Computer Hardware Engineer

Snapshot

Career Cluster(s): Information Technology; Science, Technology, Engineering & Mathematics

Interests: Computers; Computer Science; Problem-solving; Science

Earnings (Yearly Average): $132,360

Employment & Outlook: Faster Than Average Growth Expected

OVERVIEW

Sphere of Work

Computer hardware engineers research, design, develop, and test computer systems and components such as processors, circuit boards, memory devices, networks, and routers. Many hardware engineers design devices used in manufactured products that incorporate processors and other computer components and that connect to the internet. For example, many new cars, home appliances, and medical devices have internet-ready computer systems built into them.

Computer hardware engineers ensure that computer hardware components work together with the latest software. Therefore, hardware engineers often work with software developers. For example, the hardware and software for mobile phones and other devices frequently are developed at the same time. They may also work with engineers in

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the biotechnology field, providing the hardware for new products and systems being developed.

In the field of animation and illustration, computer hardware engineers play an essential role in developing and maintaining the computer systems and components used to create these forms of media. They work closely with software engineers to ensure that animation and illustration software runs smoothly on a variety of devices and platforms. They also design and develop advanced graphics cards and processors to provide artists and animators with the necessary computing power to create detailed and realistic animations and illustrations. Additionally, computer hardware engineers may be employed by animation studios or graphic design firms to provide technical support and troubleshoot any hardware-related issues.

Work Environment

Most computer hardware engineers typically work inside research laboratories, offices, or manufacturing firms where they test different types of computer models. The location of these research labs is most commonly found in or nearby large metropolitan cities. The majority of a computer hardware engineer's time would be spent working at their computer workstation. Engineers may also spend their time overseeing the installation and testing of what they created. In these instances, proper safety precautions must be taken—including a sterile environment—to ensure the safety of each engineer. Most computer hardware engineers work a standard full-time week of 40 hours and depending the time sensitivity of the workload, overtime may be required to complete projects.

Profile

Working Conditions: Mainly Inside
Physical Strength: Light Work
Education Needs: Bachelor's Degree, Master's Degree
Licensure/Certification: Typically Not Required
Opportunities for Experience: Internship
Interest Score: IRC

Duties and Responsibilities

- Designing new computer hardware and creating schematics of computer equipment to be built
- Testing the computer hardware they design
- Analyzing the test result and modifying the design as needed
- Updating existing computer equipment so that it will work with new software
- Overseeing the manufacturing process for computer hardware

Occupation Interest

A career as a computer hardware engineer will appeal to individuals who not only have a strong interest in computer science and engineering, but those who are strong critical thinkers when faced with complex problems. Computer hardware engineers must troubleshoot and find solutions for hardware and computer problems when it comes to their work. They should also be

interested in the latest technology and open to constantly learning as technology continues to advance. This includes specialized interests such as biotechnology.

A Day in the Life—Duties and Responsibilities

Computer hardware engineers use their education and skills to design, develop, and test new computer hardware and components. These include computer systems, computer chips, and the physical parts of computers. Engineers are also involved in the design and development of new routers, printers, and keyboards. Their daily responsibilities vary depending on the project they are working on. Meetings may be held throughout the day with other engineers, technology vendors, and various other employees.

Computer hardware engineers are normally involved in the entire process of product development and implementation. This includes the manufacturing process. Throughout the day, an engineer will provide technical support to other employees, including designers, the marketing department, and technology vendors. As computer technology is developed and created, engineers will perform tests and ensure that everything meets specifications and requirements. This testing process usually involves analyzing test data, product prototypes, or theoretical models. As new hardware is implemented, an engineer will monitor how it is functioning and make any modifications necessary so that it performs according to specifications. Engineers also make recommendations for additional hardware, such as keyboards, routers, and printers.

When new components are designed and manufactured, engineers have to make sure that the hardware is compatible with software developments. Because of this, hardware engineers collaborate closely with software developers throughout the process.

WORK ENVIRONMENT

Immediate Physical Environment

The physical work environment for computer hardware engineers is predominantly in a research lab. These spaces are where they would design, build, and test what they have built. Overall, the laboratories where engineers work are typically bright and open spaces that are clean and well-ventilated.

Human Environment

Throughout the day, computer hardware engineers can go between solitarily working on projects and communicating with their colleagues when needed. Engineers may also find themselves collaborating with other professionals in similar fields, ranging from software engineers, manufacturers, other engineers, or technology vendors.

Technological Environment

Computer hardware engineers work with a wide array of computer-based technologies that range from circuit boards and processors, to chips, electronic equipment, and computer hardware and software, including applications and programming. During the design process, computer-aided design (CAD) software is used, as well as servers that store large amounts of data.

EDUCATION AND TRAINING

High School/Secondary

A requirement of employers is that an applicant must have a high school diploma or a GED certificate equivalent. High school courses such as science, mathematics, engineering, or computer science will greatly benefit anyone interested in pursuing a career as a computer hardware engineer. Schools that offer extracurricular clubs involving computer science, robotics, or science are also beneficial to those wishing to get into engineering.

Suggested High School Subjects
- Algebra
- Applied Physics
- Biology
- Calculus
- Chemistry
- Computer Programming
- Computer Science
- English
- Geometry
- Microbiology
- Organic Chemistry
- Structured Computer Program Language
- Trigonometry

Related Career Pathways/Majors

Information Technology Career Cluster

- Programming & Software Development Pathway

Science, Technology, Engineering & Mathematics (STEM) Career Cluster

- Engineering & Technology Pathway

Postsecondary

Entry-level computer hardware engineers typically need a bachelor's degree in computer engineering or a related field, such as computer and information technology. Employers may prefer to hire candidates who have graduated from an engineering program accredited by a professional association, such as the Accreditation Board for Engineering and Technology, Inc. (ABET). To prepare for a major in computer or electrical engineering, students should have a solid background in math and science.

Because hardware engineers commonly work with computer software systems, a familiarity with computer programming is usually expected. This background may be obtained through computer science courses.

Some large firms or specialized jobs may require a master's degree in computer engineering. Some experienced engineers obtain a master's degree in business administration (MBA). All engineers must continue their learning over the course of their careers in order to keep up with rapid advances in technology.

Related College Majors

- Computer Engineering
- Computer Programming
- Computer Science
- Electrical Engineering
- Information Technology

Adult Job Seekers

If an adult job seeker with no prior experience in computer engineering or similar fields wishes to pursue such a career, they should enroll in a college that offers a

Transferable Skills and Abilities

Analytical Skills

- Using tools to analyze the digital circuits in hardware and determining the best design

Communication Skills

- Communicating clearly and efficiently with other engineers, software developers and programmers, as well as with nontechnical team members

Critical-thinking Skills

- Using logic and reasoning to clarify goals
- Examining assumptions
- Identifying the strengths and weaknesses of alternative solutions

Problem-solving Skills

- Identifying complex problems in computer hardware
- Developing and evaluating possible solutions
- Figuring out the best way to implement solutions

program to expand their skills. As technology continues to advance, a computer hardware engineer must be open to continuously learning during the span of their career.

Professional Certification and Licensure

Although certification is not typically required by employers, there are organizations that offer certifications should an individual decide to pursue one.

Additional Requirements

Computer hardware engineers must exhibit exceptional analytical skills when it comes to examining and developing complex computer equipment. Critical thinking is an important skill for engineers in order for them to troubleshoot problems and determine proper solutions. Additionally, engineers must be willing to continue learning throughout their careers as technology advances and their knowledge must expand with it.

EARNINGS AND ADVANCEMENT

The median annual wage for computer hardware engineers was $132,360 in 2022. The lowest 10 percent earned less than $78,380, and the highest 10 percent earned more than $208,200. Some computer hardware engineers can advance to become computer and information systems managers.

EMPLOYMENT AND OUTLOOK

Computer hardware engineers held 78,100 jobs in 2022. Employment is projected to grow 5 percent from 2022 to 2032, faster than the average for all occupations.

About 4,600 openings for computer hardware engineers are projected each year, on average, over the decade. Many of those openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Demand for computer hardware engineers is expected to grow, as these workers are needed to design parts for manufactured products that use processors and other components, such as household appliances, medical devices, and automobiles. As new technologies expand, however, an expected uptick in focus on

Famous First

The modern computer follows the template of Von Neumann architecture, created by Hungarian mathematician John von Neumann in 1945. It divides the computer into a processing unit, control unit, memory, storage, and input and output mechanisms. A limitation of this architecture is the "Von Neumann bottleneck" where instructions and data cannot be accessed simultaneously, affecting the computer's speed. Source: kids.kiddle.co
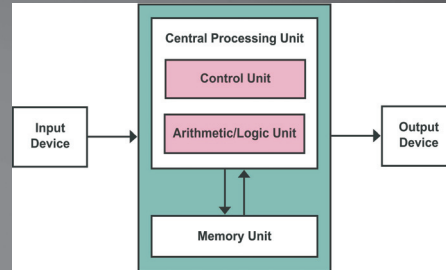
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software innovation compared with hardware may temper demand for these engineers.

Related Occupations

- Aerospace Engineer
- Computer/Information Research Scientist
- Computer/Information Systems Manager
- Computer Network Architect
- Computer Programmer
- Electrical/Electronics Engineer
- Mechanical Engineer
- Network/Computer Systems Administrator
- Software Developer/Quality Assurance Analyst/Tester

MORE INFORMATION

Association for Computing Machinery (ACM)
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Association for Women in Computing (AWC)
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Computer Research Association (CRA)
1828 L Street
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Kristina Domizio & Patrick Cooper; updated by Stuart Paterson and Daniel Vest

Conversation With...

NATALIE ENRIGHT JERGER

Professor, Edward S. Rogers Sr. Department of Electrical
and Computer Engineering, University of Toronto
In the field, 20 years

What was your individual career path in terms of education/training, entry-level job, or other significant opportunity?

I completed my Bachelor's in computer engineering from Purdue University. While in under-grad, I interned twice at Hewlett Packard. After completing my degree, I enrolled in the PhD program at the University of Wisconsin-Madison. During my PhD, I interned at Intel and IBM. After completion of my PhD, I joined the University of Toronto as an assistant professor, where I have been since then.

What are the most important skills and/or qualities for someone in your profession?

In terms of technical skills, strong foundations in math and physics are very important. Pro-gramming is a pervasive skill in engineering at well. Teamwork and collaboration are also tre-mendously important skills. Strong communication skills are also important.

What do you wish you had known going into this profession?

Probably a lot. When I went into the profession, I knew relatively little about what computer engineering was, or what computer engineers did. I was just inherently curious to understand how computers worked. Knowing up-front that establishing a strong foundation in electrical and computer engineering, and establishing a breadth of knowledge, would have been useful. I think it's natural to focus on topics and skills that one enjoys, and at the start of one's career you can't always see how broadly useful various other skills might be.

Are there many job opportunities in your profession? In what specific areas?

There are many great job opportunities in computer engineering. Focusing on my area of computer hardware and computer architecture, there are lots of great jobs at traditional pro-cessor companies like Intel and AMD. In the last few years, there has been a rise of start-ups also building novel hardware to run key, emerging applications such as machine learning. Companies such as Microsoft, Facebook, and Google also require engineers with computer hardware expertise to design and manage their datacenters. A strong understanding of

computer hardware can also make one a better programmer and software engineer so there are tons of career opportunities there as well.

How do you see your profession changing in the next five years, how will technology shift, and what skills will be required?

Moore's Law, which has been a major driver of innovation in computer hardware, has been slowing considerably in recent years, and will continue to slow down over the next five years. For decades, Moore's Law dictated that transistor sizes would halve every 1.5 to 2 years. As a result, we could double the number of transistors on each chip with every process generation. Transistors are the fundamental building blocks of digital systems and computer hardware. More transistors have resulted in more powerful computers which have, in turn, enabled more complex software. It has also allowed computers to become smaller and cheaper, which has resulted in more ubiquitous use of computers, such as through smart phones. The slowing of Moore's Law has opened the door to more specialized hardware such as chips detected to machine learning.

I think we will see more innovations in tailoring hardware to important applications. Computer hardware will continue to underpin our ability to conduct critical and important research across all disciplines, including in areas of healthcare, climate change, etc. Moving forward, computer engineers will require a broad skillset to understand all aspects of the system, from materials and circuits to hardware and software. Computer engineers should also be cognizant of the ethical implications of technology, as we consider the potential societal harms that can arise, such as bias, inequity, disinformation, and environmental harms.

What do you enjoy most about your job? What do you enjoy least about your job?

As an educator, it's definitely that "ah-ha" moment my students have, when they finally see how all the different topics they've been studying fit together to create a working computer. Some aspects of solving engineering problems often feel like puzzles—how do I fit the different pieces together, balance different objectives, etc.? I enjoy solving puzzles, so that aspect is also a lot of fun. In terms of what I enjoy least, it would be failure. As an engineer, design is an iterative process. Many ideas don't work on the first iteration and you have to get comfortable with failure, become good at debugging and identifying problems and iterating over your design.

Can you suggest a valuable "try this" for students considering a career in your profession?

I think there are a lot of great resources now for students to try out engineering projects at a young age. Building circuits or something with a simple micro-controller would be great. Try out some programming. For example, in one of the classes I have taught, students build cars, simple robots, etc., out of Lego and program them. Seeing your project move and interact is super exciting, and simple versions of this can be done prior to university.

This interview was originally published in 2022.