What Computer Professionals Do

A tremendous amount of professional work today depends, at least in part, on computing technology. Computer professionals make a lot of the work we do every day possible. The U.S. Department of Labor’s Bureau of Labor Statistics (BLS) describes the principal responsibilities of computer occupations as follows:

Computer programmers write, test, and maintain the code for the myriad of software programs computers use to perform functions. Often required to know more than one programming language, they also conceive, design, and test logical structures for solving problems by computer. While some programmers might participate in software development, most are involved in updating, repairing, modifying, and expanding existing programs.

Computer engineers apply the theories and principles of science and mathematics to design hardware, software, networks, processes, and solve technical problems. They often work as part of a team that designs new computing devices or computer-related equipment, systems, or software. Software engineers (also referred to as software developers) are often involved in the design and development of software systems for control and automation of manufacturing, business applications, gaming, or network control systems.

Computer scientists design computers and the software that runs them, develop information technologies, and develop and adapt principles for applying computers to new uses. 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. Computer scientists usually work as theorists, researchers, or inventors. Some work on multi-disciplinary projects, such as virtual reality and robotics.

Computer systems analysts solve computer problems and enable computer technology to meet the specific needs of an organization. They help an organization achieve the maximum benefit from its investment in equipment, personnel, and business processes. Computer systems analysts may design new systems, including hardware and software, or add a new software application to harness more of the computer’s power. Most computer 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 or engineering systems.

Other computer professionals include, database administrators who develop methods of organizing, analyzing, applying, and storing data; computer support specialists who provide technical assistance, support, and advice to customers and users and troubleshoot hardware, software, and network problems; network or computer systems administrators who design, install, and support organizations’ LAN (local area network), WAN (wide area network),
network segment, Internet, or intranet system; computer security specialists who plan, coordinate, and implement the organization’s information security; and Internet or web developers, also called web designers, who are responsible for website design and creation.\(^1\)

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**Employment Trends**

It is difficult to compare occupation employment numbers throughout the past decade, because the BLS has substantially changed the occupational categories that make up the computer-related workforce. That withstanding, according to BLS statistics, computer-related occupations have experienced a 38 percent increase in employment, adding roughly one million more jobs from 2003 to 2013.\(^2\) While historical comparisons are not possible for all occupations, due to changes to BLS occupational categories, when comparable data exists, the disparity is evident. While database administrators and network and computer systems administrators saw job growth from 2003 to 2013, adding 14,000 and 124,000 jobs respectively, computer programmers experienced overall decline in employment for the same period.\(^3\)

The unit of analysis in the Current Population Survey is the employee, e.g. people who report that they work as a computer programmer, while the Occupational Employment Statistics includes the number of jobs, e.g. employers who report they have computer programmers on their staff. While the numbers are not identical, both show significant job loss among computer programmers over the last decade, even as the rest of the industry expanded.\(^4\)

Computer-related occupations are disproportionately affected by both the use of temporary guest workers, including those on H-1B and L-1 visas and Optional Practical Training, and offshoring of jobs. In 2012, the United States Customs and Immigration Service approved employer hiring of 154,869 temporary foreign workers on H-1B visas in computer-related occupations, representing 61 percent of all granted H-1B visas.\(^5\) Temporary guest workers may represent a small percentage of the whole workforce, but non-U.S. citizens represent 12.8 percent of the U.S. computer workforce (and 16.5 percent of computer systems analysts and 22.5 percent of software developers).\(^6\) The over 500,000 non-U.S. citizens working in computer-related occupations in the U.S. have fewer rights in the work place and have diminished bargaining power with employers.

Available data make it difficult to assess the exact number of computer professional’s jobs lost to offshoring (U.S. jobs moved out of the country) each year, however experts identify
occupations in the computer field as extremely vulnerable to offshoring, particularly as computing and networking technology becomes more widely available and inexpensive. The Congressional Research Service report on offshoring indicates that as lower-wage countries such as India and China graduate large numbers of well-educated workers, often exceeding “the immediate needs of their local economies,” they become attractive markets for offshoring.

Who They Are: Demographic Characteristics of Computer Professionals

Computer professionals are overwhelmingly White men, however, demographics vary significantly by occupation. In 2013, women in computer professions represented anywhere from 7.5 percent of computer network architects to 39.5 percent of web developers. Similar patterns emerge with regard to race and ethnicity. In 2013, Black or African American employees represented 4.1 percent of software developers, but 13.2 percent of computer support specialists. In the same year however, Asian workers represented 7.6 percent of computer support specialists and 28.8 percent of software developers.

While the gender gap in many professions has narrowed over the last decade, in computer professions there is evidence to suggest it is widening. In 2003, 28.8 percent of those employed in computer and mathematical occupations were women. Although the field added more than 850,000 jobs in the last 10 years, women filled only about 16.2 percent of those positions. By 2013, the percentage of women in computer and mathematical occupations fell to 26.1 percent.
Education and Training

In general, computer professionals tend to have higher than average levels of education. In June 2013, 68 percent of those employed in computer and mathematical occupations held a bachelor’s degree or higher. An additional 24 percent had some college or an associate’s degree. However, there is also significant variation in the education requirements for particular computer occupations. In 2014, for example, 43.2 percent of computer support specialists had some college or an associate’s degree and 35.3 percent held a bachelor’s degree. While, in the same year, 50.8 percent of software developers held a bachelor’s degree and more than 33 percent held a master’s degree or higher.\(^\text{13}\)

Education Attainment in Selected Computer Professions, September 2014

<table>
<thead>
<tr>
<th>Professional Category</th>
<th>High School Diploma or Less</th>
<th>Some College Associate’s</th>
<th>Bachelor’s Degree</th>
<th>Master’s Degree or Higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Systems Analysts</td>
<td>6.9%</td>
<td>16.3%</td>
<td>45.8%</td>
<td>30.9%</td>
</tr>
<tr>
<td>Computer Programmers</td>
<td>6.5%</td>
<td>26.2%</td>
<td>47.8%</td>
<td>19.6%</td>
</tr>
<tr>
<td>Software Developers, Applications, and Systems Software</td>
<td>4.4%</td>
<td>11.5%</td>
<td>50.8%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Computer Support Specialists</td>
<td>13.5%</td>
<td>43.2%</td>
<td>35.3%</td>
<td>8%</td>
</tr>
<tr>
<td>Database Administrators</td>
<td>2%</td>
<td>20.6%</td>
<td>57.3%</td>
<td>19.8%</td>
</tr>
<tr>
<td>Computer Network Architects</td>
<td>19%</td>
<td>15.3%</td>
<td>43%</td>
<td>39.8%</td>
</tr>
</tbody>
</table>

In the 2009-2010 academic year, public and private institutions conferred over 80,000 computer-related degrees to U.S. citizens and permanent residents. There were 32,019 associate’s degrees conferred in computer sciences, and 38,240 bachelor’s, 10,066 master’s, and 782 doctoral degrees in computer sciences.\(^\text{14}\) The number of new graduates gives a sense of the aggregate number of newly graduated potential employees entering the workforce. However, a 2012 Census Bureau survey found that just 49 percent of computer, mathematics, and statistics bachelor’s degree holders were employed in STEM.\(^\text{15}\)
Compensation

Earnings across computer professions vary by specialty area. In May 2013, median annual earnings ranged from $46,620 for computer user support specialists to $106,920 for computer and information research scientists.\textsuperscript{16} Compensation within a single occupation also varies with experience, education, industry, and region. For example, computer network architects in the 10\textsuperscript{th} percentile report annual earnings of $53,920 while those in the 90\textsuperscript{th} percentile report earnings of $145,700, an increase of more than two and a half times.\textsuperscript{17}

There is evidence of a persistent gender gap in median earnings across computer professions.\textsuperscript{18} There is also a strong negative correlation between the percentage of women or Hispanic employees in a given occupation and its median annual earnings, and a strong positive correlation between the percentage of Asian employees and median annual earnings.\textsuperscript{19} While these correlations do not imply causality, they do highlight the strong relationship between gender, race, or ethnicity and annual earnings in computer professions.

As many computer programmers face persistent job loss, those remaining in the occupation face decreasing wages. Controlling for inflation, wages for employees in all computer, mathematics, and related occupations grew by 2.4 percent from 2003-2013.\textsuperscript{20} However, computer programmers saw the value of their earnings decrease over the last decade. The median real wages for computer programmers shrank by roughly two percent between 2003 and 2013. Real wages for computer programmers in the bottom 10 percent of income earners decreased by just over three percent, while real wages for the top 10 percent of income earners increased by just over .5 percent between 2003 and 2013.\textsuperscript{21}

Working Conditions

Computer professionals often work long hours. In 2014, 26.7 percent of computer professionals reported they usually worked more than 40 hours per week. Of these, more than half reported usually working 50 or more hours each week. There is significant variation across occupations. Approximately 19.2 percent of computer support specialists reported work weeks longer than 40 hours, compared to nearly 37 percent of information security analysts. Among web developers, 20.7 percent reported usually working 41-49 hours, while 12.8 percent reported their standard week was 50 or more hours.\textsuperscript{22}

Labor Relations

In 2013, roughly over 143,000 computer professionals were union members. While this represents an overall decrease in membership over the last decade, changes to occupation descriptions means the data are not strictly comparable. Among comparable occupations, computer support specialists saw the largest increase in membership, adding an estimated 24,420
members since 2003, while computer scientists and systems analysts have suffered the largest loss of membership, contracting by over 21,000 members in the same period.\textsuperscript{23}

A number of unions represent computer professionals, including the American Federation of Government Employees, American Federation of Teachers, International Association of Machinists and Aerospace Workers, International Federation of Professional and Technical Engineers, Office Professional Employees International Union, and the United Steelworkers.

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**Outlook**

While the BLS projects a positive outlook for computer-related occupations, estimating just fewer than 650,000 new jobs from 2012-2022, historically these projections have failed to anticipate the effects of economic contractions and offshoring on computer professionals. It is important to consider this when evaluating the BLS outlook for computer professionals. For example, BLS projects an eight percent increase in employment for computer programmers from 2012 to 2022.\textsuperscript{24} However, the steady decrease in the number of computer programmers over the last 10 years suggests this may be an overly optimistic estimate.\textsuperscript{25}

Many companies cite these projections and other estimates as evidence of a persistent shortage of workers with computer science skills.\textsuperscript{26} However, many economists report evidence that there are more trained computer professionals in the U.S. than available jobs.\textsuperscript{27} It is difficult to untangle all of the causes of these conflicting interpretations of available data; however, it is possible that, among other things, a combination of stagnant wages, spatial mismatch and barriers to relocation of workers within the U.S., and a liberal use of guest worker programs all contribute to this issue.

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For more information about guest worker visas, [click here.](#)

For more information on professional workers, check the DPE website: [www.dpeaflcio.org](http://www.dpeaflcio.org).

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*The Department for Professional Employees, AFL-CIO (DPE) comprises 22 AFL-CIO unions representing over four million people working in professional, technical and administrative support occupations. DPE-affiliated unions represent: teachers, college professors, and school administrators; library workers; nurses, doctors, and other health care professionals; engineers, scientists, and IT workers; journalists and writers, broadcast technicians and communications specialists; performing and visual artists; professional athletes; professional firefighters; psychologists, social workers, and many others. DPE was chartered by the AFL-CIO in 1977 in recognition of the rapidly growing professional and technical occupations.*
3 Ibid.
8 Ibid.
13 Ibid.
14 National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education,
17 Ibid.
19 Ibid.
21 Ibid.
23 Hirsch, Barry T. and MacPherson, David A. “2014 Union Membership and Earnings Data Book.” The Bureau of
National Affairs Inc., 2014; Hirsch, Barry T. and MacPherson, David A. “Union Membership, Coverage, Density
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25 “Table 11. Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity.” Current
http://www.bls.gov/cps/tables.htm
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