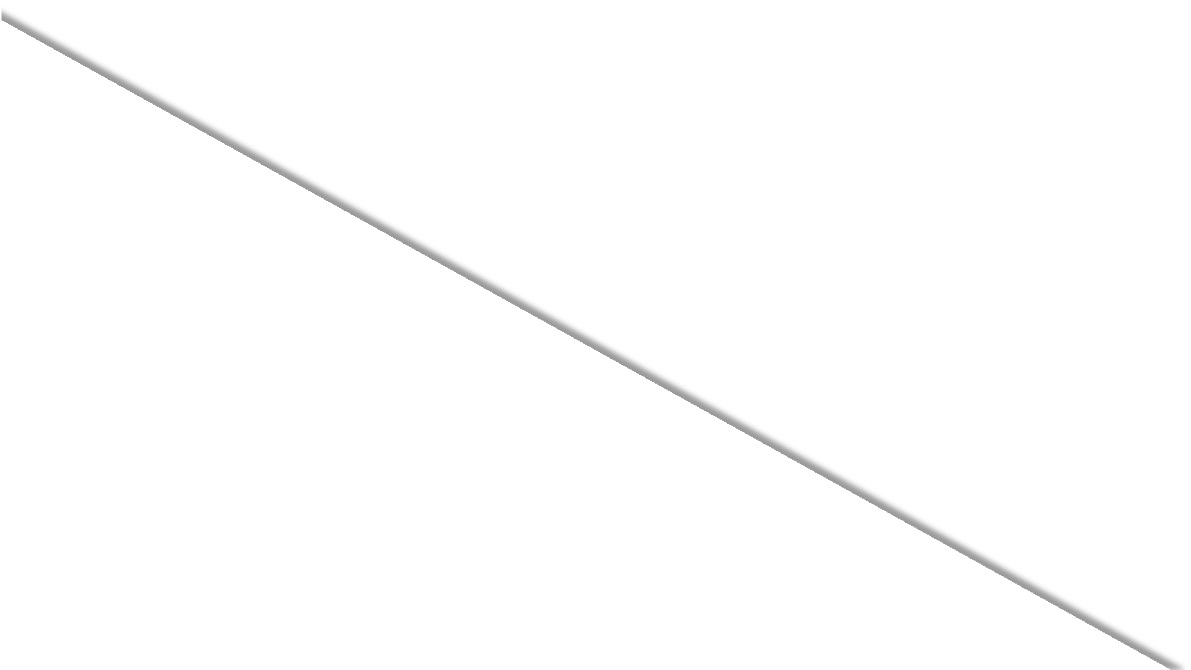
# COMPUTER ENGINEERING



**Overview-Report**

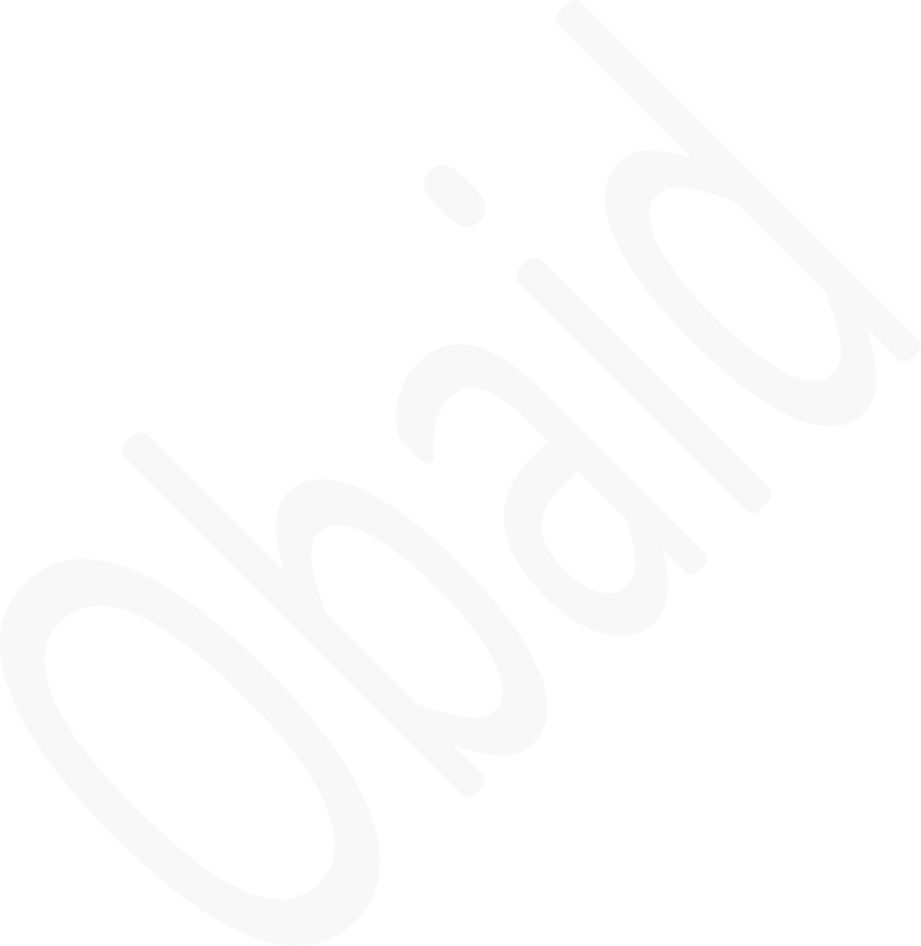
**Sunday, November 12, 2023**

**By: M.OBAID Roll # = CT-025**

**Class: CSIT-Fall 2023 (Section-A)**

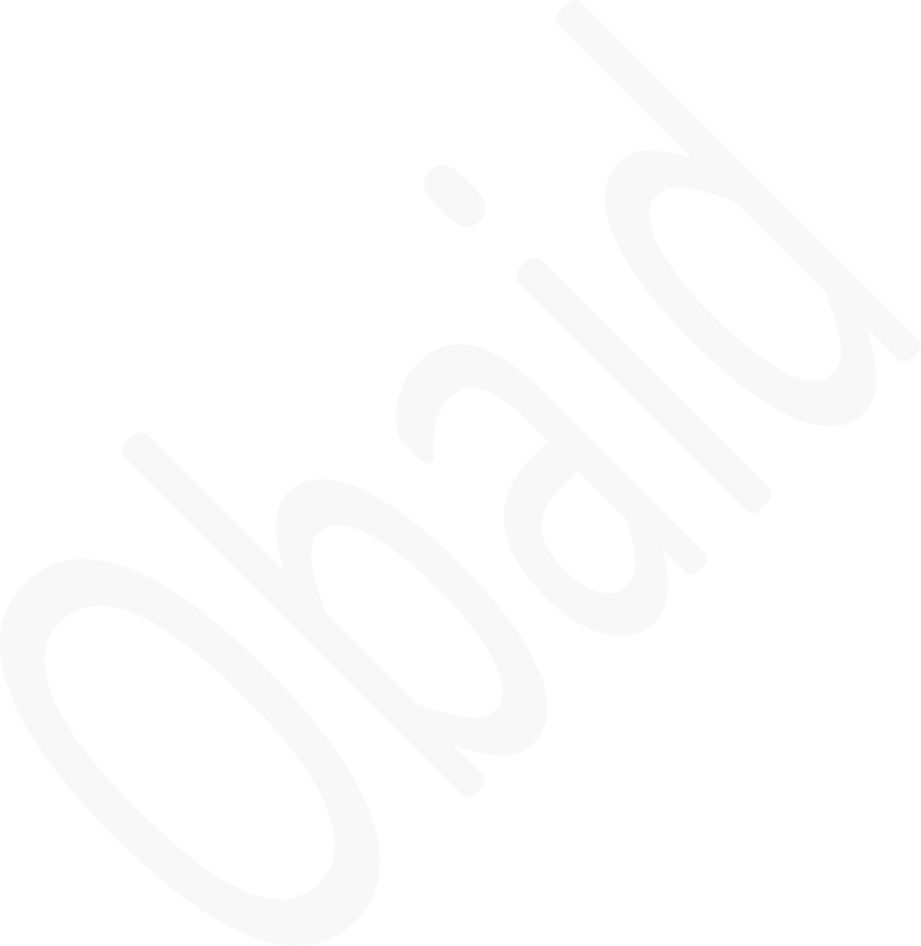
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## Executive Summary

**Computer Engineering** involves the design and development of systems based on computers and complex digital logic devices. These systems find use in such diverse tasks as computation, communication, entertainment, information processing, artificial intelligence, and control. Computer engineers will be very much involved with the “Information Highway.”

A computer engineer, equipped with a broad background in electrical engineering and computer science, will be entering an exciting and rapidly growing profession with unlimited opportunities in industry, government, and education. Many of our students have already participated in that world through internships. Some examples of internship placements are: Engineering Intern, AT&T Computer; Engineering Intern, IBM Corporation; Computer Engineering Intern, Computer Science Corporation; Computer Science Engineer Intern, Intel Corporation; and Engineering Technician, MITRE Corporation.

Computer Engineering graduates are equipped for careers as engineers, electrical designers, electrical engineers, design and applications engineers, test engineers, power systems engineers, and product engineers.

Career fields for computer engineers include computer-aided design, computer-aided manufacturing, hardware design, software design, and integrated circuit design.

## INTRODUCTION

**Computer engineering** (**COE** or **CPE**) is a branch of engineering that integrates several fields of computer science and electronic engineering required to develop computer

hardware and software 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

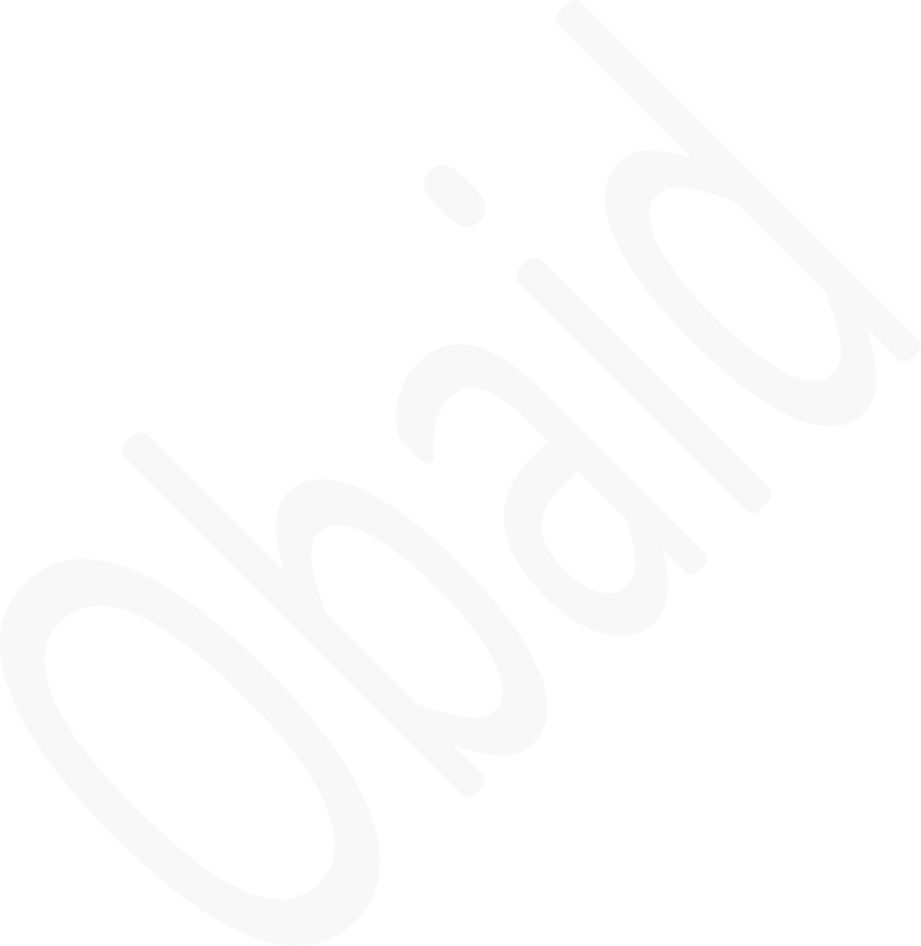
individual microcontrollers, microprocessors, personal computers, and supercomputers, to circuit design. This field of engineering not only focuses on how computer systems themselves work but also how they integrate into the larger picture.

##### TASKS

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

##### VERSATILITY

In many institutions of higher learning, 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 or two years of general engineering before declaring computer engineering as their primary focus

### EDUCATION

Computer engineering is referred to as computer science and engineering at some universities. Most entry-level computer engineering jobs require at least a bachelor's degree in computer engineering (or computer science and engineering). Typically one must learn an array

of mathematics such as calculus, algebra and trigonometry and some computer science classes. Sometimes a degree in electronic engineering is accepted, due to the similarity of the two fields. Because hardware engineers commonly work with computer software systems, a strong background in computer programming is necessary. According to BLS, "a computer engineering major is similar to electrical engineering but with some computer science courses added to the curriculum". 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. This can be helpful, especially when it comes to learning new skills or improving existing ones. For example, as the relative cost of fixing a bug increases the further along it is in the software development cycle, there can be greater cost savings attributed to developing and testing for quality code as soon as possible in the process, and particularly before release.

#### HISTORY OF COMPUTER ENGINEERING

The first

computer engineering degree program in the United States was established in 1971 at Case Western Reserve University in Cleveland, Ohio. As of 2015, there were 250 ABET-accredited computer engineering programs in the U.S. 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.

#### PROFESSION

A person with a profession in computer engineering is called a

computer engineer.

|  |  |  |  |
| --- | --- | --- | --- |
| **Title** | **Prefix** | **Suffix** | **Requirements** |
| Computer engineer | Engr. | CPE | Passed a degree in computer engineering  Institution: Educational Institution (such as College, University) |
| Certified computer engineer | Engr. | CCEP | Passed a certification exam in computer engineering  Institution: Private institution (such as computer engineering organizations and private companies) |
| Registered computer engineer | Engr. | RCEP | Passed a licensure exam in computer engineering  Institution: Public Institution (such as Country's Regulatory Board) |
| Professional computer engineer | Engr. | PCPE | Passed a professional exam in computer engineering, or work experience  Institution: Public or Private Institution |
| *\*may vary on region and country.* | | | |

###### DEMAND

One of the best things about a career as a computer engineer is the

choice and vast career options that are available to you. No matter which area of study you engage with, there will always be work. To be a computer engineer, you need to have higher education, whether this is in the form of a degree or other certifications. This can come with a certain prestige, in that you are working a career that you have put a lot of time, money and effort into to achieve where you are right now.

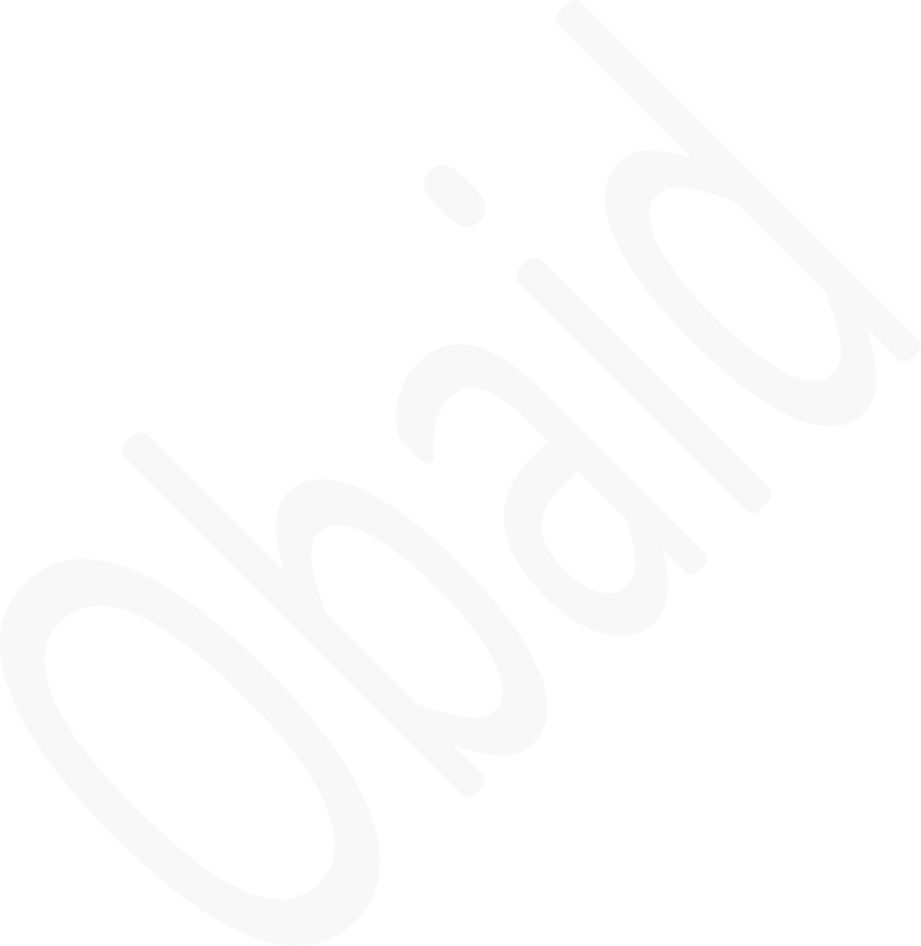
Computer engineers are in extremely high demand no matter where they work in the grand scheme of technology, and their salaries reflect that handsomely. We are living in a digital world these days, and if you're wondering what computer engineering does, all you have to do is look in your own house. The engineers out there are maintaining your Wi-Fi connections, your fiber optic cables and when your computer breaks, they're fixing it for you. We need computer engineers to function properly in today's world; it's easy to forget that!

### APPLICATIONS AND PRACTICE

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

#### COMPUTER HARWARE ENGINEERING

Computer hardware engineers "research, design, develop and test computer systems and components such as processors, circuit boards, memory devices, networks and routers," according to the U.S. Bureau of Labor Statistics

 (BLS). Computer hardware includes:

* microprocessors;
* memory chips: random-access memory (RAM), read-only memory (ROM) and non-volatile rewritable flash memory;
* data storage devices: hard disks, solid-state drives and optical drives;
* input devices: keyboards, mice, joysticks and gaming controllers, cameras, microphones, scanners, touch screens and remote sensors;
* output devices: printers, monitors, audio devices and remote controls; and
* Networking components: adapters, modems, switches and routers.

An important function of computer engineers is to integrate these components into computer and network systems. This all requires a good working knowledge

of electrical engineering.

###### FUTURE OF C.H.E

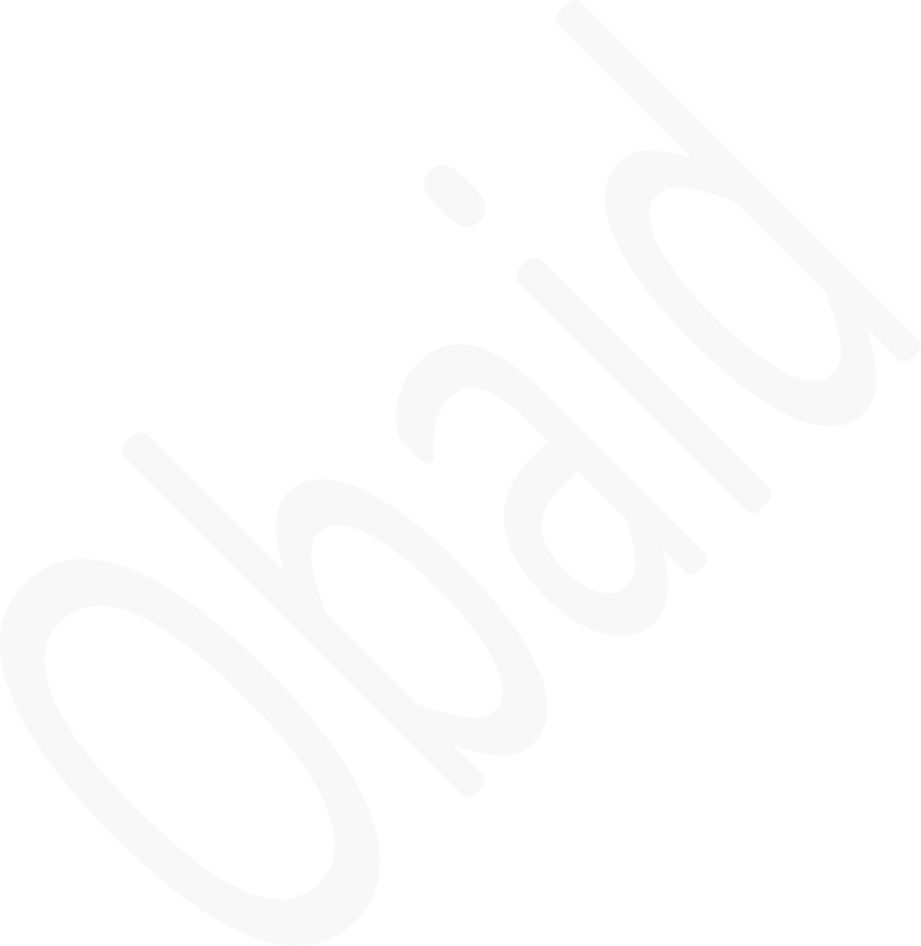
According to the BLS, Job Outlook employment for computer hardware engineers, the expected ten-year growth from 2019 to 2029 for computer hardware engineering was an estimated 2% and a total of 71,100 jobs. ("Slower than average" in their own words when compared to other occupations)". This is a decrease from the 2014 to 2024 BLS computer hardware engineering estimate of 3% and a total of 77,700 jobs.” and is down from 7% for the 2012 to 2022 BLS estimate and is further down from 9% in the BLS 2010 to 2020 estimate." Today, computer hardware is somehow equal to electronic and computer engineering (ECE) and has been divided into many subcategories; the most significant is embedded system design

#### COMPUTER SOFTWARE ENGINEERING

Another important aspect of computer engineering is software development. Computer software includes:-

* operating systems;
* applications: word processing, spreadsheets, accounting, database management, graphics, computer-assisted design (CAD), computer-assisted manufacturing (CAM), audio, video, media and games;
* networking and communications: World Wide Web (WWW), voice over Internet Protocol (VOIP), instant messaging and email;
* utilities: file handling, disk management, device drivers, archiving and backup systems;
* programming languages: editing, compiling and debugging; and
* Security antivirus, firewalls, encryption and user authentication.

###### FUTURE OF C.S.E

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" The expected ten-year growth as of 2014 for computer software engineering was an estimated seventeen percent and there was a total of 1,114,000 jobs that same year. This is down from the 2012 to 2022 BLS estimate of 22% for software developers. And, further down from the 30% 2010 to 2020 BLS estimate In addition, growing concerns over cybersecurity 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, as jobs that would have gone to computer software engineers in the United States would instead go to computer software engineers in countries such as India.[]](https://en.wikipedia.org/wiki/Computer_engineering#cite_note-bls.gov-27) In addition, the BLS Job Outlook for Computer Programmers, 2014–24 has an −8% (a decline, in their words) and a Job Outlook, 2019-29 -9% (Decline) for those who program computers (i.e. embedded systems) who are not computer application developers Furthermore, women in software fields has been declining over the years even faster than other engineering fields.

#### COMPUTER ENGINEERING LICENSING

Computer engineering is generally practiced within larger product development firms, and such practice may not be subject to licensing. However, independent consultants who advertise computer engineering, just like any form of engineering, may be subject to state laws which restrict professional engineer practice to only those who have received the appropriate License National Council of Examiners for Engineering and Surveying (NCEES) first offered

a Principles and Practice of Engineering Examination for computer engineering in 2003.

### SPECIALITY AREAS

field of computer engineering.

There are many specialty areas in the

#### PROCESSOR DESIGN

Processor design process involves choosing

an instruction set and a certain execution paradigm (e.g. VLIW or RISC) and results in a microarchitecture, which might be described in e.g. VHDL or Verilog. CPU design is divided into design of the following components: data paths (such as ALUs and pipelines), control unit: logic which controls the data paths, memory components such as register files, caches, clock circuitry such as clock drivers, PLLs, clock distribution networks, pad transceiver circuitry, logic gate cell library which is used to implement the logic.

#### CODING AND INFORMATION SECURITY

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.

#### COMMUNICATION 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 SYSTEM

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 include post-link-time code transformation algorithm development and new operating system development

#### COMPUTATIONAL ENGINEERING

Computational science and engineering is a relatively new discipline. According to the Sloan Career Cornerstone Centre, 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".

#### MOBILE COMPUTING

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 ARCHITECTURE

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 the development of new theories, algorithms, and other tools that add performance to computer systems.

Computer architecture includes CPU design, cache hierarchy layout, memory organization and load balancing.

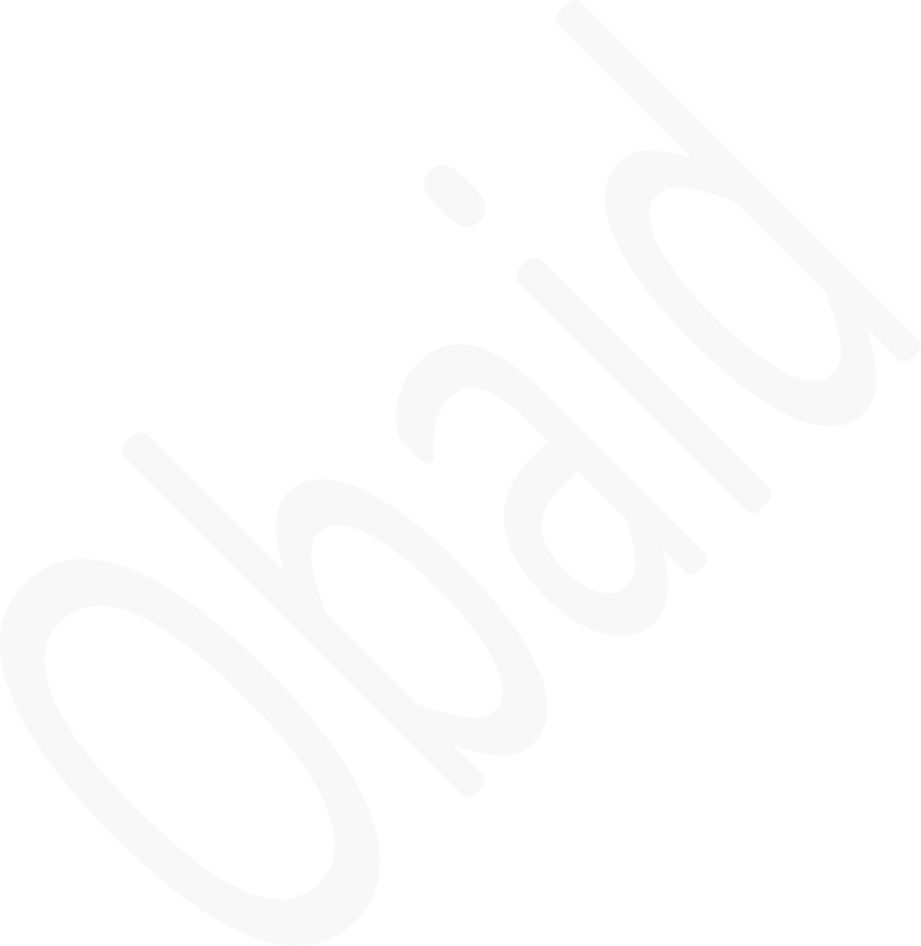
#### COMPUTER VISION AND ROBOTICS

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.

#### 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 Centre, ongoing 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."[As of 2018, computer embedded computer engineering specializations include system-on-chip design, architecture of edge computing and the Internet of things.

#### VLSI DESIGN

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.

#### 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.

#### QUANTUM COMPUTING

**Quantum computing** is a type

of computation that harnesses the collective properties of quantum states, such as superposition, interference, and entanglement, to perform calculations. The devices that perform quantum computations are known as **quantum computers**. They are believed to be able to solve

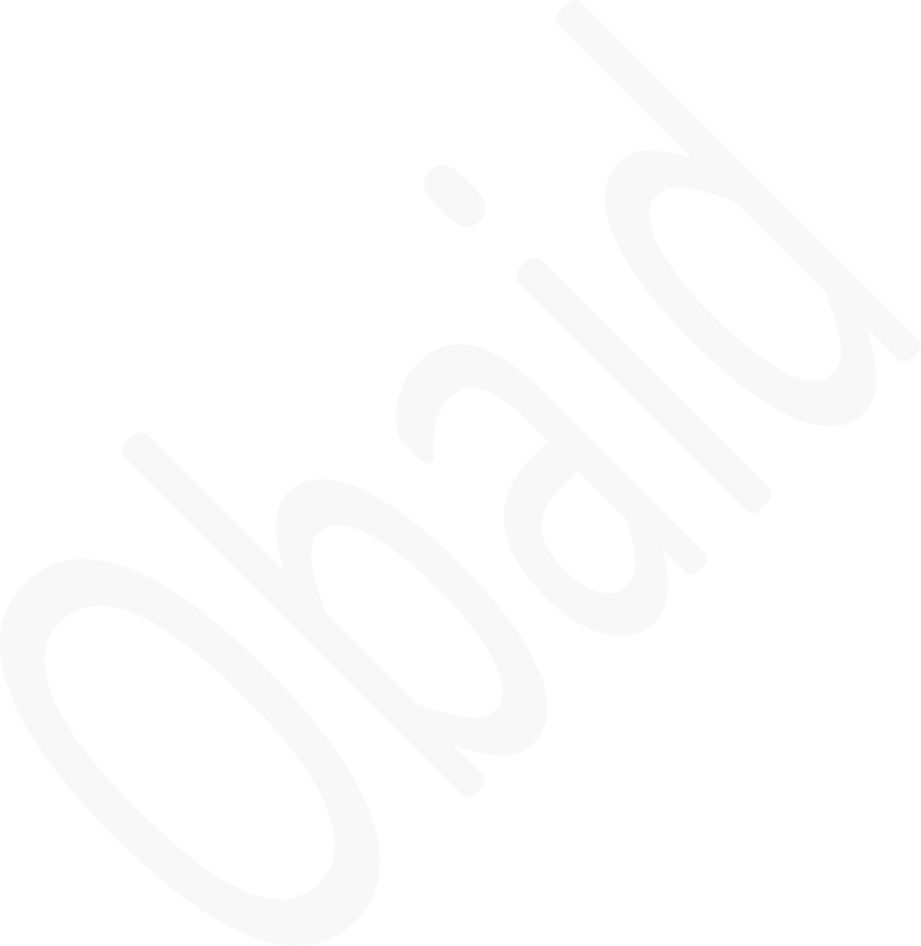
certain computational problems, such as integer factorization (which underlies RSA encryption), substantially faster than classical computers. The study of quantum computing is a subfield

of quantum information science. Expansion is expected in the next few years as the field shifts toward real-world use in pharmaceutical, data security and other applications.

### REFERENCES

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Application and Practice: - [https://www.livescience.com/48326-computer-](https://www.livescience.com/48326-computer-engineering.html) [engineering.html](https://www.livescience.com/48326-computer-engineering.html)

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