Introdução à Engenharia de Computação

Aula 1

Currículo do curso

- Principais elementos norteadores:
  - Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering (Association for Computing Machinery (ACM) / IEEE Computer Society) – 2016.
  - Diretrizes Curriculares Nacionais de Engenharia – Resolução CNE/CES 2/2019. Diretrizes Curriculares Nacionais para os Cursos de Graduação na Área de Computação – Resolução CNE/CES 5/2016.
  - Normas Gerais da Graduação – Resolução 01/2018 do Conselho de Ensino, Pesquisa e Extensão da UFMG.

Curriculum Guidelines ACM / IEEE

- Desde 1991
- Engenharia de Computação: desde 2004
- Escopo internacional

- Corpo de conhecimentos do curso
- Disciplinas que cobrem o corpo de conhecimento
- Requisitos centrais para todos os graduados na área

- Conceito de “Projeto”
- Integração hardware-software: “projeto de um computador completo”

Que é Engenharia de Computação?

Computer engineering is a discipline that embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern computing systems, computer-controlled equipment, and networks of intelligent devices. Traditionally, computer engineering is some combination of both electrical engineering (EE) and computer science (CS). It has evolved over the past four decades as a separate discipline, although intimately related to computer science and electrical engineering. Computer engineering is solidly grounded in the theories and principles of computing, mathematics, science, and engineering and it applies these theories and principles to solve technical problems through the design of computing hardware, software, networks, and processes.

Surgimento da Engenharia de Computação

Historically, the field of computer engineering has been widely viewed as “designing computers.” In fact, the design of computers themselves has been the province of relatively few highly skilled engineers whose goal was to push forward the limits of computer and microelectronics technology. The successful miniaturization of silicon devices and their increased reliability as system building blocks and complete systems on chips have created an environment in which computers have become pervasive and replaced more conventional electronic devices. These applications manifest themselves in the proliferation of mobile smart phones, tablet computers, multimedia and location-aware devices, wireless networks, and similar products. Computer engineering also reveals itself in the myriad of applications involving embedded systems, namely those computing systems that appear in applications such as automobiles, control systems, major appliances, and the internet of things.

Áreas de atuação

Increasingly, computer engineers are involved in the design of computer-based systems to address highly specialized and specific application needs. Computer engineers work in most industries, including the computer, automobile, aerospace, telecommunications, power production, manufacturing, defense, and electronics industries. They design high-tech devices ranging from tiny microelectronic integrated-circuit chips, to powerful systems that utilize those chips and efficient telecommunication systems that interconnect those systems. Computer engineers also work on distributed computing environments—local and wide area networks, wireless networks, internets, intranets—and embedded computer systems—such as in aircraft, spacecraft, and automobile control systems where they perform various functions. A wide array of complex technological systems, such as power generation and distribution systems and modern processing and manufacturing plants, rely on computer systems developed and designed by computer engineers.

Origens na Eng. Elétrica e C. Computação

As noted previously, computer engineering evolved from the disciplines of electrical engineering and computer science. Initial curricular efforts in computer engineering commonly occurred as a specialization within electrical engineering programs, extending digital logic design to the creation of small-scale digital systems and, eventually, to the design of microprocessors and computer systems. Later, curricula in computer engineering increasingly began to include and finally evolved to integrate relevant knowledge areas from computer science. Today, that trend is diminishing and CE programs reflect their own knowledge areas. This CE2016 report reflects the new approach.

Diferenças em relação à Eng. Elétrica e Ciência da Computação

An important distinction should be made between computer engineers, electrical engineers, other computer professionals, and engineering technologists. While such distinctions are sometimes ambiguous, computer engineers generally should possess the following three characteristics:

- the ability to design computers, computer-based systems, and networks that include both hardware and software as well as their integration to solve novel engineering problems, subject to trade-offs involving a set of competing goals and constraints—in this context, "design" refers to a level of ability beyond "assembling" or "configuring" systems
- a breadth of knowledge in mathematics and engineering sciences, associated with the broader scope of engineering and beyond that narrowly required for the field
- acquisition and maintenance of a preparation for professional practice in engineering

As áreas correlatas

Other related disciplines can be described as follows.

- Electrical engineering spans a wide range of areas, including bioengineering, power engineering, electronics, telecommunications, and digital systems. Related to the field of computer engineering, electrical engineers concern themselves primarily with the physical aspects of electronics including circuits, signal analysis, and microelectronic devices.
- Computer scientists concern themselves primarily with the theoretical and algorithmic aspects of computing with a focus on the theoretical underpinnings of computing.
- Software engineers have a focus on the principles underlying the development and maintenance of correct (often large-scale) software throughout its lifecycle. Information systems specialists encompass the acquisition, deployment, and management of information resources for use in organizational processes.

Profissionalismo

The public has entrusted a level of responsibility in computer engineers because the systems they design (such as x-ray machines, air traffic control systems, or nuclear power plants) affect the public directly and indirectly. Therefore, it is incumbent upon computer engineers to exercise the utmost conscientiousness in their designs and implementations of computing systems. As such, graduates should understand the responsibilities associated with engineering practice, including the professional, societal, and ethical context in which they do their work. Such responsibilities often involve complicated trade-offs involving fiscal and social contexts. This social context encompasses a range of legal and economic issues such as intellectual property rights, security and privacy issues, liability, technological access, and global implications and uses of technologies.

Capacidade de projetar

Design is fundamental to all engineering. For the computer engineer, design relates to the creation and integration of software and hardware components of modern computing systems and computer-controlled equipment. Computer engineers apply the theories and principles of science and mathematics to design and integrate hardware, software, networks, and processes and to solve technical problems. Continuing advances in computers and digital systems have created opportunities for professionals capable of applying these developments to a broad range of applications in engineering. Fundamentally, it is about making well-considered *choices* or *trade-offs*, subject to given constraints. These relate to such matters as structure and organization, techniques, technologies, methodologies, interfaces, as well as the selection of components. The outcome needs to exhibit desirable properties and these tend to relate to simplicity and elegance. Chapter 4 presents a more detailed discussion of design and related laboratory experiences.

Características do profissional

- *System Level Perspective*—Graduates should appreciate the concept of a computer system, the design of the hardware and software for that system, and the processes involved in constructing, analyzing, and maintaining it over the lifetime of the system. They should understand its operation to a greater depth than a mere external appreciation of what the system does or the way(s) in which one uses it.
- *Depth and Breadth*—Graduates should have familiarity with subject areas across the breadth of the discipline, with advanced knowledge in one or more areas.
- *Design Experiences*—Graduates should have completed a sequence of design experiences, encompassing hardware and software elements and their integration, building on prior work, and including at least one major project.
- *Use of Tools*—Graduates should be able to use a variety of computer-based and laboratory tools for the analysis and design of computer systems, including both hardware and software elements.
- *Professional Practice*—Graduates should understand the societal context in which engineering is practiced, as well as the effects of engineering projects on society.
- *Communication Skills*—Graduates should be able to communicate their work in appropriate formats (written, oral, graphical) and to critically evaluate materials presented by others in those formats.

Áreas de conhecimento da EC

Table 3.1: CE2016 Knowledge Areas

CE-CAE	Circuits and Electronics	CE-PPP	Preparation for Professional Practice
CE-CAL	Computing Algorithms	CE-SEC	Information Security
CE-CAO	Computer Architecture and Organization	CE-SGP	Signal Processing
CE-DIG	Digital Design	CE-SPE	Systems and Project Engineering
CE-ESY	Embedded Systems	CE-SRM	Systems Resource Management
CE-NWK	Computer Networks	CE-SWD	Software Design

Exemplo de unidade de conhecimento

CE-CAO	**Computer Architecture and Organization** [60 core hours]
CE-CAO-1	History and overview [1]
CE-CAO-2	Relevant tools, standards and/or engineering constraints [1]
CE-CAO-3	Instruction set architecture [10]
CE-CAO-4	Measuring performance [3]
CE-CAO-5	Computer arithmetic [3]
CE-CAO-6	Processor organization [10]
CE-CAO-7	Memory system organization and architectures [9]
CE-CAO-8	Input/Output interfacing and communication [7]
CE-CAO-9	Peripheral subsystems [7]
CE-CAO-10	Multi/Many-core architectures [5]
CE-CAO-11	Distributed system architectures [4]

Exemplo de unidade de conhecimento

CE-ESY	**Embedded Systems**
	[40 core hours]
CE-ESY-1	History and overview [1]
CE-ESY-2	Relevant tools, standards, and/or engineering constraints [2]
CE-ESY-3	Characteristics of embedded systems [2]
CE-ESY-4	Basic software techniques for embedded applications [3]
CE-ESY-5	Parallel input and output [3]
CE-ESY-6	Asynchronous and synchronous serial communication [6]
CE-ESY-7	Periodic interrupts, waveform generation, time measurement [3]
CE-ESY-8	Data acquisition, control, sensors, actuators [4]
CE-ESY-9	Implementation strategies for complex embedded systems [7]
CE-ESY-10	Techniques for low-power operation [3]
CE-ESY-11	Mobile and networked embedded systems [3]
CE-ESY-12	Advanced input/output issues [3]
CE-ESY-13	Computing platforms for embedded systems

Mathematics Knowledge Areas and Units

CE-ACF	**Analysis of Continuous Functions**
	[30 core hours]
CE-ACF-1	History and overview [1]
CE-ACF-2	Relevant tools and engineering applications [1]
CE-ACF-3	Differentiation methods [4]
CE-ACF-4	Integration methods [6]
CE-ACF-5	Linear differential equations [8]
CE-ACF-6	Non-linear differential equations [3]
CE-ACF-7	Partial differential equations [5]
CE-ACF-8	Functional series [2]

CE-DSC	**Discrete Structures**
	[30 core hours]
CE-DSC-1	History and overview [1]
CE-DSC-2	Relevant tools and engineering applications [1]
CE-DSC-3	Functions, relations, and sets [6]
CE-DSC-4	Boolean algebra principles [4]
CE-DSC-5	First-order logic [6]
CE-DSC-6	Proof techniques [6]
CE-DSC-7	Basics of counting [2]
CE-DSC-8	Graph and tree representations and properties [2]
CE-DSC-9	Iteration and recursion [2]

CE-LAL	**Linear Algebra**
	[30 core hours]
CE-LAL-1	History and overview [1]
CE-LAL-2	Relevant tools and engineering applications [2]
CE-LAL-3	Bases, vector spaces, and orthogonality [4]
CE-LAL-4	Matrix representations of linear systems [4]
CE-LAL-5	Matrix inversion [2]
CE-LAL-6	Linear transformations [3]
CE-LAL-7	Solution of linear systems [3]
CE-LAL-8	Numerical solution of non-linear systems [4]
CE-LAL-9	System transformations [3]
CE-LAL-10	Eigensystems [4]

CE-PRS	**Probability and Statistics**
	[30 core hours]
CE-PRS-1	History and overview [1]
CE-PRS-2	Relevant tools and engineering applications [2]
CE-PRS-3	Discrete probability [5]
CE-PRS-4	Continuous probability [4]
CE-PRS-5	Expectation and deviation [2]
CE-PRS-6	Stochastic Processes [4]
CE-PRS-7	Sampling distributions [4]
CE-PRS-8	Estimation [4]
CE-PRS-9	Hypothesis tests [2]
CE-PRS-10	Correlation and regression [2]

Laboratórios

Laboratory Type	Must	Should	Supplemental
Circuits and Electronics	●●●●		
Computer Architecture Design			●
Digital Signal Processing			●
Digital Logic and System Design	●●●●		
Embedded Systems	●●●●		
Introduction to Engineering			●
Networking		●●	
Software Design		●●	
Senior Project Design	●●●●		

Diretrizes Curriculares Nacionais (CNE)

Diretrizes Curriculares Nacionais (CNE)

- Conhecimentos gerais de Engenharia e específicos de EC:
  - Representam um subconjunto das recomendações do documento ACM / IEEE
- Principais elementos adicionais:
  - Currículo de 3600 horas / 5 anos
  - Estágio curricular obrigatório (180 horas)
  - Tópicos gerais obrigatórios:
    - Meio ambiente
    - Direitos humanos

Normas Gerais da Graduação - UFMG

Estrutura dos currículos

- Atividades Acadêmicas Curriculares:
  - Disciplina
  - Projeto
  - Programa
  - Estágio
  - Evento
    - Matrícula: “Atividades Complementares”
- Estruturas Formativas:
  - Tronco Comum
  - Formação Complementar (incluindo Formações Transversais)

Estrutura dos currículos

- Núcleos:
  - Específico
  - Complementar
  - Geral
  - Avançado
- Núcleo Específico:
  - Atividades obrigatórias: conhecimentos, habilidades e atitudes dos campos abrangidos pelo curso
  - Atividades optativas: perfis de conhecimentos característicos de diferentes percursos curriculares, inclusos nas áreas do curso

Estrutura dos currículos

- Núcleo Complementar:
  - Estrutura Formativa de Formação Complementar
    - Atualmente disponíveis: Formações Transversais
  - Formação Complementar Aberta

- Núcleo Geral:
  - Temas de amplo interesse; formação intelectual, crítica e cidadã
  - Disciplinas com vagas para todos os cursos

- Núcleo Avançado:
  - Disciplinas de pós-graduação afins ao curso
    - Eng. de Computação: Ciência da Computação, Engenharia Elétrica, Eng. de Produção, Estatística, Física, Inovação Tecnológica

Trajetórias Possíveis

- Trajetória básica: integralizar o curso (NE/NA/NC ou NE/NA/NG)

- Trajetórias alternativas:
  - Curso + Intercâmbio (mobilidade internacional)
  - Curso + Formação Complementar
  - Curso + Créditos do Mestrado
  - Curso + Outro Curso

Currículo do Curso de Engenharia de Computação

NÚCLEOS CURRICULARES	PERCURSO			
	NE/NA/NG		NE/NA/NC	
	Carga horária mínima	Carga horária máxima	Carga horária mínima	Carga horária máxima
Núcleo Específico - AACs Obrigatórias	2715	2715	2715	2715
Núcleo Específico - Estágio Curricular	165	165	165	165
Núcleo Específico - AACs Optativas	600	600	420	420
Área Temática (Grupo 1 - OB)	240	360	240	240
Laboratório - Área Temática (Grupo 2 - OB)	60	60	60	60
Demais Optativas (Grupo 3 - OB)	0	120	30	60
Núcleo Avançado (Grupo 4 - OB)	60	180	60	60
Atividades Complementares (Grupo 5 - OP)	0	120	0	30
Núcleo Geral	120	120	0	0
Núcleo Complementar	0	0	300	300
TOTAL	3600		3600	