Computer Engineering

The Computer Engineering programme is unique in providing a holistic view of system design.

An in-depth understanding of hardware and software is necessary to provide the enabling technology for new societal trends such as ubiquitous online presence and the Internet of Things.

Big data and cloud computing, multicore processors, heterogeneous accelerators, parallel computing are all emerging technologies that are crucial in many domains like the economic sectors, but also increasingly in the medical domain. As future computer engineer, you will be contributing to the design of systems and computational platforms. You will make sure that the requirements of particular applications are optimally supported, by selecting the right combination of hardware and software architectures for satisfying specific constraints with regard to performance, power and cost.

Programme
The Master of Science programme in Computer Engineering at TU Delft is designed for students with a Bachelor’s degree in Computer Science or Electrical Engineering.

The programme provides you with the skills that are needed in order to design, develop and use software and hardware for computer systems. The courses in the programme address the three different aspects of computer engineering: software design, hardware design and the integration of the two. Understanding the theories that underlie system software (including programming, operating systems and compilers) will help you to create software designs.

In addition, the Computer Engineering programme will prepare you for the engineering challenges that lie ahead. You will learn about modern computer architectures and networks and how to explain processors and their ability to perform their calculations, in addition to suggesting methods for optimising these calculations. The processor design project challenges you to optimise your own processors for specific applications with given optimisation targets (e.g. high speed or low power). The purpose of this hands-on project is to achieve optimum system performance that meets the design criteria.
Henrique Dantas (Portugal)

I did my Electrotechnical Engineering Bachelor in FEUP back in my hometown of Porto, Portugal. In my 4th year I got the opportunity to join the Erasmus programme and did the exchange programme at Delft University of Technology. I had a great Erasmus year and was not eager to say goodbye quite yet, so I decided to transfer to TU Delft and start my Master’s degree in Computer Engineering here. I chose the Master programme of Computer Engineering, because I enjoy the balance between hardware and software it entails. There were several reasons for moving to Delft. The number of international students is huge. Another motivation was the prestige of TU Delft and the quality of the Professors. There are a lot of great courses and I have more freedom to follow the ones I like than in Portugal. For example I attended an entrepreneurship course that included a study trip to San Francisco and Silicon Valley, very cool indeed!

**Research themes**

The Master’s thesis project can be chosen between the spectrum of hardware and software and can be performed at a company, in a research facility or at the university. The TU Delft Computer Engineering Lab (CE Lab) has an excellent network with big industry, including such companies as IBM, Intel, NVIDIA and Google. It therefore offers students the opportunity to work with the latest developments in hardware platforms and applications. The lab also has contacts with other international universities, as well as with TU Delft spin-off companies and start-ups. There are five different research themes that drive many of the courses:

**Quantum Computing** The CE lab is part of the QuTech research lab that aims to build a quantum gates based computer. We are looking at the different architectural design choices that depend on the underlying qubit technology, the encoding scheme chosen and the kind of logical qubit one wants to implement.

**Big Data Architectures** involves the design of cutting-edge high performance computing systems to address the current explosion of dataset sizes in a wide range of application domains. Project examples include the design of a private cloud system for child cancer diagnostics based on genetic data, and the acceleration of new scientific simulation algorithms on multicore systems such as GPUs and FPGAs.

**Liquid Architectures** involves the design of innovative reconfigurable processor architectures that change their characteristics dynamically based on the needs of the programmes they run. Project examples include the analysis and performance optimisation of reconfigurable embedded processors and the design of new software tools, such as compilers to efficiently utilize these processors.
Dependable Nano Computing This research pillar, driven by technology scaling, globalization of IC supply chain and Internet of things, focuses on three topics: 1. Reliability (including modelling, monitoring, mitigation etc.) 2. Testability (including Fault Modeling and Design-for-Testability for 3D stacked ICs and emerging memories) 3. Hardware security (including PUF technology, secure design, etc).

In-Memory Computing targets the development, design and the demonstration of a new architecture paradigm for big data problems. This research is based on the integration of the storage and computation in the same physical location (using a crossbar topology) and the use of non-volatile resistive-switching technology, based on memristors, instead of CMOS technology.

Examples of graduation projects

- Acceleration of Cancer Diagnosis Algorithms on Super Computing FPGA Platforms
- GPU-Based Simulation of Brain Neuron Models
- Porting Linux to the rVEX Reconfigurable VLIW Softcore
- Hardware Acceleration of Short-read Mapping with the Burrows-Wheeler Aligner
- Interconnect Test for 3D Stacked Memories
- A Quantum Emulation Platform

Career prospects

A Master’s degree in Computer Engineering is considered one of the top 10 studies in the world in terms of job opportunities and salary prospective. A degree from TU Delft constitutes an excellent foundation for a successful international career. Our graduates are employed in many companies, both local and international, and they have taken on a wide variety of tasks. Examples range from designing custom-made computational circuits for mobile phones and implantable medical devices to the design and maintenance of large-scale telecommunication networks. Many of our graduates are working in prominent companies, including NXP, ASML, Philips, Apple, IBM, ARM, Intel, Google and NVIDIA. Others have opted for academic careers, continued their studies in order to pursue a PhD or started their own companies based on their Master’s thesis work.

I am the head of the Computer Engineering Laboratory where everybody enthusiastically performs research in many advanced areas such as Single Electron Tunneling, Memristor based computing or advanced processor architectures. We not only focus on embedded applications but also investigate what the specific-system requirements are of Big Data and other high performance computing domains. We actively involve MSc students in our research and expose them to state-of-the-art technologies.

I am always surprised to see how quickly our students learn to build their own processors during the first year of their Master’s and even more amazed to see what they are capable of at the end of the two year programme, when doing their master thesis research. The field of computer engineering is interesting to students from various backgrounds. Our Master’s and PhD students have found interesting and well paid jobs in a wide range of companies, and some have even started their own companies. They are praised for their ability to combine deep low-level understanding of hardware with excellent programming skills.

In collaboration with Wayne Luk from Imperial College, we started a company called Bluebee, which provides solutions for hardware acceleration in various application domains (primarily oriented towards Big Data), including finance and bioinformatics.
Admission requirements and application procedures

Dutch BSc degree
If you hold a Dutch BSc degree closely related to the Master’s programme, you will be admitted directly. However, if your undergraduate programme is not closely related to the Master’s programme you will be required to take additional courses in what is called a bridging programme. This may be a standard programme or it may be tailored to your specific situation.

To see which Master’s programmes are open to you on completion of your bachelor’s degree from a non-technical Dutch university go to www.studychoice.nl. If you completed your bachelor’s at a technical university, go to www.doorstroommatrix.nl

Dutch HBO degree
An HBO Bachelor’s degree does not qualify you for direct admission to a TU Delft Master’s programme. You will first need to complete a supplementary programme in order to bring your knowledge to the required level. You can do this during your HBO programme by means of a bridging programme after completing your HBO diploma. Entrance requirements for mathematics and English (some exceptions) apply for the bridging programme.
See www.hbodoorstroom.tudelft.nl for detailed information. Applications through Studielink:
www.tudelft.studielink.nl

International applicants
To be considered for admission to an MSc programme you need to meet TU Delft’s general admission requirements.

1. A University Bachelor’s degree (or proof that you have nearly completed a Bachelor’s programme) in a main subject closely related to the MSc programme to which you are applying, with good grades on the key courses.
2. A BSc Cumulative Grade Point Average (CGPA) of at least 75% of the scale maximum
3. Proof of English language proficiency. A TOEFL (Test of English as a Foreign Language) with an overall Band score of at least 90 and a minimum score of 21 for each section. Please note that we only accept the TOEFL internet-based test. Or an IELTS (academic version) with an overall Band score of at least 6.5 and a minimum of 6.0 for each section. Or proof that you have passed the University of Cambridge ‘Certificate of Proficiency in English’ with a minimum grade B or the University of Cambridge ‘Certificate in Advanced English’

For international students, the application period starts October 1 and closes at April 1. To start an MSc application, please complete the online application and pay the refundable application fee of € 100. Next, you will receive an email with the link to upload the required documents.

For more information about the application procedure and studying at TU Delft in general, go to www.admissions.tudelft.nl.

Introduction week
All international students will be welcomed with the award-winning introduction programme. The introduction consists of a variety of workshops and projects, during which you will get to know other international students, visit the highlights of Delft and learn the ins and outs of the TU Delft campus.

After this very interesting and fun week, you will be introduced to the EEMCS faculty. During the Master Kick Off, you will receive helpful information about the Dutch education system and meet the fellow students from your programme in a variety of social and educational activities.

For further information
Please visit the webpage for all details, complete requirements, deadlines and contact information, please visit:
www.tudelft.nl/msc/ee

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