

## B. WEB SCIENCE STREAM

The CSE stream Web Science focuses on the technology behind the development of web-based systems. A student learns techniques needed to design intelligent and reliable web-based systems, their role in on-line business and learns to analyze the use of such systems. A student learns skills to design effective web-based systems, and to analyze existing web-based systems and the data generated through their use. A student also has insight into business, privacy and security issues related to web-based systems.

### Mandatory courses

Quarter	Code	Unit	EC	Exam <sup>1</sup>
<b>CSE mandatory course</b>				<b>5</b>
1	2IMA10	Advanced algorithms	5	w+a
<b>Stream mandatory courses</b>				<b>20</b>
1	2IMM20	Foundations of data mining	5	a
2	2IMV20	Visualization	5	a
4	2IMM10	Recommender systems	5	w+a
4	2IMD15	Data engineering	5	a
<b>Stream electives<sup>2</sup></b>				<b>20</b>
1	2IMV25	Interactive virtual environments	5	a
1	2IMS25	Principles of data protection	5	w+a
2	2IMS20	Cyberattacks Crime and Defenses	5	w+a
3	2IMM15	Web information retrieval and data mining	5	a
3	2MMD30	Graphs and algorithms	5	w+a
3	2IMV10	Visual computing project	5	a
4	0EM190	Infonomics	5	a
<b>Free electives (possibly including internship)</b>				<b>40</b>
<b>Seminar and master project</b>				<b>35</b>
4 or 6		Seminar <sup>3</sup>	5	a
7 and 8	2IMC00	Master project <sup>4</sup>	30	a

(W= written exam, a = assignments)

## C. SYSTEMS SCIENCE STREAM

A student graduating in the stream Systems Science is familiar with the architectures and architectural principles of large-scale software systems and is capable to apply complex model-based methods required for the rigorous functional and quantitative analysis of system behaviors. He/she understands the role of software-foundations as well as processes and tools—in its interaction with hardware and sensors in large-scale software-intensive systems.

### Mandatory courses

Quarter	Code	Unit	EC	Exam <sup>1</sup>
<b>CSE mandatory course</b>				<b>5</b>
1	2IMA10	Advanced algorithms	5	w+a
<b>Stream mandatory courses</b>				<b>20</b>
1	2IMF30	System validation	5	w+a
2	2IMN15	Internet of Things	5	w+a
2	2IMF25	Automated reasoning	5	w+a
3	2IMN20	Real-time systems	5	w+a
<b>Stream electives<sup>2</sup></b>				<b>20</b>
1	2IMN10	Architecture of distributed systems	5	w+a
1	2IMF20	Hardware verification	5	w+a
2	2IMN25	Quantitative evaluation of embedded systems	5	w+a
3	2IMF35	Algorithms for model checking	5	w+a
3	2IMS15	Verification of security protocols	5	w
4	2IMN35	VLSI Programming	5	a
<b>Free electives (possibly including internship)</b>				<b>40</b>
<b>Seminar and master project</b>				<b>35</b>
4 or 6		Seminar <sup>3</sup>	5	a
7 and 8	2IMC00	Master project <sup>4</sup>	30	a

(W= written exam, a = assignments)

### Electives

The electives prepare for specialization. There is a wide variety of courses to choose from, and courses from other programs or even from other universities are also possible depending on relevance and permission.

### Research seminar

The seminar prepares for the final project. Each of the computer science research groups offer a seminar covering subjects typical of the specific research area.

### Final project

The final project of the program is of 6 months' duration, to be produce it in the final semester. The student will specialize in a single subject and demonstrates that he/she is able to organize a research project independently. It can be done within one of the computer science research groups, possibly in collaboration with a partner in industry.



# Master Data Science and Artificial Intelligence Master Computer Science and Engineering

**TU/e**  
EINDHOVEN  
UNIVERSITY OF  
TECHNOLOGY

[TUE.NL/EN/EDUCATION/GRADUATE-SCHOOL/GRADUATE-PROGRAMS/](https://tue.nl/en/education/graduate-school/graduate-programs/)

## 1. MASTER DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

**Aim:** learn to combine advanced data analysis techniques with AI methods and techniques in order to understand use and develop intelligent systems to support and strengthen human intellect. Advanced techniques and methods in the field of Data Science and AI are combined.

**Knowledge to be gained:** students learn to develop a scientific perspective combined with an engineering approach. Learn to be able to combine, adapt, improve and develop advanced data analytic techniques and AI methods.

**After graduation:** Graduates of the Master DS&AI are technical specialists in Data Science and Artificial Intelligence who can design reliable techniques from a scientific perspective with a critical mind. There are numerous fields in which data science and AI are applied, for example research laboratories, banks, (government)

organizations, hospitals, multinationals and internet companies. As the program is taught in English, alumni can also find jobs at companies or universities abroad.

**Curriculum:** a two-year master program, divided into semesters (September to January, and February to July). In the two years, core and specialization courses, electives and professional development courses need to be followed, (possibly followed by an internship). A final graduation project also needs to be carried out.

### Mandatory courses (6 courses)

The DS&AI Master is organized into the following course trajectories, each representing an expertise area of Data Science and Artificial Intelligence:

- **Data Engineering and Management**
- **Algorithmic Data Analysis**
- **Explainable Data Analytics**
- **Statistics**
- **Data Mining and Machine Learning**
- **AI and Machine Learning**

Each trajectory has a different set of compulsory courses that provide foundations to continue in the trajectory; at least four of these compulsory courses must be taken. In addition, the following two mandatory courses connect the different expertise areas:

- **Ethics in Data Science and Artificial Intelligence**
- **Data Intelligence Challenge (a challenge-based group project course).**

#### Specialization electives (6 courses)

Each of the six DS&AI course trajectories continues with elective courses presenting state-of-the-art, specialist knowledge on expertise areas in Data Science and Artificial Intelligence and is closely connected to the research in our research groups.

In the DS&AI Master, a student specializes in at least two of the program's expertise areas by choosing two of the six course trajectories as 'major' trajectories and taking several coherent courses in each

#### Free electives (3 courses)

A student may continue exploring more subjects from other expertise areas of Data Science and Artificial Intelligence or study subjects from other areas. A student is not restricted to any subjects. He/she may use elective options to study technical or non-technical topics to broaden his/her perspective. Courses from other departments at TU/e, from other universities, and even from universities abroad can be chosen. For this, an approval of our Examination Committee is needed.

You **complete** your Master program with a **graduation phase** consisting of a research seminar, a graduation pre-study and the final graduation project.

#### Research seminar

The seminar prepares for the final project. Each of the computer science research groups offer a seminar

covering subjects typical of the specific research area. Through the seminar a student learns the fundamental techniques to conduct research in a systematic manner.

#### Graduation pre-study

Under guidance of a supervisor, a student learns how to identify and develop a valid research question for a graduation project, devise an appropriate research method, and ensure feasibility of executing the project regarding assumptions on data, existing techniques, stakeholder and societal expectations.

#### Graduation project

The program concludes with a research project in which the student proves him/herself as an engineer in Data Science and Artificial Intelligence.

#### Disclaimer new Master DS&AI

In the period before official accreditation by the NVAO a disclaimer has to be used in the communication efforts towards prospective students outlining what the legal status of the program is.

This program is not registered in the official educational program register of the Netherlands (i.e. the CROHO) yet, and therefore a new proposal for initial accreditation has been submitted. This procedure might take a maximum of six months and there is no guarantee of a positive decision from the accreditation committee of NVAO (Nederlands-Vlaamse Accreditatie Organisatie). Only after a positive examination of the operational decision by NVAO, this program can start. We are preparing the program to launch in September 2020. We can keep you informed as soon as accreditation is confirmed and we have more information. For more information about the accreditation details, please visit: [www.nvao.net](http://www.nvao.net).

## 2. MASTER COMPUTER SCIENCE AND ENGINEERING

**Aim:** learn to design quality software. Combination of scientific perspective with the approach of an engineer. Learn to systematically produce inventories of requirements and incorporate them into a design. Become able to make qualitative and quantitative judgements.

**Knowledge to be gained:** program teaches a knowledge of algorithms, performance, hardware, design/documentation methods. Teach the student to create reliable protocols for the behavior of complex software systems.

**After graduation:** Graduate has developed a scientific perspective combined with a practical approach. Graduate will be able to play a leading role in the development of a specialist field, whether in scientific research, in industry, in commercial businesses or in (government) organizations.

Most graduates start their careers with a job in a design team, but quickly develop into team leaders and managers (or they start their own businesses).

**Curriculum:** The Master program Computer Science and Engineering is a two-year program of **120ECTS** in total.

The CSE curriculum is structured in **streams**, which provide an organized set of courses in particular subject areas within computer science. The streams provide guidance for the directions in which a student can specialize, and to ensure comprehensive and coherent set of courses.. The streams are:

- **Software science**
- **Web science**
- **Systems science**

Each stream has the same structure:

Units	
CSE mandatory course	5
Stream mandatory courses	20
Stream elective courses	20
Free electives	40
Seminar	5
Master project	30

## STREAM DESCRIPTIONS

### A. SOFTWARE SCIENCE STREAM

You learn model-driven engineering techniques to increase the quality of computer programs. A graduate of the stream Software Science, gains in-depth knowledge of techniques needed to model and design efficient and reliable software and understand the strengths and weaknesses of these techniques and can apply them in the appropriate situation, taking limitations of cost, time, and other resources into account. A graduate can analyze existing software systems and understand the fundamental issues involved in software maintenance.

#### Mandatory courses and stream electives

Quarter	Code	Unit	EC	Exam <sup>1</sup>
<b>CSE mandatory course</b>			<b>5</b>	
1	2IMA10	Advanced algorithms	5	w+a
<b>Stream mandatory courses</b>			<b>20</b>	
2	2IMP10	Program verification techniques	5	w+a
3	2IMP25	Software evolution	5	w+a
3	2IMD10	Database technology	5	w+a
4	2IMP20	Generic language technology	5	w+a
<b>Stream electives<sup>2</sup></b>			<b>20</b>	
1	2IMI15	Metamodeling and interoperability <sup>3</sup>	5	w+a
1	2IMG15	Algorithms for geographic data	5	a
2	2IMA15	Geometric algorithms	5	a
3	2IMF15	Proving with computer assistance	5	w+a
4	2IMF10	Process algebra	5	w+a
4	2IMV15	Simulation in computer graphics	5	a
<b>Free electives (possibly including internship)</b>			<b>40</b>	
<b>Seminar and master project</b>			<b>35</b>	
4 or 6		Seminar <sup>4</sup>	5	a
7 and 8	2IMC00	Master project <sup>5</sup>	30	a

(W= written exam, a = assignments)

