MSc Computer and Embedded Systems Engineering

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Agenda

- What is Computer and Embedded Systems Engineering?
- CESE versus other MSc. programmes
- Curriculum MSc. CESE
- CESE research groups
- Thesis projects
- Entry requirements
- Some statistics

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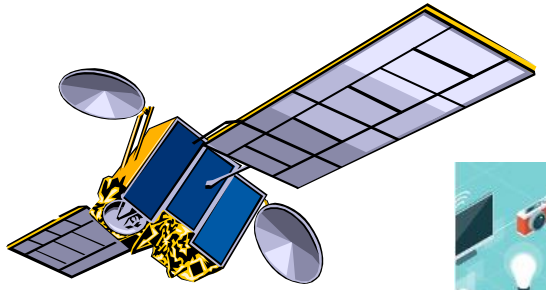
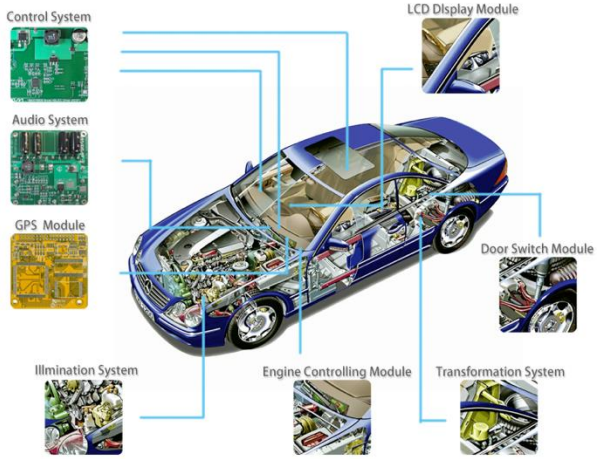
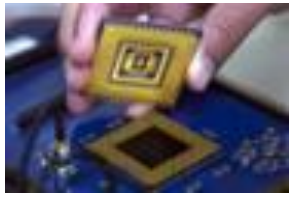
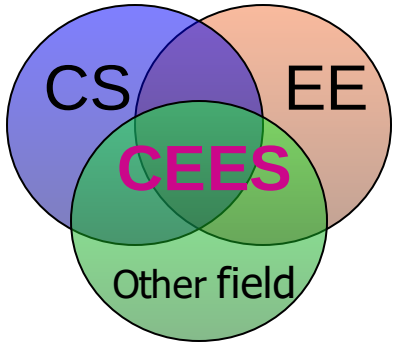
Computer and embedded systems engineering







- System control
- Applications (AI, Big Data)
- Networking
- Sensor and actuator processing
- Operating systems
- Computer architectures
- Computer components (CPU, GPU, FPGA)
- Computer devices (CMOS, memristor, quantum device)



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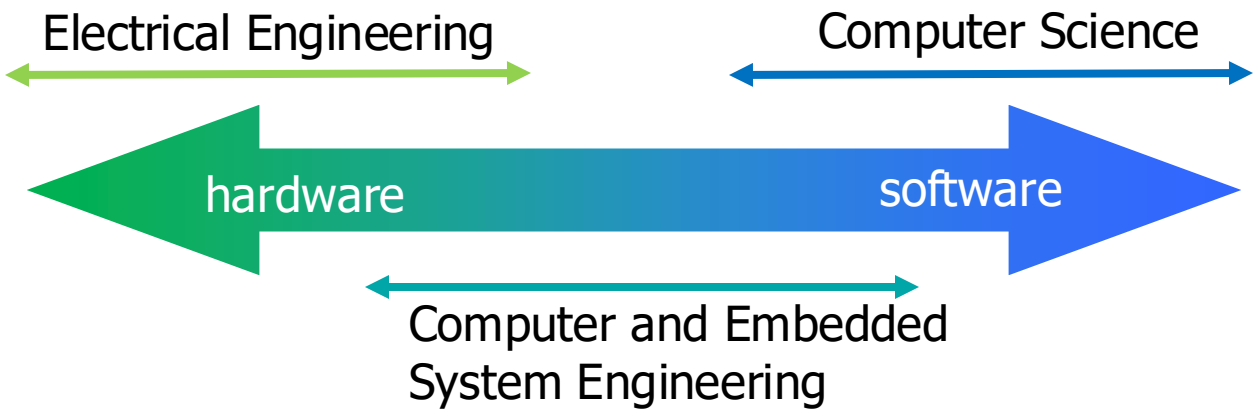
MSc. CESE versus other programmes

As an CESE student:

- you will learn about hardware and software, and their integration
- you will learn how to use hardware and software to control other systems
- you can specialize on many different CS, EE and Systems & Control topics



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Curriculum

First Year (60 EC)			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Computer Engineering (5 EC)	Software Systems (5 EC)	Specialization (5 EC)	Effective & Responsible Engineering (5 EC)
Systems Engineering (5 EC)	Real-time Systems (5 EC)	Embedded Systems Lab (5 EC)	Specialization (5 EC)
Software Fundamentals or Hardware Fundamentals (both 5 EC)	Specialization (5 EC)	Modern Computer Architecture (5 EC)	Processor Design Project (5 EC)

Second Year (60 EC)			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Project, internship, or set of elective courses (e.g. quantum, AI, sustainability, entrepreneurship)	Thesis project (45 EC)		

HW

SW

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Duration: 2 years (2 x 60 EC = 120 EC)

Programme

Common core	
System Engineering	5 EC
Effective & Responsible Engineering	5 EC
Software Fundamentals/Hardware Fundamentals (homologation)	5 EC
Computer Engineering	5 EC
Software Systems	5 EC

Integration set 1	
Real-Time Systems	5 EC
Embedded Systems Lab	5 EC

Integration set 2	
Modern Computer Architectures	5 EC
Processor Design Project	5 EC

Both integration sets should be taken. However, students doing the specialization Control may replace integration set 2 by Systems & Control spec. courses.

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Specialisation Courses

At least 13 EC on specialization courses should be chosen:

- Software

  Supercomputing for Big Data, Smart Phone Sensing, Evolutionary Algorithms, Network Security, Software Architecture, Security and Cryptography, Modelling and Problem Solving, Constraint Solving, Distributed Algorithms, Compiler Construction, Machine and Deep Learning, Probabilistic AI and Reasoning, Elements of Statistical Learning, Alternative Learning Strategies, Introduction to High Performance Computing.

- Computer Architecture

  Advanced Computing Systems, Computer Arithmetic, Supercomputing for Big Data, Reconfigurable Computing Design, Embedded Computer Architectures 2, Compiler Construction, Digital IC Design, Digital IC Design II, Hardware Architectures for Artificial Intelligence, Hardware Dependability, Modelling, Algorithms and Data Structures, Digital VLSI Systems on Chip, High Speed Digital Design for Embedded Systems, Quantum Computing Architecture.

Specialisation Courses (cont.)

- Networking

  High-Performance Data Networking, Ad-hoc Networks, Wireless IoT and Local Area Networks, Advanced Practical I.o.T. and Seminar, Smart Phone Sensing, Quantum Communication and Cryptograph, Network Security, Mobile Networks, Telecommunication Network Architectures, Networking, Telecom Business Architectures and Models, Fundamentals of Wireless Communications, Performance Analysis, Networked and Distributed Control Systems.

- Control

  Intelligent Control Systems, Control System Design, Control theory, Filtering & Identification, Optimization for Systems and Control, Non-linear Control Systems Theory, Modelling and Control of Hybrid Systems, Digital Control, Networked and Distributed Control Systems, Dynamic Programming and Stochastic Control, Model Predictive Control, Fault Diagnosis and Fault Tolerance Control, Robust Control, Statistical Signal Processing, Modelling of Dynamical Systems.

Other electives

The remaining 15-17 EC constitute a free elective space that can be filled with e.g.

- Industry internship
- Research internship
- Joint Interdisciplinary Project
- Interdisciplinary Advanced Artificial Intelligence Project
- More specialization courses
- Other CS, EE and System and Control courses
- A few non-technical courses (language, business)

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Research groups for thesis projects

Group	Department
Algorithms	ST
Bioelectronics	ME
Computer Engineering	Q&CE
Cyber Security	IS
Distributed Systems	ST
Electronic Instrumentation	ME
Embedded Systems	ST
Interactive Intelligence	IS
Multimedia Computing	IS
Network Architectures and Services	Q&CE
Networked Systems	ST
Quantum Circuits Architecture & Technology	Q&CE
Signal Processing Systems	ME
Software Engineering	ST
Cognitive Robotics	Faculty ME
Delft Centre for Systems and Control	Faculty ME

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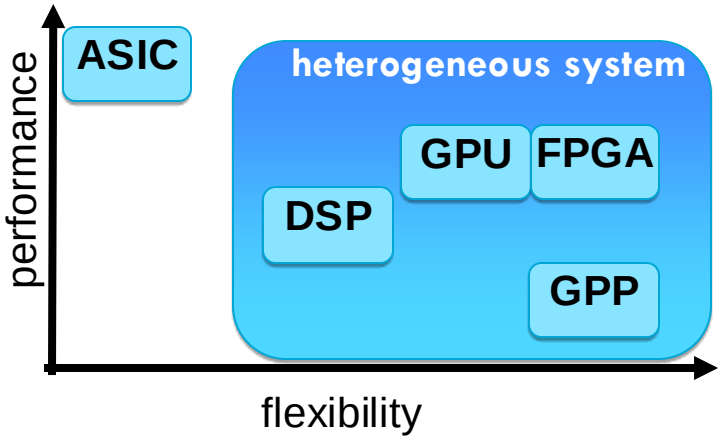
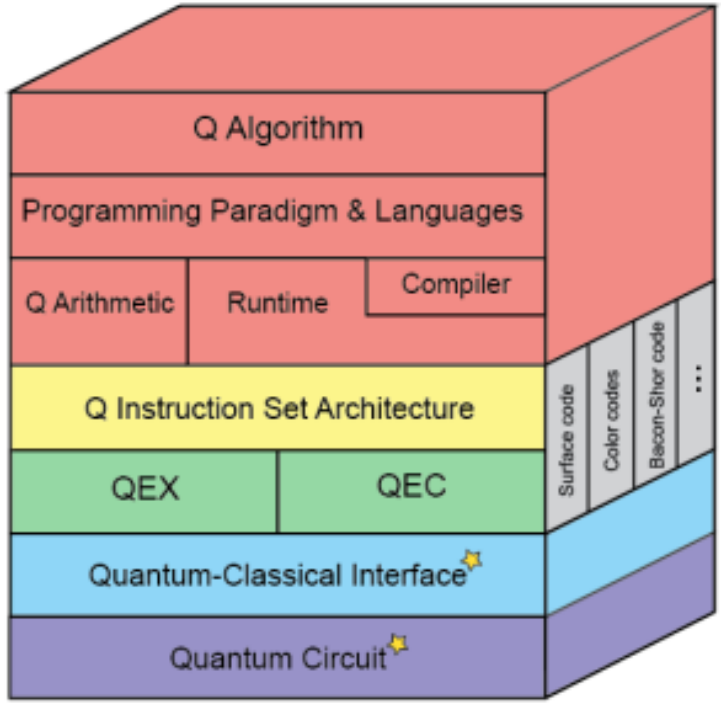
Some Research Topics

- Liquid architectures
  - Which parts of the application will use which hardware resources?
  - How to use runtime reconfiguration?
- Big data architectures
- AI architectures
- Neuromorphic computing
- In-memory computing
- Hardware security
- Quantum computing
  - New logic building blocks and architectures to build Quantum computers.





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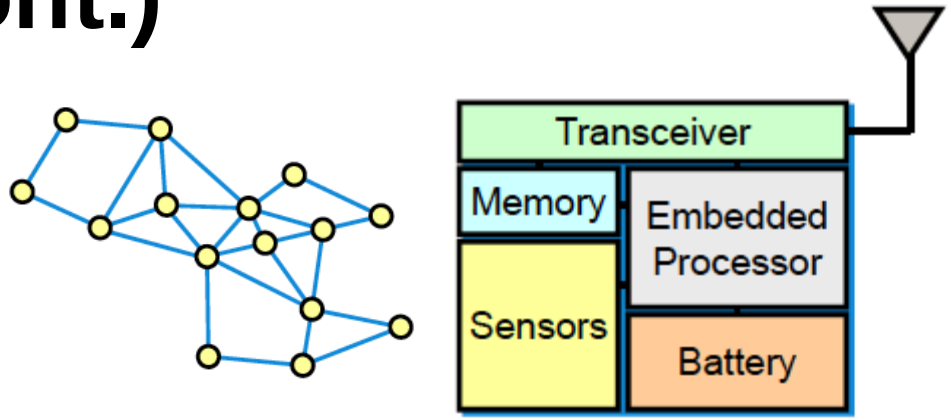
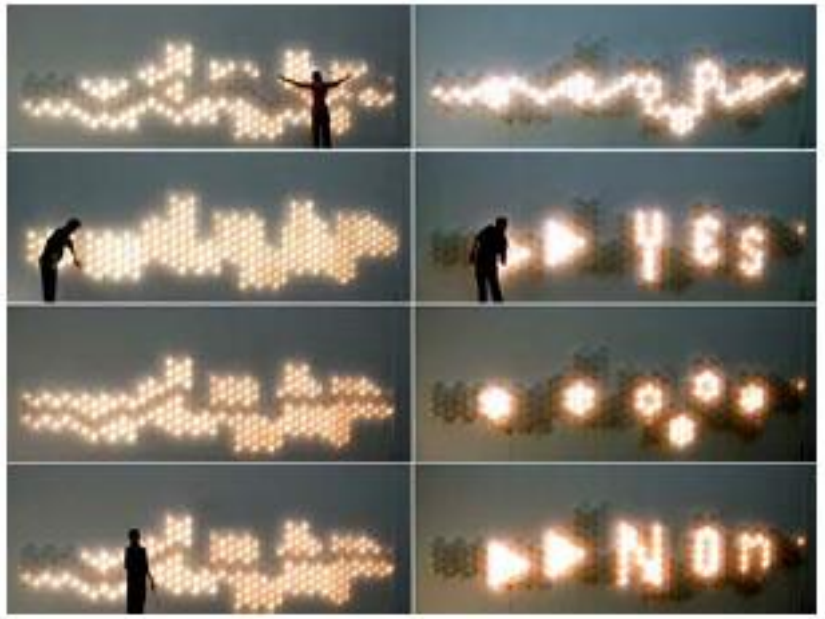
Some Research Topics (cont.)

- Wireless sensor networks
- Energy-efficient networks and systems
- Internet of Things
- Embedded AI
- Cyber physical systems
- Visible light communication





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Some Thesis Projects

- Brain-inspired feature extraction for near sensor extreme edge processing with Spiking Neural Networks
- An Area and Energy Efficient Arithmetic Unit for Stacked Machine Learning Models
- Securing an Efficient Lightweight AES Accelerator
- Building an Event-Driven Timing Simulator for Embedded Hybrid GPU-AI Accelerator
- Protecting CAN XL Protocol from Denial-of-Service Attacks
- Efficient Execution of User-Provided Graph Algorithms in a Graph Database
- Vector Processing in NUMA Systems
- RISC-V 32-bit instruction set extension to address the control of diamond qubits

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Some Thesis Projects (cont.)

- Energy Aware Online Non-Preemptive Scheduling on Multi-core Embedded Systems
- Secure Task Management in FreeRTOS: A RISC-V Core Approach with Physical Memory Protection
- Embedded Firmware Debugging and Telemetry
- Reducing journey times for en-route charging using V2X communication
- Indoor Localization for Efficient Bike-Sharing Management
- Underwater 3D localization and communication for mobile networked robots
- Real-time Adaptive Nonlinear MPC for Collision Imminent Control and Planning in Automated Vehicles
- Experimental Validation of Model-Based Control Methods for Shape Regulation in Soft Robots

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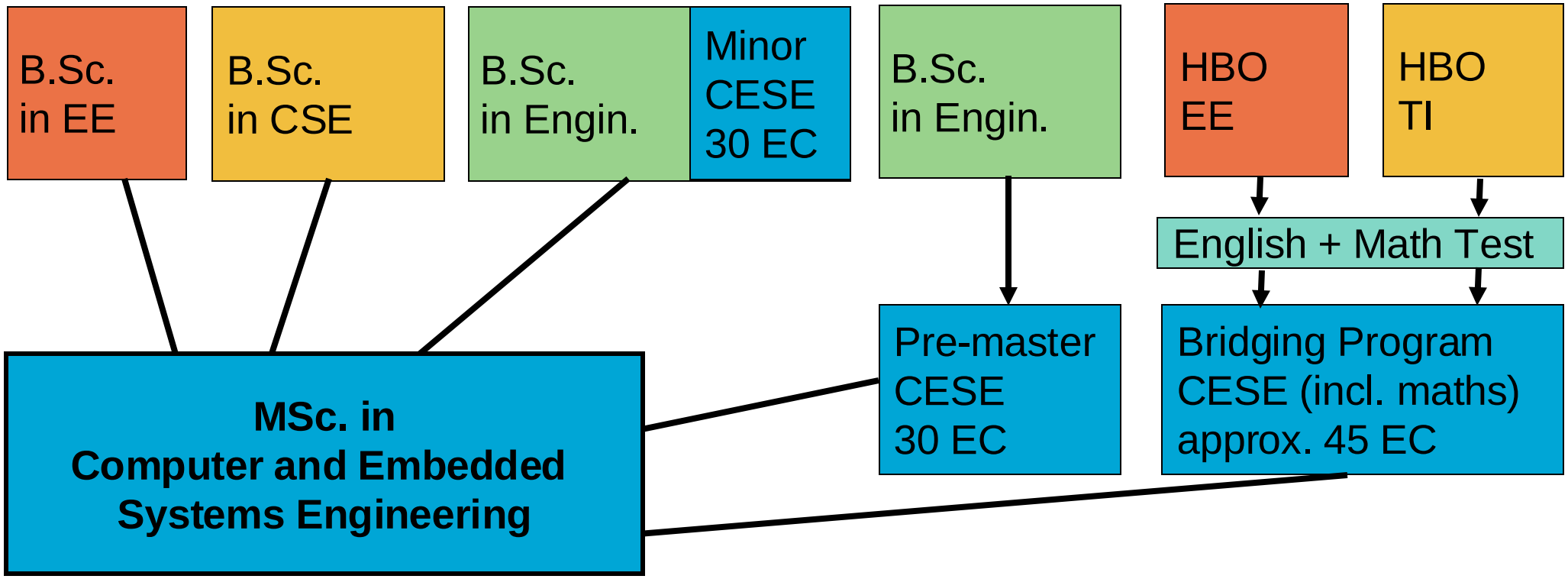
Entry Requirements



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New students per year

Year	total	NL	Int EU	Non EU
2017/2018	95	41	16	38
2018/2019	95	37	28	30
2019/2020	77	51	5	21
2020/2021	90	46	6	28
2021/2022	88	49	10	29
2022/2023	110	55	19	36
2023/2024	89	49	18	22
2024/2025	91	50	25	16

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Who is employing our students?

- Philips
- NXP
- ASML
- ARM
- Alten
- Fox-IT
- Vanderlande
- Rijkswaterstaat
- ABB
- TU Delft
- Technolution
- Erasmus MC
- Intel
- Qualcomm
- NVIDIA
- Synopsys
- WhatsApp
- TomTom
- CERN
- Thales
- Robot Care Systems
- Lely Industries
- Ned. Octrooibureau
- ISIS Space
- Deloitte
- MyOmega Systems
- Imagination Techn.
- Bosch
- BMW
- ....

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CESE webpage

Staff page

Thank you!