Internet technologies and the explosive growth in electronic commerce-doing business on the Internet-have resulted in rising demand for computer software engineers who can develop Internet, intranet, and other web applications. Likewise, expanding electronic data processing systems in business, telecommunications, government, and other settings continue to become more sophisticated and complex. Growing numbers of systems software engineers will be needed to implement, safeguard, and update systems and resolve problems. Consulting opportunities for computer software engineers also should continue to grow as businesses increasingly need help to manage, upgrade, and customize their increasingly complex computer systems.

Earnings

Median annual earnings of computer software engineers, applications, who worked full time in 2000 were about $67,670. The middle 50 percent earned between $53,390 and $85,490. The lowest 10 percent earned less than $42,710, and the highest 10 percent earned more than $106,680. Median annual earnings in the industries employing the largest numbers of computer applications software engineers in 2000 were:

Computer and office equipment	$74,300
Computer and data processing services	$69,520
Engineering and architectural services	$68,790
Professional and commercial equipment	$64,920
Management and public relations	$62,660

Median annual earnings of computer software engineers, systems software, who worked full time in 2000 were about $69,530. The middle 50 percent earned between $54,460 and $86,520. The lowest 10 percent earned less than $43,600, and the highest 10 percent earned more than $105,240. Median annual earnings in the industries employing the largest numbers of computer systems software engineers in 2000 were:

Computer and office equipment	$74,600
Computer and data processing services	$70,150
Telephone communication	$68,930
Engineering and architectural services	$68,030
Commercial banks	$65,620

According to the National Association of Colleges and Employers, starting salary offers for graduates with a bachelor's degree in computer engineering averaged $53,924 in 2001, and those with a master's degree averaged $58,026. Starting salary offers for graduates with a bachelor's degree in computer science averaged $52,723.

According to Robert Half International, starting salaries for software engineers in software development ranged from $62,750 to $92,000 in 2001. In addition to typical benefits, computer software engineers may be provided with profit sharing, stock options, and a company car with a mileage allowance.

Related Occupations

Other workers who extensively use mathematics and logic include systems analysts, computer scientists, and database administrators; computer programmers; financial analysts and personal financial advisors; computer hardware engineers; statisticians; mathematicians; management analysts; actuaries; and operations research analysts.

Computer Support Specialists and Systems Administrators

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- Computer support specialists and systems administrators are projected to be among the fastest growing occupations over the 2000-10 period.
- Job prospects should best for college graduates who are up to date with the latest skills and technologies; certifications and practical experience are essential for persons without degrees.

Nature of the Work

In the last decade, computers have become an integral part of everyday life, used for a variety of reasons at home, in the workplace, and at schools. And almost every computer user encounters a problem occasionally, whether it is the disaster of a crashing hard drive or the annoyance of a forgotten password. The explosion of computer use has created a high demand for specialists to provide advice to users, as well as day-to-day administration, maintenance, and support of computer systems and networks. Computer support specialists provide technical assistance, support, and advice to customers and other users.

This group includes technical support specialists and help-desk technicians. These troubleshooters interpret problems and provide technical support for hardware, software, and systems. They answer phone calls, analyze problems using automated diagnostic programs, and resolve recurrent difficulties. Support specialists may work either within a company that uses computer systems or directly for a computer hardware or software vendor.

Increasingly, these specialists work for help-desk or support services firms, where they provide computer support on a contract basis to clients. Technical support specialists are troubleshooters, providing valuable assistance to their organization's computer users. Because many non-technical employees are not computer experts, they often run into computer problems they cannot resolve on their own. Technical support specialists install, modify, clean, and repair computer hardware and software. They also may work on monitors, keyboards, printers, and mice. Technical support specialists answer phone calls from their organizations' computer users and may run automatic diagnostics programs to resolve problems. They also may write training manuals and train computer users how to properly use the new computer hardware and software. In addition, technical support specialists oversee the daily performance of their company's computer systems and evaluate software programs for usefulness.

Help-desk technicians assist computer users with the inevitable hardware and software questions not addressed in a product's instruction manual. Help-desk technicians field telephone calls and e-mail messages from customers seeking guidance on technical problems. In responding to these requests for guidance, help-desk technicians must listen carefully to the customer, ask questions to diagnose the nature of the problem, and then patiently walk the customer through the problem-solving steps.

Help-desk technicians deal directly with customer issues, and companies value them as a source of feedback on their products. These technicians are consulted for information about what gives customers the most trouble as well as their concerns. Most computer support specialists start out at the help desk. Network or computer systems administrators design, install, and support an organization's LAN, WAN, network segment, Internet, or Intranet system. They provide day-to-day onsite administrative support for software users in a variety of work environments, including professional offices, small businesses, government, and large corporations. They maintain network hardware and software, analyze problems, and monitor the network to ensure availability to system users. These workers gather data to identify customer needs and then use that information to identify, interpret, and evaluate system and network

requirements. Administrators also may plan, coordinate, and implement network security measures.

Systems administrators are the information technology employees responsible for the efficient use of networks by organizations. They ensure that the design of an organization's computer site allows all the components, including computers, the network, and software, to fit together and work properly. Furthermore, they monitor and adjust performance of existing networks and continually survey the current computer site to determine future network needs. Administrators also troubleshoot problems as reported by users and automated network monitoring systems and make recommendations for enhancements in the construction of future servers and networks.

In some organizations, computer security specialists may plan, coordinate, and implement the organization's information security. These and other growing specialty occupations reflect the increasing emphasis on client-server applications, the expansion of Internet and Intranet applications, and the demand for more end-user support.

Working Conditions

Computer support specialists and systems administrators normally work in well lit, comfortable offices or computer laboratories. They usually work about 40 hours a week, but that may include evening or weekend work if the employer requires computer support over extended hours. Overtime may be necessary when unexpected technical problems arise. Like other workers who type on a keyboard for long periods, computer support specialists and systems administrators are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome.

Due to the heavy emphasis on helping all types of computer users, computer support specialists and systems administrators constantly interact with customers and fellow employees as they answer questions and give valuable advice. Those who work as consultants are away from their offices much of the time, sometimes spending months working in a client's office.

As computer networks expand, more computer support specialists and systems administrators may be able to connect to a customer's computer remotely using modems, laptops, e-mail, and the Internet to provide technical support to computer users. This capability would reduce or eliminate travel to the customer's workplace.

Systems administrators also can administer and configure networks and servers remotely, though it not as common as with computer support specialists.

Employment

Computer support specialists and systems administrators held about 734,000 jobs in 2000. Of these, about 506,000 were computer support specialists and about 229,000 were network and computer systems administrators. Although they worked in a wide range of industries, about one-third of all computer support specialists and systems administrators were employed in business services industries, principally computer and data processing services. Other industries that employed substantial numbers of these workers include banks, government agencies, insurance companies, educational institutions, and wholesale and retail vendors of computers, office equipment, appliances, and home electronic equipment. Many computer support specialists also worked for manufacturers of computers and other office equipment and for firms making electronic components and other accessories.

Employers of computer support specialists and systems administrators range from start-up companies to established industry leaders. With the continued development of the Internet, telecommunications, and e-mail, industries not typically associated with computers-such as

construction-increasingly need computer-related workers. Small and large firms across all industries are expanding or developing computer systems, creating an immediate need for computer support specialists and systems administrators.

Training, Other Qualifications, and Advancement

Due to the wide range of skills required, there are a multitude of ways workers can become a computer support specialist or a systems administrator. While there is no universally accepted way to prepare for a job as a computer support specialist, many employers prefer to hire persons with some formal college education. A bachelor's degree in computer science or information systems is a prerequisite for some jobs; however, other jobs may require only a computer-related associate degree. For systems administrators, many employers seek applicants with bachelor's degrees, though not necessarily in a computer-related field.

Many companies are becoming more flexible about requiring a college degree for support positions because of the explosive demand for specialists. However, certification and practical experience demonstrating these skills will be essential for applicants without a degree. Completion of a certification training program, offered by a variety of vendors and product makers, may help some people to qualify for entry-level positions. Relevant computer experience may substitute for formal education.

Beginning computer support specialist start out at an organization dealing directly with customers or in-house users. Then, they may advance into more responsible positions in which they use what they learn from customers to improve the design and efficiency of future products. Job promotions usually depend more on performance than on formal education. Eventually, some computer support specialists become applications developers, designing products rather than assisting users. Computer support specialists at hardware and software companies often enjoy great upward mobility; advancement sometimes comes within months of initial employment.

Entry-level network and computer systems administrators are involved in routine maintenance and monitoring of computer systems, typically working behind the scenes in an organization. After gaining experience and expertise, they often are able to advance into more senior-level positions in which they take on more responsibilities. For example, senior network and computer systems administrators may present recommendations to management on matters related to a company's network. They also may translate the needs of an organization into a set of technical requirements, based on the available technology. As with support specialists, administrators may become software engineers, actually involved in the designing of the system or network, not just the day-to-day administration.

Persons interested in becoming a computer support specialist or systems administrator must have strong problem-solving, analytical, and communication skills because troubleshooting and helping others are a vital part of the job. The constant interaction with other computer personnel, customers, and employees require computer support specialists and systems administrators to communicate effectively on paper, via e-mail, or in person.

Strong writing skills are useful when preparing manuals for employees and customers. As technology continues to improve, computer support specialists and systems administrators must keep their skills current and acquire new ones. Many continuing education programs are offered by employers, hardware and software vendors, colleges and universities, and private training institutions. Professional development seminars offered by computing services firms also can enhance one's skills.

Job Outlook

Computer support specialists and systems administrators are projected to be among the fastest growing occupations over the 2000-10 period. Employment is expected to increase much faster than the average for all occupations as organizations continue to adopt and integrate increasingly sophisticated technology. Job growth will continue to be driven by rapid gains in computer and data processing services, which is projected to be the fastest growing industry in the U.S. economy.

The falling prices of computer hardware and software should help businesses expand their computing applications and integrate new technology into their operations. To maintain a competitive edge and operate more efficiently, firms will continue to demand computer specialists who are knowledgeable about the latest technologies and able to apply them to meet the needs of the organization.

Demand for computer support specialists is expected to increase because of the rapid pace of improved technology. As computers and software become more complex, support specialists will be needed to provide technical assistance to customers and other users. Consulting opportunities for computer support specialists also should continue to grow as businesses increasingly need help managing, upgrading, and customizing more complex computer systems.

Demand for systems administrators will grow as a result of the upsurge in electronic commerce and as computer applications continue to expand. Companies are looking for workers knowledgeable in the function and administration of networks. Such employees have become increasingly hard to find as systems administration has moved from being a separate function within corporations to one which forms a crucial element of business in an increasingly high-technology economy.

The growth of electronic commerce means more establishments use the Internet to conduct their business online. This translates into a need for information technology specialists who can help organizations use technology to communicate with employees, clients, and consumers. Explosive growth in these areas also is expected to fuel demand for specialists knowledgeable about network, data, and communications security.

Job prospects should be best for college graduates who are up to date with the latest skills and technologies, particularly if they have supplemented their formal education with some relevant work experience. Employers will continue to seek computer specialists who possess a strong background in fundamental computer skills combined with good interpersonal and communication skills. Due to the rapid growth in demand for computer support specialists and systems administrators, those who have strong computer skills but do not have a bachelor's degree should continue to qualify for some entry-level positions. However, certifications and practical experience are essential for persons without degrees.

Earnings

Median annual earnings of computer support specialists were $36,460 in 2000. The middle 50 percent earned between $27,680 and $48,440. The lowest 10 percent earned less than $21,260, and the highest 10 percent earned more than $63,480. Median annual earnings in the industries employing the largest numbers of computer support specialists in 2000 were:

Professional and commercial equipment	$42,970
Computer and data processing services	$37,860
Personnel supply services	$34,080
Colleges and universities	$32,830
Miscellaneous business services	$21,070

Median annual earnings of network and computer systems administrators were $51,280 in 2000. The middle 50 percent earned between $40,450 and $65,140. The lowest 10 percent earned less than $32,450, and the highest 10 percent earned more than $81,150. Median annual earnings in the industries employing the largest number of network and computer systems administrators in 2000 were:

Computer and data processing services	$54,400
Telephone communication	$52,620
Management and public relations	$51,340
Elementary and secondary schools	$45,450
Colleges and universities	$44,010

According to Robert Half International, starting salaries in 2001 ranged from $30,500 to $56,000 for help-desk support staff, and from $48,000 to $61,000 for more senior technical support specialists. For systems administrators, starting salaries in 2001 ranged from $50,250 to $70,750.

Related Occupations

Other computer-related occupations include computer programmers; computer software engineers; systems analysts, computer scientists, and database administrators; and operations research analysts.

Computer Operators

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- Employment is expected to decline sharply due to advances in technology.
- Opportunities will be best for operators who have formal computer-related education, are familiar with a variety of operating systems, and keep up-to-date with the latest technology.

Nature of the Work

Computer operators oversee the operation of computer hardware systems, ensuring that these machines are used as efficiently as possible. They may work with mainframes, minicomputers, or networks of personal computers. Computer operators must anticipate problems and take preventive action, as well as solve problems that occur during operations.

The duties of computer operators vary with the size of the installation, the type of equipment used, and the policies of the employer. Generally, operators control the console of either a mainframe digital computer or a group of minicomputers. Working from operating instructions prepared by programmers, users, or operations managers, computer operators set controls on the computer and on peripheral devices required to run a particular job.

Computer operators load equipment with tapes, disks, and paper, as needed. While the computer is running-which may be 24 hours a day for large computers-computer operators monitor the control console and respond to operating and computer messages. Messages indicate the individual specifications of each job being run. If an error message occurs, operators must locate and solve the problem or terminate the program. Operators also maintain logbooks or operating records, listing each job that is run and events, such as machine malfunctions, that occur during their shift. In addition, computer operators may help programmers and systems analysts test and debug new programs.

As the trend toward networking computers accelerates, a growing number of computer operators are working on personal computers (PCs) and minicomputers. In many offices, factories, and other work settings, PCs and minicomputers are connected in networks, often referred to as local area networks (LANs) or multi-user systems.

Whereas users in the area operate some of these computers, many require the services of full-time operators. The tasks performed on PCs and minicomputers are very similar to those performed on large computers. As organizations continue to look for opportunities to increase productivity, automation is expanding into additional areas of computer operations. Sophisticated software, coupled with robotics, enables a computer to perform many routine tasks formerly done by computer operators. Scheduling, loading and downloading programs, mounting tapes, rerouting messages, and running periodic reports can be done without the intervention of an operator. Consequently, these improvements will change what computer operators do in the future. As technology advances, the responsibilities of many computer operators are shifting to areas such as network operations, user support, and database maintenance.

Working Conditions

Computer operators generally work in well-lighted, well-ventilated, comfortable rooms. Because many organizations use their computers 24 hours a day, 7 days a week, computer operators may be required to work evening or night shifts and weekends. Shift assignments usually are made based on seniority. However, increasingly automated operations will lessen the need for shift work, because many companies let the computer take over operations during less desirable working hours. In addition, advances in telecommuting technologies-such as faxes,

modems, and e-mail-and data center automation, such as automated tape libraries, enable some operators to monitor batch processes, check systems performance, and record problems for the next shift.

Because computer operators generally spend a lot of time in front of a computer monitor, as well as performing repetitive tasks such as loading and unloading printers, they may be susceptible to eyestrain, back discomfort, and hand and wrist problems.

Employment

Computer operators held about 194,000 jobs in 2000. Most jobs are found in organizations such as wholesale trade establishments, manufacturing companies, business services firms, financial institutions, and government agencies that have data-processing needs requiring large computer installations. As more companies contract out the operation of their data-processing centers, a larger number of computer operators will be employed by service firms in the computer and data-processing services industry.

Training, Other Qualifications, and Advancement

Computer operators usually receive on-the-job training in order to become acquainted with their employer's equipment and routines. The length of training varies with the job and the experience of the worker. However, previous work experience is the key to obtaining an operator job in many large establishments. Employers generally look for specific, hands-on experience with the type of equipment and related operating systems they use. Additionally, formal computer-related training, perhaps through a community college or technical school, is recommended. Related training also can be obtained through the Armed Forces and from some computer manufacturers. As computer technology changes and data processing centers become more automated, employers will increasingly require candidates to have formal training and experience for operator jobs. And although not required, a bachelor's degree in a computer-related field can be helpful when one is seeking employment as a computer operator.

Because computer technology changes so rapidly, operators must be adaptable and willing to learn. Analytical and technical expertise also are needed, particularly by operators who work in automated data centers, to deal with unique or high-level problems that a computer is not programmed to handle. Operators must be able to communicate well, and to work effectively with programmers, users, and other operators. Computer operators also must be able to work independently because they may have little or no direct supervision.

A few computer operators may advance to supervisory jobs, although most management positions within data-processing or computer-operations centers require advanced formal education, such as a bachelor's or higher degree. Through on-the-job experience and additional formal education, some computer operators may advance to jobs in areas such as network operations or support. As they gain experience in programming, some operators may advance to jobs as programmers or analysts. A move into these types of jobs is becoming much more difficult, as employers increasingly require candidates for more-skilled computer jobs to possess at least a bachelor's degree.

Job Outlook

Employment of computer operators is expected to decline sharply through the year 2010. Experienced operators are expected to compete for the small number of openings that will arise each year to replace workers who transfer to other occupations or leave the labor force. Opportunities will be best for operators who have formal computer-related education, are familiar with a variety of operating systems, and keep up-to-date with the latest technology.

Advances in technology have reduced both the size and cost of computer equipment, while increasing the capacity for data storage and processing automation. Sophisticated computer

hardware and software are now used in practically every industry, in such areas as factory and office automation, telecommunications, medicine, education, and administration. The expanding use of software that automates computer operations gives companies the option of making systems user-friendly, greatly reducing the need for operators. Such improvements require operators to monitor a greater number of operations at the same time and be capable of solving a broader range of problems that may arise. The result is that fewer operators will be needed to perform more highly skilled work.

Computer operators who are displaced by automation may be reassigned to support staffs that maintain personal computer networks or assist other members of the organization. Operators who keep up with changing technology, by updating their skills and enhancing their training, should have the best prospects of moving into other areas such as network administration and technical support. Others may be retrained to perform different job duties, such as supervising an operations center, maintaining automation packages, or analyzing computer operations to recommend ways to increase productivity. In the future, operators who wish to work in the computer field will need to know more about programming, automation software, graphics interface, client/server environments, and open systems, in order to take advantage of changing opportunities.

Earnings

Median annual earnings of computer operators were $27,670 in 2000. The middle 50 percent earned between about $21,280 and $35,320 a year. The highest 10 percent earned more than $43,950, and the lowest 10 percent earned less than $17,350. Median annual earnings in the industries employing the largest numbers of computer operators in 2000 are shown below:

Computer and data processing services	$28,530
Hospitals	$26,550
Commercial banks	$22,840
Personnel supply services	$22,130
Miscellaneous business services	$21,980

The average salary for computer operators employed by the Federal Government was $37,574 in early 2001. According to Robert Half International, the average starting salaries for console operators ranged from $28,250 to $40,500 in 2001. Salaries generally are higher in large organizations than in small ones.

Related Occupations

Other occupations involving work with computers include computer software engineers; computer programmers; computer support specialists and systems administrators; and systems analysts, computer scientists, and database administrators. Other occupations in which workers operate electronic office equipment include data entry and information-processing workers, as well as secretaries and administrative assistants.

Computer and Information Systems Managers

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- Projected job growth stems primarily from rapid growth among computer-related occupations.
- Employers prefer managers with advanced technical knowledge acquired through computer-related work experience and formal education.
- Job opportunities should be best for applicants with a master's degree in business administration with technology as a core component.

Nature of the Work

The need for organizations to incorporate existing and future technologies in order to remain competitive has become a more pressing issue over the last several years. As electronic commerce becomes more common, how and when companies use technology are critical issues. Computer and information systems managers play a vital role in the technological direction of their organizations. They do everything from constructing the business plan to overseeing network and Internet operations.

Computer and information systems managers plan, coordinate, and direct research and design the computer-related activities of firms. They determine technical goals in consultation with top management, and make detailed plans for the accomplishment of these goals. For example, working with their staff, they may develop the overall concepts of a new product or identify computer-related problems standing in the way of project completion.

Computer and information systems managers direct the work of systems analysts, computer programmers, support specialists, and other computer-related workers. These managers plan and coordinate activities such as the installation and upgrading of hardware and software, programming and systems design, the development of computer networks, and the implementation of Internet and intranet sites. They are increasingly involved with the upkeep and maintenance of networks. They analyze the computer and information needs of their organization and determine personnel and equipment requirements. They assign and review the work of their subordinates, and stay abreast of the latest technology in order to purchase necessary equipment.

The duties of computer and information systems managers vary with their specific titles. Chief technology officers, for example, evaluate the newest and most innovative technologies and determine how these can help their organization. The chief technology officer, who often reports to the organization's chief information officer, manages and plans technical standards and tends to the daily information technology issues of their firm.

Because of the rapid pace of technological change, chief technology officers must constantly be on the lookout for developments that could benefit their organization. They are responsible for demonstrating to a company how information technology can be used as a competitive weapon that not only cuts costs, but also increases revenue.

Management of information systems (MIS) directors manage information systems and computing resources for entire organizations. They also work under the chief information officer and deal directly with lower-level information technology employees. These managers oversee a variety of user services such as an organization's help desk, which employees can call with questions or problems. MIS directors may also make hardware and software upgrade recommendations based on their experience with an organization's technology.

Computer and information system managers need strong communication skills. They coordinate the activities of their unit with those of other units or organizations. They confer with top

executives; financial, production, marketing, and other managers; and contractors and equipment and materials suppliers.

Working Conditions
Computer and information systems managers spend most of their time in an office. Most work at least 40 hours a week and may have to work evenings and weekends to meet deadlines or solve unexpected problems. Some computer and information systems managers may experience considerable pressure in meeting technical goals within short timeframes or tight budgets. As networks continue to expand and more work is done remotely, computer and information system managers have to communicate with and oversee offsite employees using modems, laptops, e-mail, and the Internet.

Like other workers who sit continuously in front of a keyboard, computer and information system managers are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome.

Employment
Computer and information systems managers held about 313,000 jobs in 2000. About 2 in 5 works in services industries, primarily for firms providing computer and data processing services. Other large employers include insurance and financial services firms, government agencies, and manufacturers.

Training, Other Qualifications, and Advancement
Strong technical knowledge is essential for computer and information systems managers, who must understand and guide the work of their subordinates, yet also explain the work in non-technical terms to senior management and potential customers. Therefore, these management positions usually require work experience and formal education similar to that of other computer occupations.

Many computer and information systems managers have experience as systems analysts; others may have experience as computer support specialists, programmers, or other information technology professionals. A bachelor's degree is usually required for management positions, although employers often prefer a graduate degree, especially a master's degree in business administration (MBA) with technology as a core component.

This degree differs from a traditional MBA in that there is a heavy emphasis on information technology in addition to the standard business curriculum. This becomes important because more computer and information systems managers make not only important technology decisions but also important business decisions for their organizations. A few computer and information systems managers may have only an associate degree, provided they have sufficient experience and were able to learn additional skills on the job.

Computer and information systems managers need a broad range of skills. In addition to technical skills, employers also seek managers with strong business skills. Employers want managers who have experience with the specific software or technology to be used on the job, as well as a background in either consulting or business management. The expansion of electronic commerce has elevated the importance of business insight, because many managers are called upon to make important business decisions. Managers need a keen understanding of people, processes, and customer's needs.

Computer and information systems managers must possess strong interpersonal, communication, and leadership skills because they are required to interact not only with their employees, but also with people inside and outside their organization. They must also possess great team skills to work on group projects and other collaborative efforts. Computer and

information systems managers increasingly interact with persons outside their organization, reflecting their emerging role as vital parts of their firm's executive team.

Computer and information systems managers may advance to progressively higher leadership positions in their field. Some may become managers in non-technical areas such as marketing, human resources, or sales. In high technology firms, managers in non-technical areas often must possess the same specialized knowledge as do managers in technical areas.

Job Outlook

Employment of computer and information systems managers is expected to increase much faster than the average for all occupations through the year 2010. Technological advancements will increase the employment of computer-related workers; as a result, the demand for managers to direct these workers also will increase. In addition, job openings will result from the need to replace managers who retire or move into other occupations.

Opportunities for obtaining a management position will be best for workers possessing an MBA with technology as a core component, advanced technical knowledge, and strong communication and administrative skills.

Rapid growth in employment can be attributed to the explosion in information technology and the fast-paced expansion of the computer and data processing services industry. In order to remain competitive, firms will continue to install sophisticated computer networks and set up more complex Internet and intranet sites. Keeping a computer network running smoothly is essential to almost every organization. Firms will be more willing to hire managers who can accomplish that.

The security of computer networks will continue to increase in importance as more business is conducted over the Internet. Organizations need to understand how their systems are vulnerable and how to protect their infrastructure and Internet sites from hackers, viruses, and other acts of cyber-terrorism. As a result, there will be a high demand for managers proficient in computer security issues.

Due to the explosive growth of electronic commerce and the ability of the Internet to create new relationships with customers, the role of computer and information systems managers will continue to evolve in the future. They will continue to become more vital to their companies and the environments in which they work. The expansion of e-commerce will spur the need for computer and information systems managers with both business savvy and technical proficiency.

Opportunities for those who wish to become computer and information systems managers should be closely related to the growth of the occupations they supervise and the industries in which they are found.

Earnings

Earnings for computer and information systems managers vary by specialty and level of responsibility. Median annual earnings of these managers in 2000 were $78,830. The middle 50 percent earned between $59,640 and $100,820. The lowest 10 percent earned less than $44,090, and the highest 10 percent earned more than $127,460. Median annual earnings in the industries employing the largest numbers of computer and information systems managers in 2000 were:

Professional and commercial equipment	$92,270
Computer and data processing services	$88,410
Commercial banks	$82,490
Management and public relations	$73,930
Colleges and universities	$64,460

According to Robert Half International Consulting, average starting salaries in 2001 for high-level information technology managers ranged from $92,250 to $152,500. According to a 2001 survey by the National Association of Colleges and Employers, starting salary offers for those with an MBA, a technical undergraduate degree, and 1 year or less of experience averaged $61,196; for those with a master's degree in management information systems/business data processing, $57,225.

In addition, computer and information systems managers, especially those at higher levels, often receive more benefits-such as expense accounts, stock option plans, and bonuses-than do non-managerial workers in their organizations.

Related Occupations

The work of computer and information systems managers is closely related to that of computer programmers, computer software engineers; systems analysts, computer scientists, and database administrators; and computer support specialists and systems administrators. Computer and information systems managers also have some high-level responsibilities similar to those of top executives.

Systems Analysts, Computer Scientists, and Database Administrators

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- As computer applications expand, systems analysts, computer scientists, and database administrators are projected to be the among the fastest growing occupations.
- Relevant work experience and a bachelor's degree are prerequisites for many jobs; for more complex jobs, a graduate degree is preferred.

Nature of the Work

The rapid spread of computers and information technology has generated a need for highly trained workers to design and develop new hardware and software systems and to incorporate new technologies. These workers-computer systems analysts, computer scientists, and database administrators-include a wide range of computer specialists. Job tasks and occupational titles used to describe these workers evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers.

Systems analysts solve computer problems and enable computer technology to meet individual needs of an organization. They help an organization realize the maximum benefit from its investment in equipment, personnel, and business processes. This process may include planning and developing new computer systems or devising ways to apply existing systems' resources to additional operations. Systems analysts may design new systems, including both hardware and software, or add a new software application to harness more of the computer's power. Most systems analysts work with a specific type of system that varies with the type of organization they work for-for example, business, accounting, or financial systems, or scientific and engineering systems. Some systems analysts also are referred to as systems developers or systems architects.

Analysts begin an assignment by discussing the systems problem with managers and users to determine its exact nature. They define the goals of the system and divide the solutions into individual steps and separate procedures. Analysts use techniques such as structured analysis, data modeling, information engineering, mathematical model building, sampling, and cost accounting to plan the system. They specify the inputs to be accessed by the system, design the processing steps, and format the output to meet the users' needs. They also may prepare cost-benefit and return-on-investment analyses to help management decide whether implementing the proposed system will be financially feasible.

When a system is accepted, analysts determine what computer hardware and software will be needed to set it up. They coordinate tests and observe initial use of the system to ensure it performs as planned. They prepare specifications, work diagrams, and structure charts for computer programmers to follow and then work with them to "debug," or eliminate errors from, the system. Analysts, who do more in-depth testing of products, may be referred to as software quality assurance analysts. In addition to running tests, these individuals diagnose problems, recommend solutions, and determine if program requirements have been met.

In some organizations, 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. As this becomes more commonplace, these analysts increasingly work with object-oriented programming languages, as well as client/server applications development, and multimedia and Internet technology.

One obstacle associated with expanding computer use is the need for different computer systems to communicate with each other. Because of the importance of maintaining up-to-date information-accounting records, sales figures, or budget projections, for example-systems analysts work on making the computer systems within an organization compatible so that information can be shared. Many systems analysts are involved with "networking," connecting all the computers internally-in an individual office, department, or establishment-or externally, because many organizations now rely on e-mail or the Internet. A primary goal of networking is to allow users to retrieve data and information from a mainframe computer or a server and use it on their machine. Analysts must design the hardware and software to allow free exchange of data, custom applications, and the computer power to process it all.
Networks come in many variations and network systems and data communications analysts analyze, design, test, and evaluate systems such as local area networks (LAN), wide area networks (WAN), Internet, Intranets, and other data communications systems. These analysts perform network modeling, analysis and planning; they also may research related products and make necessary hardware and software recommendations.

Telecommunications specialists focus on the interaction between computer and communications equipment. The growth of the Internet and expansion of the World Wide Web, the graphical portion of the Internet, have generated a variety of occupations related to design, development, and maintenance of Web sites and their servers. For example, webmasters are responsible for all technical aspects of a website, including performance issues such as speed of access, and for approving site content. Internet developers or web developers, also called web designers, are responsible for day-to-day site design and creation.

Computer scientists work as theorists, researchers, or inventors. Their jobs are distinguished by the higher level of theoretical expertise and innovation they apply to complex problems and the creation or application of new technology. Those employed by academic institutions work in areas ranging from complexity theory, to hardware, to programming language design. Some work on multidisciplinary projects, such as developing and advancing uses of virtual reality, in human-computer interaction, or in robotics. Their counterparts in private industry work in areas such as applying theory, developing specialized languages or information technologies, or designing programming tools, knowledge-based systems, or even computer games.

With the Internet and electronic business creating tremendous volumes of data, there is growing need to be able to store, manage, and extract data effectively. Database administrators work with database management systems software and determine ways to organize and store data. They determine user requirements, set up computer databases, and test and coordinate changes. It is the responsibility of an organization's database administrator to ensure performance, understand the platform the database runs on, and add new users. Because they also may design and implement system security, database administrators often plan and coordinate security measures. With the volume of sensitive data generated every second growing rapidly, data integrity, backup, and keeping databases secure have become an increasingly important aspect of the job for database administrators.

Working Conditions
Systems analysts, computer scientists, and database administrators normally work in offices or laboratories in comfortable surroundings. They usually work about 40 hours a week-the same as many other professional or office workers. However, evening or weekend work may be necessary to meet deadlines or solve specific problems. Given the technology available today, telecommuting is common for computer professionals. As networks expand, more work can be done from remote locations using modems, laptops, electronic mail, and the Internet.

Like other workers who spend long periods in front of a computer terminal typing on a keyboard, they are susceptible to eye strain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome or cumulative trauma disorder.

Employment

Systems analysts, computer scientists, and database administrators held about 887,000 jobs in 2000, including about 71,000 who were self-employed. Employment was distributed among the following detailed occupations:

Computer system analysts	$431,000
Network systems and data communications analysts	$119,000
Database administrators	$106,000
Computer and information scientists, research	$28,000
All other computer specialists	$203,000

Although they are increasingly employed in every sector of the economy, the greatest concentration of these workers is in the computer and data processing services industry. Firms in this industry provide nearly every service related to commercial computer use on a contract basis. Services include systems integration, networking, and reengineering; data processing and preparation; information retrieval, including on-line databases and Internet; onsite computer facilities management; development and management of databases; and a variety of specialized consulting. Many systems analysts, computer scientists, and database administrators work for other employers, such as government, manufacturers of computer and related electronic equipment, insurance companies, financial institutions, and universities.

A growing number of computer specialists, such as systems analysts and network and data communications analysts, are employed on a temporary or contract basis-many of whom are self-employed, working independently as contractors or self-employed consultants. For example, a company installing a new computer system may need the services of several systems analysts just to get the system running. Because not all of them would be needed once the system is functioning, the company might contract with systems analysts or a temporary help agency or consulting firm. Such jobs may last from several months up to 2 years or more. This growing practice enables companies to bring in people with the exact skills they need to complete a particular project, rather than having to spend time or money training or retraining existing workers. Often, experienced consultants then train a company's in-house staff as a project develops.

Training, Other Qualifications, and Advancement

Rapidly changing technology means an increasing level of skill and education demanded by employers. Companies are looking for professionals with a broader background and range of skills, including not only technical knowledge, but also communication and other interpersonal skills. This shift from requiring workers to possess solely sound technical knowledge emphasizes workers who can handle various responsibilities. While there is no universally accepted way to prepare for a job as a systems analyst, computer scientist, or database administrator, most employers place a premium on some formal college education. A bachelor's degree is a prerequisite for many jobs; however, some jobs may require only a 2-year degree. Relevant work experience also is very important. For more technically complex jobs, persons with graduate degrees are preferred.

For systems analyst, programmer-analyst, as well as database administrator positions, many employers seek applicants who have a bachelor's degree in computer science, information science, or management information systems (MIS). MIS programs usually are 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. Many employers increasingly seek individuals with a master's degree in business administration (MBA) with a concentration in information systems, as more firms move their business to the Internet. For some networks systems and data communication analysts, such as webmasters, an associate degree or certificate generally is sufficient, although more advanced positions might require a computer-related bachelor's degree. For computer and information scientists, a doctoral degree generally is required due to the highly technical nature of their work.

Despite the preference towards technical degrees, persons with degrees in a variety of majors find employment in these computer occupations. The level of education and type of training employers require depend on their needs. One factor affecting these needs is changes in technology. As demonstrated by the current demand for workers with skills related to the Internet, 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.

Most community colleges and many independent technical institutes and proprietary schools offer an associate degree in computer science or a related information technology field. Many of these programs may be more geared toward meeting the needs of local businesses and are more occupation-specific than those designed for a 4-year degree. Some jobs may be better suited to the level of training these programs offer. Employers usually look for people who have broad knowledge and experience related to computer systems and technologies, strong problem-solving and analytical skills, and good interpersonal skills. Courses in computer science or systems design offer good preparation for a job in these computer occupations. For jobs in a business environment, employers usually want systems analysts to have business management or closely related skills, while a back ground in the physical sciences, applied mathematics, or engineering is preferred for work in scientifically oriented organizations. Art or graphic design skills may be desirable for webmasters or Web developers.

Jobseekers can enhance their employment opportunities by participating in internship or co-op programs offered through their schools. Because many people develop advanced computer skills in one occupation and then transfer those skills into a computer occupation, a related background in the industry in which the job is located, such as financial services, banking, or accounting, can be important. Others have taken computer science courses to supplement their study in fields such as accounting, inventory control, or other business areas. For example, a financial analyst proficient in computers might become a systems analyst or computer support specialist in financial systems development, while a computer programmer might move into a systems analyst job.

Systems analysts, computer scientists, and database administrators must be able to think logically and have good communication skills. They often deal with a number of tasks simultaneously; the ability to concentrate and pay close attention to detail is important. Although these computer specialists sometimes work independently, they often work in teams on large projects. They must be able to communicate effectively with computer personnel, such as programmers and managers, as well as with users or other staff who may have no technical computer background.

Computer scientists employed in private industry may advance into managerial or project leadership positions. Those employed in academic institutions can become heads of research departments or published authorities in their field. Systems analysts may be promoted to senior

or lead systems analyst. Those who show leadership ability also can become project managers or advance into management positions such as manager of information systems or chief information officer. Database administrators also may advance into managerial positions such as chief technology officer, based on their experience managing data and enforcing security.

Computer specialists with work experience and considerable expertise in a particular subject area or application may find lucrative opportunities as independent consultants or choose to start their own computer consulting firms.

Technological advances come so rapidly in the computer field that continuous study is necessary to keep skills up to date. Employers, hardware and software vendors, colleges and universities, and private training institutions offer continuing education. Additional training may come from professional development seminars offered by professional computing societies.

Technical or professional certification is a way to demonstrate a level of competency or quality in a particular field. Product vendors or software firms also offer certification and may require professionals who work with their products to be certified. Many employers regard these certifications as the industry standard. For example, one method of acquiring enough knowledge to get a job as a database administrator is to become certified in a specific type of database management. Voluntary certification also is available through other organizations. Professional certification may provide a job seeker a competitive advantage.

Job Outlook

Systems analysts, computers scientists, and database administrators are expected to be the among the fastest growing occupations through 2010. Employment of these computer specialists is expected to increase much faster than the average for all occupations as organizations continue to adopt and integrate increasingly sophisticated technologies. Growth will be driven by very rapid growth in computer and data processing services, which is projected to be the fastest growing industry in the U.S. economy. In addition, many job openings will arise annually from the need to replace workers who move into managerial positions or other occupations or who leave the labor force.

The demand for networking to facilitate the sharing of information, the expansion of client/server environments, and the need for computer specialists to use their knowledge and skills in a problem-solving capacity will be major factors in the rising demand for systems analysts, computer scientists, and database administrators. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand computerized operations and integrate new technologies. In order to maintain a competitive edge and operate more efficiently, firms will continue to demand computer specialists who are knowledgeable about the latest technologies and are able to apply them to meet the needs of businesses.

Increasingly, more sophisticated and complex technology is being implemented across all organizations, which should fuel the demand for these computer occupations. There is a growing demand for system analysts to help firms maximize their efficiency using available technology. The explosive growth in electronic commerce-doing business on the Internet-and the continuing need to build and maintain databases that store critical information on customers, inventory, and projects is fueling demand for database administrators familiar with the latest technology.

The development of new technologies usually leads to demand for various workers. The expanding integration of Internet technologies by businesses, for example, has resulted in a growing need for specialists who can develop and support Internet and intranet applications.

The growth of electronic commerce means more establishments use the Internet to conduct their business online. This translates into a need for information technology professionals who can help organizations use technology to communicate with employees, clients, and consumers. Explosive growth in these areas also is expected to fuel demand for specialists knowledgeable about network, data, and communications security.

As technology becomes more sophisticated and complex, employers demand a higher level of skill and expertise. Individuals with an advanced degree in computer science, computer engineering, or an MBA with a concentration in information systems should enjoy very favorable employment prospects. College graduates with a bachelor's degree in computer science, computer engineering, information science, or management information systems also should enjoy favorable prospects for employment, particularly if they have supplemented their formal education with practical experience. Because employers continue to seek computer specialists who can combine strong technical skills with good interpersonal and business skills, graduates with non-computer science degrees but who have had courses in computer programming, systems analysis, and other information technology areas, also should continue to find jobs in these computer fields. In fact, individuals with the right experience and training can work in these computer occupations regardless of their college major or level of formal education.

Earnings

Median annual earnings of computer systems analysts were $59,330 in 2000. The middle 50 percent earned between $46,980 and $73,210 a year. The lowest 10 percent earned less than $37,460, and the highest 10 percent earned more than $89,040. Median annual earnings in the industries employing the largest numbers of computer systems analysts in 2000 were:

Computer and data processing services	$64,110
Professional and commercial equipment	$63,530
Federal Government	$59,470
Local government	$52,490
State government	$51,230

Median annual earnings of database administrators were $51,990 in 2000. The middle 50 percent earned between $38,210 and $71,440. The lowest 10 percent earned less than $29,400, and the highest 10 percent earned more than $89,320. In 2000, median annual earnings of database administrators employed in computer and data processing services were $63,710, and in telephone communication, $52,230.

Median annual earnings of network systems and data communication analysts were $54,510 in 2000. The middle 50 percent earned between $42,310 and $69,970. The lowest 10 percent earned less than $33,360, and the highest 10 percent earned more than $88,620. Median annual earnings in the industries employing the largest numbers of network systems and data communications analysts in 2000 were:

Management and public relations	$60,260
Commercial banks	$59,910
Computer and data processing services	$59,160
Telephone communications	$51,780
State government	$42,000

Median annual earnings of computer and information scientists, research, were $70,590 in 2000. The middle 50 percent earned between $54,700 and $89,990. The lowest 10 percent earned less than $41,390, and the highest 10 percent earned more than $113,510. Median annual earnings of computer and information scientists employed in computer and data

processing services in 2000 were $71,940. Median annual earnings of all other computer specialists were $50,590 in 2000. Median annual earnings of all other computer specialists employed in computer and data processing services were $51,970, and in professional and commercial equipment, $80,270 in 2000.

According to the National Association of Colleges and Employers, starting offers for graduates with a master's degree in computer science averaged $61,453 in 2001. Starting offers for graduates with a bachelor's degree in computer science averaged $52,723; in computer programming, $48,602; in computer systems analysis, $45,643; in information sciences and systems, $45,182; and in management information systems, $45,585.

According to Robert Half International, starting salaries in 2001 ranged from $72,500 to $105,750 for database administrators. Salaries for Internet-related occupations ranged from $58,000 to $82,500 for webmasters and $56,250 to $76,750 for Internet/Intranet developers.

Related Occupations

Other workers who use logic and creativity to solve business and technical problems are computer programmers, computer software engineers, computer and information systems managers, financial analysts and personal financial advisors, urban and regional planners, engineers, mathematicians, statisticians, operations research analysts, management analysts, and actuaries.

Computer Programmers

From: ComputerJobs.com, 280 Interstate North Parkway, SE Suite 00, Atlanta, GA 30339-2411, 800-850-0045

Significant Points

- Employment growth will be considerably slower than that of other computer specialists, due to the spread of pre-packaged software solutions.
- Three out of 5 computer programmers held at least a bachelor's degree in 2000.
- Prospects should be best for college graduates with knowledge of a variety of programming languages and tools; those with less formal education or its equivalent in work experience should face strong competition for programming jobs.

Nature of the Work

Computer programmers write, test, and maintain the detailed instructions, called programs, that computers must follow to perform their functions. They also conceive, design, and test logical structures for solving problems by computer. Many technical innovations in programming-advanced computing technologies and sophisticated new languages and programming tools-have redefined the role of a programmer and elevated much of the programming work done today. Job titles and descriptions may vary, depending on the organization. In this occupational statement, computer programmer refers to individuals whose main job function is programming; this group has a wide range of responsibilities and educational backgrounds.

Computer programs tell the computer what to do, such as which information to identify and access, how to process it, and what equipment to use. Programs vary widely depending upon the type of information to be accessed or generated. For example, the instructions involved in updating financial records are very different from those required to duplicate conditions on board an aircraft for pilots training in a flight simulator. Although simple programs can be written in a few hours, programs that use complex mathematical formulas, whose solutions can only be approximated, or that draw data from many existing systems, may require more than a year of work. In most cases, several programmers work together as a team under a senior programmer's supervision.

Programmers write programs according to the specifications determined primarily by computer software engineers and system analysts. After the design process is complete, it is the job of the programmer to convert that design into a logical series of instructions that the computer can follow. They then code these instructions in a conventional programming language, such as COBOL; an artificial intelligence language, such as Prolog; or one of the most advanced object-oriented languages such as Java, C++, or Smalltalk. Different programming languages are used depending on the purpose of the program. COBOL, for example, is commonly used for business applications, whereas Fortran (short for "formula translation") is used in science and engineering. C++ is widely used for both scientific and business applications. Programmers generally know more than one programming language; and since many languages are similar, they often can learn new languages relatively easily. In practice, programmers often are referred to by the language they know, such as Java programmers, or the type of function they perform or environment in which they work, such as database programmers, mainframe programmers, or Internet programmers.

Many programmers update, repair, modify, and expand existing programs. When making changes to a section of code, called a routine, programmers need to make other users aware of the task the routine is to perform. They do this by inserting comments in the coded instructions, so others can understand the program. Many programmers use computer-assisted software engineering (CASE) tools to automate much of the coding process. These tools enable a programmer to concentrate on writing the unique parts of the program, because the tools

automate various pieces of the program being built. CASE tools generate whole sections of code automatically, rather than line by line. This also yields more reliable and consistent programs and increases programmers' productivity by eliminating some routine steps.

Programmers test a program by running it, to ensure the instructions are correct and it produces the desired information. If errors do occur, the programmer must make the appropriate change and recheck the program until it produces the correct results. This process is called debugging. Programmers may continue to fix these problems throughout the life of a program. Programmers working in a mainframe environment may prepare instructions for a computer operator who will run the program. They also may contribute to a manual for users.

Programmers often are grouped into two broad types-applications programmers and systems programmers. Applications programmers write programs to handle a specific job, such as a program to track inventory, within an organization. They may also revise existing packaged software. Systems programmers, on the other hand, write programs to maintain and control computer systems software, such as operating systems, networked systems, and database systems. These workers make changes in the sets of instructions that determine how the network, workstations, and central processing unit of the system handle the various jobs they have been given and how they communicate with peripheral equipment, such as terminals, printers, and disk drives. Because of their knowledge of the entire computer system, systems programmers often help applications programmers determine the source of problems that may occur with their programs.

Programmers in software development companies may work directly with experts from various fields to create software-either programs designed for specific clients or packaged software for general use ranging from games and educational software to programs for desktop publishing, financial planning, and spreadsheets. Much of this type of programming is in the preparation of packaged software, which comprises one of the most rapidly growing segments of the computer services industry.

In some organizations, particularly small ones, workers commonly known as programmer-analysts are responsible for both the systems analysis and the actual programming work. Advanced programming languages and new object-oriented programming capabilities are increasing the efficiency and productivity of both programmers and users. The transition from a mainframe environment to one that is primarily personal computer (PC) based has blurred the once rigid distinction between the programmer and the user. Increasingly, adept end-users are taking over many of the tasks previously performed by programmers. For example, the growing use of packaged software, like spreadsheet and database management software packages, allows users to write simple programs to access data and perform calculations.

Working Conditions

Programmers generally work in offices in comfortable surroundings. Many programmers may work long hours or weekends, to meet deadlines or fix critical problems that occur during off hours. Given the technology available, telecommuting is becoming common for a wide range of computer professionals-including computer programmers. As computer networks expand, more programmers are able to connect to a customer's computer system remotely to make corrections or fix problems, using modems, e-mail, and the Internet.

Like other workers who spend long periods of time in front of a computer terminal typing at a keyboard, programmers are susceptible to eyestrain, back discomfort, and hand and wrist problems, such as carpal tunnel syndrome.

Employment

Computer programmers held about 585,000 jobs in 2000. Programmers are employed in almost every industry, but the largest concentration is in the computer and data processing services industry, which includes firms that write and sell software. Large numbers of programmers can also be found working for firms that provide engineering and management services, telecommunications companies, manufacturers of computer and office equipment, financial institutions, insurance carriers, educational institutions, and government agencies.

A large number of computer programmers are employed on a temporary or contract basis or work as independent consultants, as companies demand expertise with new programming languages or specialized areas of application. Rather than hiring programmers as permanent employees and then laying them off after a job is completed, employers can contract with temporary help agencies, consulting firms, or directly with programmers themselves. A marketing firm, for example, may only require the services of several programmers to write and debug the software necessary to get a new customer resource management system running. This practice also enables companies to bring in people with a specific set of skills-usually in one of the latest technologies-as it applies to their business needs. Bringing in an independent contractor or consultant with a certain level of experience in a new or advanced programming language, for example, enables an establishment to complete a particular job without having to retrain existing workers. Such jobs may last anywhere from several weeks to a year or longer. There were 22,000 self-employed computer programmers in 2000.

Training, Other Qualifications, and Advancement

While there are many training paths available for programmers, mainly because employers' needs are so varied, the level of education and experience employers seek has been rising, due to the growing number of qualified applicants and the specialization involved with most programming tasks. Bachelor's degrees are commonly required, although some programmers may qualify for certain jobs with 2-year degrees or certificates.

Employers are primarily interested in programming knowledge, and computer programmers are able to get certified in a language such as C++ or Java. College graduates who are interested in changing careers or developing an area of expertise also may return to a 2-year community college or technical school for additional training. In the absence of a degree, substantial specialized experience or expertise may be needed. Even with a degree, employers appear to be placing more emphasis on previous experience, for all types of programmers.

High school graduate or equivalent or less	11.8%
Some college, no degree	17.2%
Associate degree	11.0%
Bachelor's degree	47.4%
Graduate degree	12.8%

About 3 out of 5 computer programmers had a bachelor's degree or higher in 2000 (table 1). Of these, some hold a degree in computer science, mathematics, or information systems, whereas others have taken special courses in computer programming to supplement their study in fields such as accounting, inventory control, or other areas of business. As the level of education and training required by employers continues to rise, this proportion should increase in the future.

Required skills vary from job to job, but the demand for various skills generally is driven by changes in technology. Employers using computers for scientific or engineering applications usually prefer college graduates who have degrees in computer or information science, mathematics, engineering, or the physical sciences. Graduate degrees in related fields are required for some jobs. Employers who use computers for business applications prefer to hire

people who have had college courses in management information systems (MIS) and business and who possess strong programming skills. Although knowledge of traditional languages still is important, increasing emphasis is placed on newer, object-oriented programming languages and tools, such as C++ and Java. Additionally, employers are seeking persons familiar with fourth and fifth generation languages that involve graphic user interface (GUI) and systems programming. Employers also prefer applicants who have general business skills and experience related to the operations of the firm. Students can improve their employment prospects by participating in a college work-study program or by undertaking an internship.

Most systems programmers hold a 4-year degree in computer science. Extensive knowledge of a variety of operating systems is essential. This includes being able to configure an operating system to work with different types of hardware and adapting the operating system to best meet the needs of a particular organization. Systems programmers also must be able to work with database systems, such as DB2, Oracle, or Sybase, for example.

When hiring programmers, employers look for people with the necessary programming skills who can think logically and pay close attention to detail. The job calls for patience, persistence, and the ability to work on exacting analytical work, especially under pressure. Ingenuity and imagination also are particularly important, when programmers design solutions and test their work for potential failures. The ability to work with abstract concepts and to do technical analysis is especially important for systems programmers, because they work with the software that controls the computer's operation. Because programmers are expected to work in teams and interact directly with users, employers want programmers who are able to communicate with non-technical personnel.

Entry-level or junior programmers may work alone on simple assignments after some initial instruction or on a team with more experienced programmers. Either way, beginning programmers generally must work under close supervision. Because technology changes so rapidly, programmers must continuously update their training by taking courses sponsored by their employer or software vendors.

For skilled workers who keep up to date with the latest technology, the prospects for advancement are good. In large organizations, programmers may be promoted to lead programmer and be given supervisory responsibilities. Some applications programmers may move into systems programming after they gain experience and take courses in systems software. With general business experience, programmers may become programmer analysts or systems analysts or be promoted to a managerial position.

Other programmers, with specialized knowledge and experience with a language or operating system, may work in research and development areas, such as multimedia or Internet technology. As employers increasingly contract out programming jobs, more opportunities should arise for experienced programmers with expertise in a specific area to work as consultants.

Technical or professional certification is a way to demonstrate a level of competency or quality. In addition to language-specific certificates that a programmer can obtain, product vendors or software firms also offer certification and may require professionals who work with their products to be certified. Voluntary certification also is available through other organizations. Professional certification may provide a job seeker a competitive advantage.

Job Outlook

Employment of programmers is expected to grow about as fast as the average for all occupations through 2010. Jobs for both systems and applications programmers should be most plentiful in data processing service firms, software houses, and computer consulting businesses. These types of establishments are part of computer and data processing services, which is projected to be the fastest growing industry in the economy over the 2000-10 period. As organizations attempt to control costs and keep up with changing technology, they will need programmers to assist in conversions to new computer languages and systems. In addition, numerous job openings will result from the need to replace programmers who leave the labor force or transfer to other occupations such as manager or systems analyst.

Employment of programmers, however, is expected to grow much slower than that of other computer specialists. With the rapid gains in technology, sophisticated computer software now has the capability to write basic code, eliminating the need for more programmers to do this routine work. The consolidation and centralization of systems and applications, developments in packaged software, advanced programming languages and tools, and the growing ability of users to design, write, and implement more of their own programs means more of the programming functions can be transferred to other types of workers. As the level of technological innovation and sophistication increases, programmers should continue to face increasing competition from programming businesses overseas where much routine work can be contracted out at a lower cost.

Nevertheless, employers will continue to need programmers who have strong technical skills and who understand an employer's business and its programming needs. This will mean that programmers will need to keep up with changing programming languages and techniques. Given the importance of networking and the expansion of client/server environments and web-based environments, organizations will look for programmers who can support data communications and help implement electronic commerce and intranet strategies. Demand for programmers with strong object-oriented programming capabilities and technical specialization in areas such as client/server programming, multimedia technology, and graphic user interface (GUI), should arise from the expansion of intranets, extranets, and Internet applications. Programmers also will be needed to create and maintain expert systems and embed these technologies in more and more products.

As programming tasks become increasingly sophisticated and an additional level of skill and experience is demanded by employers, graduates of 2-year programs and people with less than a 2-year degree or its equivalent in work experience should face strong competition for programming jobs.

Competition for entry-level positions, however, also can affect applicants with a bachelor's degree. Prospects should be best for college graduates with knowledge of, and experience working with, a variety of programming languages and tools-including C++ and other object-oriented languages like Java, as well as newer, domain-specific languages that apply to computer networking, data base management, and Internet application development. Obtaining vendor or language specific certification also can provide a competitive edge. Because demand fluctuates with employers' needs, job seekers should keep up to date with the latest skills and technologies. Individuals who want to become programmers can enhance their prospects by combining the appropriate formal training with practical work experience.

Earnings

Median annual earnings of computer programmers were $57,590 in 2000. The middle 50 percent earned between $44,850 and $74,500 a year. The lowest 10 percent earned less than $35,020; the highest 10 percent earned more than $93,210. Median annual earnings in the industries employing the largest numbers of computer programmers in 2000 were:

Personnel supply services	$65,780
Professional and commercial equipment	$63,780
Computer and data processing services	$61,010
Commercial banks	$60,180
Management and public relations	$57,120

According to the National Association of Colleges and Employers, starting salary offers for graduates with a bachelor's degree in computer programming averaged $48,602 a year in 2001. According to Robert Half International, average annual starting salaries in 2001 ranged from $58,500 to $90,000 for applications development programmers/developers, and from $54,000 to $77,750 for software development programmers/analysts. Average starting salaries for Internet programmers/analysts ranged from $56,500 to $84,000.

Related Occupations

Other professional workers who deal with data and detail include computer software engineers; systems analysts, computer scientists, and database administrators; statisticians; mathematicians; engineers; financial analysts and personal financial advisors; accountants and auditors; actuaries; and operations research analysts.

Appendix B
IT Professional Degrees

Major: Computer Science (CS)
College of Letters and Science
Degree: Bachelor of Science
Computer Science, University of California, One Shields Avenue, Davis, CA 95616

PREPARATORY SUBJECT MATTER		UNITS
Math 21A, B, C	Calculus	4-4-4
Math 22A	Linear Algebra	3
Math 22B	Differential Equations	3
Statistics 32	Statistical Analysis	3
ECS 20	Discrete Mathematics for Computer Science	4
ECS 30	Programming and Problem Solving	4
ECS 40	Software Development	4
ECS 50 or EEC 70	Computer Organization and Machine-Dependent Programming Computer Structure and Assembly Language	4
	One series from the following four:	
Chem 2 A, B, C	General Chemistry	5-5-5
Chem 2 A, B and Biological Science 1A	General Chemistry Introductory Biology	5-5 5
Chem 2 AH, BH, CH	General Chemistry	5-5-5
Physics 9 A, B, C and Math 21D	Classical Physics and Vector Analysis	4-4-4 4
	TOTAL PREPARATORY UNITS	**52-53**

COMPUTER SCIENCE CORE		UNITS
ECS 110	Data Structures and Programming	4
ECS 120* or 122B*	Introduction to Theory of Computation Algorithm Design and Analysis	4
ECS 122A	Algorithm Design and Analysis	4
ECS 140A	Programming Languages	4
ECS 150** or 151A**	Operating Systems and System Programming Operating System Design	4
ECS 154A, B	Computer Architecture	4-4
	TOTAL COMPUTER SCIENCE CORE UNITS	**28**

* Completion of only 120 or 122B will satisfy the core requirement, but not a computer science elective simultaneously.

** Completion of only 150 or 151A will satisfy the core requirement, but not a computer science elective simultaneously.

COMPUTER SCIENCE ELECTIVES		UNITS
Minimum of 4 courses and a minimum of 13 units from:		
ECS 120*	Introduction to the Theory of Computation	4
ECS 122B*	Algorithm Design and Analysis	4
ECS 130	Scientific Computation	4
ECS 140B	Programming Languages	4
ECS 142	Compilers	4

ECS 150**	Operating Systems and Systems Programming	4
ECS 151A**	Operating System Design	4
ECS 151B	Operating System Design	3
ECS 152A	Computer Networks	4
ECS 152B	Computer Networks	4
ECS 153	Introduction to Computer Security	4
ECS 158	Programming on Parallel Architectures	4
ECS 160	Introduction to Software Engineering	4
ECS 163	User/Computer Interfaces	4
ECS 165A	Database Systems	4
ECS 165B	Database Systems	4
ECS 168	Information Systems	3
ECS 170	Introduction to Artificial Intelligence	4
ECS 175	Computer Graphics	4
ECS 177	Introduction to Visualization	4
ECS 178	Introduction to Geometric Modeling	4
ECS 188	Ethics and the Information Age	3
ECS 192 or 199	Internship/Special Study (3 units from one course (192 or 199); Dept. approval)	3
EEC 180A	Digital Systems I	5
EEC 180B	Digital Systems II	5
Math 160***	Database Theory, Design and Performance	3
	TOTAL COMPUTER SCIENCE ELECTIVE UNITS	**13**

* Completion of only 120 or 122B will satisfy the core requirement, but not a computer science elective simultaneously.

** Completion of only 150 or 151A will satisfy the core requirement, but not a computer science elective simultaneously.

*** Completion of Math 160 will satisfy either a computer science elective or a math elective, but not both requirements simultaneously.

MATHEMATICS ELECTIVES		**UNITS**
Math 108	Abstract Mathematics	4
One course from the following:		
Math 115A, B, C	Theory of Numbers	4
Math 127A, B, C	Advanced Calculus	
Math 131or Stat 131A	Mathematical Probability Probability Theory	
Math 141	Euclidean Geometry	
Math 145	Combinatorial Mathematics	
Math 147	Topology	
Math 149A, B	Topics in Discrete Mathematics	
Math 150A, B, C	Abstract Algebra	
Math	**One upper division math course numbered below 188**	**4**
	TOTAL MATHEMATICS ELECTIVE UNITS	**12**
	TOTAL UNITS FOR CS MAJOR	**105-106**

Major: Computer Science and Engineering (CSE)
College of Engineering
Degree: Bachelor of Science
Department of Computer Science, University of California, One Shields Avenue, Davis, CA 95616

LOWER DIVISION PROGRAM		**UNITS**
Math 21A, B, C, D	Calculus	16
Math 22A	Linear Algebra	3
Math 22B	Differential Equations	3
Physics 9A, B, C, D	Classical Physics	19
Chemistry 2A	General Chemistry	5
ECS 20	Discrete Mathematics for Computer Science	4
ECS 30 or ECS 35	Introduction Programming and Problem Solving Structure and Interpretation of Computer Programs	4
ECS 40	Software Development & Object-Oriented Programming	4
ECS 50 or EEC 70	Computer Organization and Machine-Dependent Programming Computer Structure and Assembly Language	4
Eng 17	Circuits I	4
English 1 or 3 or Comp Lit 1, 2, 3 or 4 or Native Am Studies 5	Expository Writing	4
Communication 1 or 3	Public Speaking or Interpersonal Communication	4
GE	General Education	12
Unrestricted Elective	Unrestricted	4
	TOTAL LOWER DIVISION UNITS	**90**

UPPER DIVISION PROGRAM		**UNITS**
ECS 110	Data Structures and Programming	4
ECS 120* or 122A*	Theory of Computation Algorithm Design and Analysis	4
ECS 140A	Programming Languages	4
ECS 150** or 151A**	Operating Systems and System Programming Operating System Design	4
ECS 152A	Computer Networks	4
ECS 154A, B	Computer Architecture	4-4
ECS 160	Introduction to Software Engineering	4
EEC 100	Circuits II	5
EEC 172	Microcomputer-Based System Design	4
EEC 180A	Digital Systems I	5
Math 131 or Stat 131A	Mathematical Probability Probability Theory	4

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ECS 188 or Eng 190	Ethics and the Information Age	3

A minimum of 4 courses and a minimum of 13 units from:		**UNITS**
ECS 120*	Introduction to the Theory of Computation	4
ECS 122A*	Algorithm Design and Analysis	4
ECS 122B	Algorithm Design and Analysis	4
ECS 130	Scientific Computation	4
ECS 140B	Programming Languages	4
ECS 142	Compilers	4
ECS 150**	Operating System and Systems Programming	4
ECS 151A**	Operating System Design	4
ECS 151B	Operating System Design	3
ECS 152B	Computer Networks	4
ECS 153	Introduction to Computer Security	4
ECS 158	Programming on Parallel Architectures	4
ECS 163	User/Computer Interfaces	4
ECS 165A	Database Systems	4
ECS 165B	Database Systems	4
ECS 168	Information System	3
ECS 170	Introduction to Artificial Intelligence	4
ECS 175	Computer Graphics	4
ECS 177	Introduction to Visualization	4
ECS 178	Introduction to Geometric Modeling	4
ECS 192 or 199 or EEC 194	Internship/Special Study/Micromouse Design (3 units from one course (192 or 199 or 194); Dept. approval)	3
EEC 180B	Digital Systems II	5
	General Education (at least 2 upper division GE)	21
Unrestricted Elective	Unrestricted	4
	TOTAL UPPER DIVISION UNITS	**90**
	TOTAL UNITS REQUIRED FOR CSE MAJOR	**180**

* Completion of both ECS 120 and 122A will satisfy a computer science theory requirement and a computer elective requirement.

** Completion of both ECS 150 and 151A will satisfy a portion of the computer software operative system requirement and a computer elective requirement.

Employment Opportunities

Exercise 1 – Review Questions

Name:	
Period:	
Date:	

Exercise Objective:

To complete this exercise, you will define a list of vocabulary words and answer a few questions regarding employment opportunities within the Information Technology career field.

Discussion of Fundamentals:

Vocabulary is one of the most essential tools found in a computer technician's toolbox. The same is true for those individuals seeking employment. You'll need a strong command of the language used in the process of just finding a job. This skill will become apparent during the job interview. You not only need to walk the walk… You'll also need to talk the talk.

Research Resources:

Company	Web Site	Description
Computerjobs.com	http://www.computerjobs.com/	ComputerJobs.com is the Internet's leading IT employment Web site. Founded in 1995 by and for information technology professionals, the company provides its visitors with high quality computer-related job opportunities and career-related content organized into 18 vertical skill sets and 19+ major metropolitan markets.
Yahoo Hot Jobs	http://www.hotjobs.com/	Unlike most sites, HotJobs.com lets you decide whether you want to see jobs posted by Staffing Firms or only those jobs posted directly by employers. If you decide to view Staffing Firm jobs, you'll notice that we clearly label them "Staffing Firm" at every step along the way.
Department of Labor	http://www.careervoyages.gov/	Start exploring career options - whether you are in high school, have graduated, have a vocational certificate, have a 2-year or 4-year college degree, or have knowledge and skills acquired through training centers, on-the-job training, or work experience. Be in demand by knowing about high growth jobs with better wages and a brighter future.

Required Materials:

Employment Opportunities Technical Manual
Employment Opportunities Appendix A – IT Job Brief
Employment Opportunities Appendix B – IT Professional Degrees

Procedure:

1. Research and develop a detailed definition for each of the following terms. Refer to the list of required materials as well as other materials you feel are appropriate. Write your definitions on a separate piece of paper with each definition of three sentences or more.
   - Employability Skills
   - Interpersonal Relationship Skills
   - Information Technology (IT)
   - IT Computer Certification
   - CompTIA
   - Resume

2. Rank the following career fields according to maximum possible earnings. Highlight the career that has the worst job outlook and provide the reason why.
   - Computer Hardware Engineer
   - Computer Software Engineer
   - Computer Support Specialist/Systems Administrator
   - Computer Operator
   - Systems Analysts
   - Computer Scientists, and Database Administrator
   - Computer and Information Systems Manager
   - Computer Programmer

3. Which of the IT computer certifications can you prepare for using courses available in this school?

4. Add to the list you created in question 2 the college degrees or computer certifications required for each profession. This will require some research on employment and college sites.

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Employment Opportunities

Exercise 2 – SCANS

Name:	
Period:	
Date:	

Exercise Objective:
You'll use the SCANS Employment Credential to get a better idea of what Employability and Interpersonal skills you already possess. You'll identify what competencies you need to focus on as you endeavor to be 100% employable.

Discussion of Fundamentals:
Do you have the necessary employability and interpersonal relationship skills necessary to find a job and then keep it once you're hired? Most employers value general employability and interpersonal relationship skills above the specific vocation skills of the entry-level employee. They've realized that it's much easier to teach technical skills to new workers with a strong work ethic than it is to instill employability and interpersonal skills in employees with weaker work ethics.

Research Resources:

Company	Web Site	Description
SCANS	http://www.scans.jhu.edu/	The SCANS 2000 Center is dedicated to creating a workforce development system that properly prepares workers and learners to compete in the international economy of the 21st century.
Academic Innovations	http://www.academicinnovations.com/	What Work Requires of Schools is the title of the initial SCANS report. This 61 page report defines the five competencies and three-part foundation that constitute the SCANS skills.

Required Materials:
Employment Opportunities Technical Manual
SCANS Employment Credential

Procedure:
Print the attached SCANS Employment Credential and study it carefully. When printed back-to-back, this document becomes a tri-fold record of your employability skills. Keep it in your records. You will use it when applying for a job or submitting your college application.

1. Go down the list of Employability and Interpersonal Competencies. Rate yourself for each item using the top line of the competency description.

   The rating key:
   - **5** Mastery
   - **4** Proficient
   - **3** Partially Proficient
   - **2** Marginally Proficient
   - **1** Supervision Needed
   - **0** No Experience

2. Have a teacher record their rating underneath yours. Since you may not have the opportunity to demonstrate all of the SCANS competencies in a single class, you may should give this credential to a variety of teachers to get a better reflection of your skill level.

3. Compare your ratings with those of your teachers. Adjust your rating based upon teacher feedback and then highlight those competencies that you need to work on to achieve 100% employability.

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GENERAL EMPLOYIBILITY COMPETENCIES

INFORMATION PROCESSING
The student identifies the purpose for an Information search and develops an effective plan for the collection of relevant information using appropriate sources. The student locates, selects, and evaluates information in an organized manner in order to create clear and concise oral, visual, or written communication.

COMPUTER USAGE
The student demonstrates proficiency in the use of computer technology by selecting appropriate programs to fit the needs of the desired outcome. The student responsibly operates, manipulates, and integrates word processing, graphics, spreadsheet, data base, internet, and email software programs for written communication and graphic representation.

TECHNOLOGY USAGE
The student selects, sets up, and uses a variety of technological tools. The student identifies and analyzes situations to circumvent, troubleshoot, and solve problems in the respective technologies used.

RESOURCING
The student plans and utilizes time, money, materials, facilities, and human resources. The student selects appropriate resources and uses them efficiently to complete the task or project.

ORAL COMMUNICATION
The student organizes ideas and communicates with clarity oral messages matched to the audience and situation. The student demonstrates listening with clear feedback to verbal and nonverbal messages.

WRITTEN COMMUNICATION
The student employs the writing process to produce effective written communication for an intended audience. The student composes, creates, and records information completely and accurately in order to communicate thoughts, information, and messages.

READING
The student interprets the meaning of written communication, identifies and explains the main idea and relevant details, ascertains the meaning of unknown vocabulary, and judges the accuracy, appropriateness, and plausibility of written communication.

MATHEMATICS USAGE
The student approaches practical problems by choosing appropriately from a variety of mathematical techniques and uses data to construct logical explanations for real world situations. The student expresses math concepts orally and in writing and understands the role of chance in the occurrence and prediction of events.

SYSTEMS USAGE
The student explains how current social, organizational, and technological systems work and operates effectively within them. The student explains how a system's structures relate to goals, respond to the demands of the system, and functions within the formal and informal social and organizational systems.

INTERPERSONAL COMPETENCIES

LEADERSHIP
The student demonstrates competencies through the organization and coordination of group and individual tasks. The student can employ effective communication and listening skills to persuade and motivate others to accomplish goals. The student demonstrates a sensitivity toward individual ideas and beliefs and will generate credibility through competence and integrity.

GROUP DYNAMICS
The student organizes tasks and assumes different responsibilities as a contributing group member. Through positive interaction with respect for group diversity, the student negotiates, compromises, and reaches consensus when working toward a common goal.

PROBLEM SOLVING
The student recognizes and defines the problem, generates alternative solutions, chooses the best alternative, and implements a plan of action. The student considers the consequences of these actions and makes informed decisions.

RESPONSIBILITY
The student initiates and/or completes tasks consistently, exhibits regular and timely attendance, and is prepared to work and learn. The student demonstrates a high level of effort and perseverance towards reaching goals. The student takes care of materials and equipment, respects the property of others, and completes tasks on time.

SELF CONFIDENCE
The student believes in own self worth and maintains a positive view of self. The student demonstrates knowledge of their own personal strengths and limitations, displays initiative, is aware of their impact on others, and responds to constructive criticism.

SELF MANAGEMENT
The student sets realistic goals, organizes resources, prioritizes, and monitors own progress. The student evaluates information and motivates self in assessing progress toward completion of goals.

SOCIABILITY
The student demonstrates understanding, friendliness, adaptability, empathy, and politeness in new and on-going group settings, and responds as the situation requires. The student cooperates as a team member, negotiates to arrive at a decision, demonstrates positive ways of solving conflicts, and relates to diverse groups.

COMMUNITY SERVICE
The student will complete 60 to 100 hours of community service in one or several projects as authorized by school administration and as verified by the system designed by local schools and communities.

PERSONAL IDENTIFICATION
The student produces a personal portfolio of major achievements and accomplishments and successfully produces a resume for employment purposes.

DoDDS

SCANS INTEGRATION

TODAY'S STUDENTS ---

TOMORROW'S WORKFORCE ---

Students Can Achieve Necessary Skills
EMPLOYMENT CREDENTIAL

Why are SCANS Competencies Important?
The Secretary of Labor's Commission on Achieving Necessary Skills (SCANS) in its initial June 1991 report identified the skills and competencies represented in this pamphlet as those that were the most important for people who will enter the workforce of the future and expect to compete for higher paying jobs.

How Do Students Earn Competencies?
Over long periods as opportunities are provided to demonstrate acceptable performance. Competencies are awarded on Certificates of Competence based on teacher observation during classroom activities.

How will Competencies be used by Employers?
Students will present their certificate at interviews as part of their personal portfolio. An Employment Credential indicating those SCANS competencies earned during the last 2 years of high school may also be used by students when they apply for Jobs as well as for college admission and scholarship.

Department of Defense Education Activity
CSS
Computer Service & Support

INSTRUCTIONS:
Students should perform a self-assessment indicating what they feel is their own rating for each of the competencies listed on the opposite side of this credential. Teachers will record their rating underneath the students. Since a student may not have the opportunity to demonstrate all of the SCANS competencies in a single class, the student should give this credential to a variety of teachers to get a better reflection of their skill level.

Student's Name	**Rating Key:**												
Rater's Name													

Rating Key:

- **5** Mastery
- **4** Proficient
- **3** Partially Proficient
- **2** Marginally Proficient
- **1** Supervision Needed
- **0** No Experience

General Employability Competencies	5	4	3	2	1	0	Interpersonal Competencies	5	4	3	2	1	0
Information Processing Select and evaluate information Select ways to organize information Interpret and communicate information							**Leadership** Organize group work Involve all group members Set positive examples for others						
Computer Usage Use word processing, communications Use a graphics program Use a spreadsheet program, database Use the Internet responsibly Use Email responsibly							**Group Dynamics** Contribute ideas, suggestions, and effort for completion of group tasks Solve conflict In positive ways Cooperate as a member or a multiethnic, mixed gender team						
Technology Usage Set up appropriate machines / equipment Produce a product using technology Maintain and troubleshoot technology							**Problem Solving** Identify and define problems/issues Generate and select from alternative strategies to solve problems Make informed decisions						
Resourcing Schedule time to meet task/project deadlines Select appropriate human/material resources Allocate human and material resources to complete a task/project							**Responsibility** Display punctuality and regular attendance Complete tasks on time Protect materials and equipment, respect the rights and property or others						
Oral Communication Deliver messages with clarity Follow oral directions Participate in group discussions							**Self Confidence** Display confidence in self and work Demonstrate initiative Assess and evaluate criticism						
Written Communication Organize thoughts into expressive written form Proofread, edit, and revise documents Use correct grammar/spelling In writing							**Self Management** Exhibit self control Work without close supervision Evaluate and monitor personal performance						
Reading Investigate meaning of unknown words Extract the main ideas of messages Identify relevant details, facts, and specifications from reading Follow written instructions							**Sociability** Compromise Exhibit sensitivity to the attitude, values, and feelings of others Exhibit trustworthy behavior						
Mathematics Usage Use measuring tools and systems Use basic computational skills Use graphic formats to display and obtain information							**Community Service** Complete 60 hours service Complete 100 hours service						
System Usage Identify the system and its purpose Monitor and Improve performance Adapt to situational changes							**Personal Identification** Produce a portfolio Produce a resume						

Employment Opportunities

Exercise 3 – The Job Hunt

Name:	
Period:	
Date:	

Exercise Objective:

It's time to put all this knowledge about employment opportunities to practical use. You are going to search for a job in the IT profession based upon the credentials you'll have upon completing this course.

Discussion of Fundamentals:

Upon completion of the CSS course, you'll receive all the training necessary to pass the CompTIA A+ certification exam. Many DoDDS schools also offer Cisco Academy courses. Based upon your reading, you know that both the A+ and the CCNA exam can open quite a few employment opportunities for you.

The CompTIA A+ exam is a widely-acknowledged, general certification is for computer service technicians. It is sponsored by The Computing Technology Industry Association (CompTIA) and leans heavily toward hardware. But naturally, to install and repair computers, technicians must know something about networks, operating systems and customer relations, too. The exam assesses basic computer service and repair skills, by covering a broad range of these topics.

Cisco Career Certifications are highly specialized for network professionals, and indicate three levels of technical proficiency: Associate (CCNA), Professional and Expert. The Cisco Certified Internet work Expert (CCIE) certification is at the top of the training pyramid for network support. The Cisco Certified Design Professional (CCDP) certification is at the top of the training pyramid for network design. Each allows you to specialize in routing & switching, WAN switching or other specialties such as security, a growing field. All other certifications are beginning or intermediate steps toward the top of the two pyramids, but are valuable on their own.

Research Resources:

Company	Web Site	Description
Computerjobs.com	http://www.computerjobs.com/	ComputerJobs.com is the Internet's leading IT employment Web site. Founded in 1995 by and for information technology professionals, the company provides its visitors with high quality computer-related job opportunities and career-related content organized into 18 vertical skill sets and 19+ major metropolitan markets.
CompTIA	http://www.comptia.org/	Representing more than 8,000 computing and communications companies, CompTIA helps its members stay competitive and profitable by providing vendor-neutral standards in certification, e-commerce, customer service and workforce development to meet these industry-wide challenges.
Cisco Academy	http://cisco.netacad.net/	Our comprehensive, global e-learning program offers students an opportunity to pursue IT curricula through online instructor-led training and hands-on laboratory exercises. As a result, students can apply classroom learning to actual technology challenges, which ultimately prepares tomorrow's workforce for life-long learning opportunities.

Required Materials:

Employment Opportunities Technical Manual

Procedure:

Assume you are a high school graduate with a CompTIA A+ Certification.

1. Use the internet to locate three employment advertisements and print out the information sheet for each job announcement.

2. Create a table listing the three jobs in order of your preference. Your table should include the ranking, job title, location, salary, and the URL where you found the announcement.

3. Repeat assuming that you are a high school graduate with a CCNA certificate.

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