COMPUTER ENGINEERING

8.1 What is computer engineering: Computer engineering is a discipline that integrates several fields of electrical engineering and computer science required to develop computer hardware and software.[1] Computer engineers usually have training in electronic engineering (or electrical engineering), software design, and hardware-software integration instead of only software engineering or electronic engineering. Computer engineers are involved in many hardware and software aspects of computing, from the design of individual microprocessors, personal computers, and supercomputers, to circuit design. This field of engineering not only focuses on how computer systems themselves work, but also how they integrate into the larger picture.[2]

Usual tasks involving computer engineers include writing software and firmware for embedded microcontrollers, designing VLSI chips, designing analog sensors, designing mixed signal circuit boards, and designing operating systems. Computer engineers are also suited for robotics research, which relies heavily on using digital systems to control and monitor electrical systems like motors, communications, and sensors.

In many institutions, computer engineering students are allowed to choose areas of in-depth study in their junior and senior year, because the full breadth of knowledge used in the design and application of computers is beyond the scope of an undergraduate degree. Other institutions may require engineering students to complete one year of General Engineering before declaring computer engineering as their primary focus.[

History

The first computer engineering degree program in the United States was established at Case Western Reserve University in 1972. As of October 2004, there were 170 ABET-accredited computer engineering programs in the US. In Europe, accreditation of computer engineering schools is done by a variety of agencies part of the EQANIE network. Due to increasing job requirements for engineers who can concurrently design hardware, software, firmware, and manage all forms of computer systems used in industry, some tertiary institutions around the world offer a bachelor's degree generally called computer engineering. Both computer engineering and electronic engineering programs include analog and digital circuit

design in their curriculum. As with most engineering disciplines, having a sound knowledge of mathematics and science is necessary for computer engineers.

Work

There are two major specialties in computer engineering: software and hardware.

Computer software engineering

Computer software engineers develop, design, and test software. Some software engineers design, construct, and maintain computer programs for companies. Some set up networks such as "intranets" for companies. Others make or install new software or upgrade computer systems. Computer software engineers can also work in application design. This involves designing or coding new programs and applications to meet the needs of a business or individual. Computer software engineers can also work as freelancers and sell their software products/applications to an enterprise/individual.

Impact of globalization

The initial impact of outsourcing, and the relatively lower cost of international human resources in developing third world countries led to a massive migration of software development activities from corporations in North America and Europe to India and later: China, Russia, and other developing countries. This approach had some flaws, mainly the distance / timezone difference that prevented human interaction between clients and developers and the massive job transfer. This had a negative impact on many aspects of the software engineering profession. For example, some students in the developed world avoid education related to software engineering because of the fear of offshore outsourcing (importing software products or services from other countries) and of being displaced by foreign visa workers.[33] Although statistics do not currently show a threat to software engineering itself; a related career, computer programming does appear to have been affected.[34][35] Nevertheless, the ability to smartly leverage offshore and near-shore resources via the follow-the-sun workflow has improved the overall operational capability of many organizations. When North Americans are leaving work, Asians are just arriving to work. When Asians are leaving work, Europeans are arriving to work. This provides a continuous ability to have human oversight on business-critical processes 24 hours per day, without paying overtime compensation or disrupting a key human resource, sleep patterns.

While global outsourcing has several advantages, global - and generally distributed - development can run into serious difficulties resulting from the distance between developers. This is due to the key elements of this type of distance which have been identified as geographical, temporal, cultural and communication (which includes the use of different languages and dialects of English in different locations). Research has been carried out in the area of global software development over the last 15 years and an extensive body of relevant work published which highlights the benefits and problems associated with the complex activity. As with other aspects of software engineering research is ongoing in this and related areas.

Computer hardware engineering

The work of computer hardware engineers is similar to that of electronics engineers in that they may design and test circuits and other electronic components; however, computer hardware engineers do that work only as it relates to computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of these engineers.

They work on the design, planning, development, testing, and even the supervision of manufacturing of computer hardware -- including everything from chips to device controllers. They also focus on computer networks for the transmission of data and multimedia.

They work on the interface between different pieces of hardware and strive to provide new capabilities to existing and new systems or products. The work of a computer engineer is grounded in the hardware -- from circuits to architecture -- but also focuses on operating systems and software. Computer engineers must understand logic design, microprocessor system design, computer architecture, computer interfacing, and continually focus on system requirements and design.

It is primarily software engineers who focus on creating the software systems used by individuals and businesses, but computer engineers may also design and develop some software applications.

This can range from circuit boards and microprocessors to routers. Some update existing computer equipment to be more efficient and work with newer software. Most computer hardware engineers work in research laboratories and high-tech manufacturing firms. Some also work for the federal government. According to BLS, 95% of computer hardware engineers work in metropolitan areas. They generally work full-time. Approximately 25% of their work requires more than 40 hours a week. The median salary for employed qualified computer hardware engineers (2012) was $100,920 per year or $48.52 per hour. Computer hardware engineers held 83,300 jobs in 2012.

8.2 Specialty areas

There are many specialty areas in the field of computer engineering.

Coding, cryptography, and information protection

Computer engineers work in Coding, Cryptography, and Information Protection to develop new methods for protecting various information, such as digital images and music, fragmentation, copyright infringement and other forms of tampering. Examples include work on wireless communications, multi-antenna systems, optical transmission, and digital watermarking.

Communications and wireless networks

Those focusing on communications and wireless networks, work advancements in telecommunications systems and networks (especially wireless networks), modulation and error-control coding, and information theory. High-speed network design, interference suppression and modulation, design and analysis of fault-tolerant system, and storage and transmission schemes are all a part of this specialty.

Compilers and operating systems

This specialty focuses on compilers and operating systems design and development. Engineers in this field develop new operating system architecture, program analysis techniques, and new techniques to assure quality. Examples of work in this field includes post-link-time code transformation algorithm development and new operating system development.

Computational science and engineering

Computational Science and Engineering is a relatively new discipline. According to the Sloan Career Cornerstone Center, individuals working in this area, "computational methods are applied to formulate and solve complex mathematical problems in engineering and the physical and the social sciences. Examples include aircraft design, the plasma processing of nanometer features on semiconductor wafers, VLSI circuit design, radar detection systems, ion transport through biological channels, and much more".

Computer networks, mobile computing, and distributed systems

In this specialty, engineers build integrated environments for computing, communications, and information access. Examples include shared-channel wireless networks, adaptive resource management in various systems, and improving the quality of service in mobile and ATM environments. Some other examples include work on wireless network systems and fast Ethernet cluster wired systems.

Computer systems: architecture, parallel processing, and dependability

Engineers working in computer systems work on research projects that allow for reliable, secure, and high-performance computer systems. Projects such as designing processors for multi-threading and parallel processing are included in this field. Other examples of work in this field include development of new theories, algorithms, and other tools that add performance to computer systems.[9]

Computer vision and robotics

In this specialty, computer engineers focus on developing visual sensing technology to sense an environment, representation of an environment, and manipulation of the environment. The gathered three-dimensional information is then implemented to perform a variety of tasks. These include, improved human modeling, image communication, and human-computer interfaces, as well as devices such as special-purpose cameras with versatile vision sensors.[9]

Embedded systems

Individuals working in this area design technology for enhancing the speed, reliability, and performance of systems. Embedded systems are found in many devices from a small FM radio to the space shuttle. According to the Sloan Cornerstone Career Center, on going developments in embedded systems include "automated vehicles and equipment to conduct search and rescue, automated

transportation systems, and human-robot coordination to repair equipment in space."

Integrated circuits, VLSI design, testing and CAD

This specialty of computer engineering requires adequate knowledge of electronics and electrical systems. Engineers working in this area work on enhancing the speed, reliability, and energy efficiency of next-generation very-large-scale integrated (VLSI) circuits and microsystems. An example of this specialty is work done on reducing the power consumption of VLSI algorithms and architecture.

Signal, image and speech processing

Computer engineers in this area develop improvements in human–computer interaction, including speech recognition and synthesis, medical and scientific imaging, or communications systems. Other work in this area includes computer vision development such as recognition of human facial features.[9]

8.3 Education

Most entry-level computer engineering jobs require at least a bachelor's degree in computer engineering. Sometimes a degree in electrical engineering is accepted, due to the similarity of the two fields. Because hardware engineers commonly work with computer software systems, a background in computer programming usually is needed. According to BLS, "a computer engineering major is similar to electrical engineering but with some computer science courses added to the curriculum".[8] Some large firms or specialized jobs require a master's degree. It is also important for computer engineers to keep up with rapid advances in technology. Therefore, many continue learning throughout their careers.

8.4 Job outlook in the United States

Computer software engineering

According to the U.S. Bureau of Labor Statistics (BLS), "computer applications software engineers and computer systems software engineers are projected to be among the faster than average growing occupations from 2012 to 2022".[7] BLS reports an expected growth of 22% for software developers from 2012 to 2022 (down from the 30% 2010 to 2020 estimate).[10] In addition, growing concerns over cyber security add up to put computer software engineering high above the average rate of increase for all fields. However, some of the work will be outsourced in

foreign countries. Due to this, job growth will not be as fast as during the last decade.

Computer hardware engineering

According to the BLS, "employment of computer hardware engineers is expected to only increase 7% from 2012 to 2022 ("Slower than average" in their own words when compared to other occupations) and is down from 9 percent in the BLS 2010 to 2020 estimate." Today, computer hardware is somehow equal to Electronic and Computer Engineering (ECE) and has divided to many subcategories, the most significant of them is Embedded system design.