



Master in Computer science

The 2024-2025 programme is subject to change. It is provided for information purposes only.

Programme mnemonic

MA-INFO

> Focus *Professional* : M-INFOS

Studies level

Master 120 credits

Learning language

english

Schedule

office hours

Studies category / subcategory

Sciences and technics / Sciences

Campus

Plaine

Programme objectives

The Master program aims to train students to become high-level computer scientists in the IT industry and/or research. The program wishes to form a new generation of IT executives, managers and researchers who are autonomous, aware of their role in society, and can efficiently acquire new knowledge all along with their career. In particular the students are expected to

- # be able to gather information and acquire new knowledge autonomously and with scientific rigour, and adopt a critical attitude in this process.
- # master the main mathematical and formal tools needed in computer science.
- # be able to read technical literature in English and engage in a technical conversation in English
- # master the main concepts and skills related to programming, programming languages, algorithms, software engineering, operating systems, computational intelligence and theoretical results in computer science.

be able to design—alone or within a group—a computer application of significant complexity, efficiently using the tools of software engineering.

Programme's added value

The Master program offers a mandatory common core of 30 ECTS and five optional modules covering major advanced topics in Computer Science:

- # Software and critical systems,
- # Computational intelligence,
- # Optimization,
- # Algorithms,
- # Web and information systems.

Other optional courses are made available by other related MA programs (e.g. in Applied Sciences).

The advanced classes benefit from the excellence of the research conducted in the Computer Science Department of the Faculty of Science, as witnessed by the publications record and the several awarded prizes, and collaboration with researchers from ULB Applied Sciences and VUB (Vrije Universiteit Brussel).

In the second year of the Master, students can take a three-month full-time internship in either a private company or a research centre.

The program is completed by a MA thesis intended to prepare the student to enter the labour market or to pursue a research career (e.g. by enrolling in doctoral studies).

Teaching methods

Courses are typically structured in two parts: a theoretical part, in which concepts and theories are developed, and a more practical part, where those concepts are applied to examples and case studies. Courses are complemented by medium- to large-size projects, often inspired by recent and challenging applications of Computer Science.



Teaching assistants are always present during the many practical sessions to offer help and are often available to answer student questions.

Computer rooms, equipped with state-of-the-art hardware and operating systems, are available to students for practicals and projects.

Succeed in your studies

Choose

The information and guidance counsellors at the InfOR-études [<https://www.ulb.be/en/studies-info-desk-1>] service will help you choose your studies throughout the year.

Succeed

Take part in preparatory courses [<https://www.ulb.be/en/studies-info-desk-1>] or get help to succeed [<https://www.ulb.be/en/studies-info-desk-1>], before or during your studies.

Get help

Apply for financial aid, look for accommodation or a student job, get support [<https://www.ulb.be/fr/aides-services-et-accompagnement/aid-services-and-support-1>] for your specific needs.

International/Openness

Students can participate in international exchange programs (e.g. Erasmus) to attend classes abroad during one semester. The Computer Science department has several ongoing agreements with other departments around Europe and North America. More specifically, students who follow the specialisation on Optimization may complete one or two semesters at the Université de Nantes (France) and earn a joint degree from the two institutions.

Job opportunities

Graduates find work in various sectors: banks, insurance companies, software industry, consulting, hospitals, schools, universities, national and international administrations. They can work as project leaders, IT specialists, data scientists, network architects, security experts, teachers, or researchers. Some conduct their businesses, and others are high-level executives in administrations.

In summary, the main occupations that the program provides access to are:

- # IT Project Manager
- # IT Consultant
- # IT Manager
- # Computer security architect
- # Teacher
- # Data scientist
- # Researcher

Contacts

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 <https://sciences.ulb.be/departement-d-informatique>

Jury President

Jean-François RASKIN

Jury Secretary

Joël GOOSSENS



Master in Computer science

Focus Professional

The master programme includes three main types of courses: computer science lectures, an introduction to research through the writing of a Master's dissertation, and courses intended to prepare students to enter the job market.

The programme is designed for students who have general skills in computer science, which they can have acquired during the Bachelor in Computer Science at ULB:

- > they are able to gather information and acquire new knowledge autonomously and with scientific rigour, and are able to adopt a critical attitude in this process.
- > they master the main mathematical and formal tools needed in computer science.
- > they can read technical literature in English and engage in a technical conversation in English, as most of the courses in the programme are taught in English (with a few exceptions for electives).
- > They master the main concepts and skills related to programming, programming languages, algorithms, software engineering, operating systems, and fundamental theoretical results in computer science.
- > they are able to design—alone or within a group—a computer application of significant complexity, efficiently using the tools of software engineering.

Students who have not acquired the appropriate background during their Bachelor may, in some cases, have the opportunity to compensate for deficiencies with a tailored curriculum.

Bloc 1 | M-INFOS | MA-INFO

Cours obligatoires

ELEC-H473	Microprocessor architecture Dragomir MILOJEVIC (Coordinator) ⌚ 5 credits [lecture: 24h, practical work: 36h] 📅 second term 🗨 English
INFO-F403	Introduction to language theory and compiling Gilles GEERAERTS (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h, project: 30h] 📅 first term 🗨 English
INFO-F404	Real-Time Operating Systems Joël GOOSSENS (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 30h] 📅 first term 🗨 English
INFO-F405	Introduction to cryptography Christophe PETIT (Coordinator) ⌚ 5 credits [lecture: 24h, tutorial classes: 24h, project: 30h] 📅 first term 🗨 English
INFO-F408	Computability and complexity Jean-François RASKIN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] 📅 first term 🗨 English
MEMO-F403	Preparatory work for the master thesis Maarten JANSEN (Coordinator) ⌚ 5 credits [personal assignments: 60h] 📅 second term 🗨 English

Options 1

Option - 2 modules complets dans la liste des modules 1.1 à 1.5 à choisir au cours des deux blocs.

Le cours INFO-H-410 est à prendre seulement par les étudiants qui n'ont pas eu de cours d'intelligence artificielle en bachelier.

A total of 30 credits chosen from the following

Module 1.1. Software and critical systems

INFO-F410 (optional)	Embedded systems design Jean-François RASKIN (Coordinator) ⌚ 5 credits [lecture: 12h, tutorial classes: 12h, project: 60h] 📅 second term 🗨 English
INFO-F412 (optional)	Formal verification of computer systems Jean-François RASKIN (Coordinator) ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨 English

INFO-F514 (optional) **Protocols, cryptanalysis and mathematical cryptology** | Olivier MARKOWITCH (Coordinator) and Christophe PETIT
⌚ 5 credits [lecture: 24h] 📅 second term 🗨 English

Module 1.2. Computational Intelligence

INFO-F409 (optional) **Learning dynamics** | Tom LENAERTS (Coordinator)
⌚ 5 credits [lecture: 24h, project: 60h] 📅 first term 🗨 English

INFO-F422 (optional) **Statistical foundations of machine learning** | Gianluca BONTEMPI (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 second term 🗨 English

INFO-F439 (optional) **Methods in Bioinformatics** | Matthieu DEFRANCE (Coordinator) and Wim VRANKEN
⌚ 5 credits [lecture: 24h, project: 90h] 📅 second term 🗨 English

INFO-H410 (optional) **Techniques of artificial intelligence** | Hugues BERSINI (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h] 📅 second term 🗨 English

Module 1.3. Optimization

INFO-F424 (optional) **Combinatorial optimization** | Bernard FORTZ (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 12h, project: 30h] 📅 second term 🗨 English

INFO-F524 (optional) **Continuous optimization** | Bernard FORTZ (Coordinator)
⌚ 5 credits [lecture: 24h, project: 60h] 📅 second term 🗨 English

INFO-H413 (optional) **Heuristic optimisation** | Thomas,T STUTZLE (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 📅 second term 🗨 English

Module 1.4. Algorithms

INFO-F413 (optional) **Randomized algorithms** | Jean CARDINAL (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 first term 🗨 English

INFO-F420 (optional) **Computational geometry** | Stefan LANGERMAN F. SWARZBERG (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 first term 🗨 English

INFO-F521 (optional) **Graph theory** | Gwenaël JORET (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 first term 🗨 English

Module 1.5. Data Science

INFO-H415 (optional) **Advanced databases** | Esteban ZIMANYI (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] 📅 first term 🗨 English

INFO-H417 (optional) **Database systems architecture** | Mahmoud SAKR (Coordinator)
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 📅 first term 🗨 English

One course chosen from the following

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] 📅 second term 🗨 English

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] 📅 second term 🗨 English



Master in Computer science

Focus Professional

Bloc 2 | M-INFOS | MA-INFO

Cours obligatoires

- INFO-F530 **Computer science seminar** | Tom LENAERTS (Coordinator), Bernard FORTZ, John IACONO and Olivier MARKOWITCH
 ⌚ 5 credits [seminars: 36h, project: 60h] 📅 first and second terms 🗨 English
- MEMO-F524 **Masters thesis** | Jean-François RASKIN (Coordinator)
 ⌚ 20 credits [mfe/tfe: 240h] 📅 first and second terms

An alternative chosen from the two following

Options 1

35 ECTS à choisir dans les options 1 dont minimum 2 modules complets au cours des 2 blocs. (60 crédits sur l'ensemble du cycle)

Le cours INFO-H-410 est à prendre seulement par les étudiants qui n'ont pas eu de cours d'intelligence artificielle en bachelier.

Up to 60 credits chosen from the following

Module 1.1 Software and critical systems

- INFO-F410 (optional) **Embedded systems design** | Jean-François RASKIN (Coordinator)
 ⌚ 5 credits [lecture: 12h, tutorial classes: 12h, project: 60h] 📅 second term 🗨 English
- INFO-F412 (optional) **Formal verification of computer systems** | Jean-François RASKIN (Coordinator)
 ⌚ 5 credits [lecture: 36h, tutorial classes: 12h] 📅 second term 🗨 English
- INFO-F514 (optional) **Protocols, cryptanalysis and mathematical cryptology** | Olivier MARKOWITCH (Coordinator) and Christophe PETIT
 ⌚ 5 credits [lecture: 24h] 📅 second term 🗨 English

Module 1.2 Computational Intelligence

- INFO-F409 (optional) **Learning dynamics** | Tom LENAERTS (Coordinator)
 ⌚ 5 credits [lecture: 24h, project: 60h] 📅 first term 🗨 English
- INFO-F422 (optional) **Statistical foundations of machine learning** | Gianluca BONTEMPI (Coordinator)
 ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 second term 🗨 English
- INFO-H410 (optional) **Techniques of artificial intelligence** | Hugues BERSINI (Coordinator)
 ⌚ 5 credits [lecture: 24h, tutorial classes: 12h] 📅 second term 🗨 English

Module 1.3 Optimization

- INFO-F424 (optional) **Combinatorial optimization** | Bernard FORTZ (Coordinator)
 ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 12h, project: 30h] 📅 second term 🗨 English
- INFO-F524 (optional) **Continuous optimization** | Bernard FORTZ (Coordinator)
 ⌚ 5 credits [lecture: 24h, project: 60h] 📅 second term 🗨 English
- INFO-H413 (optional) **Heuristic optimisation** | Thomas, T STUTZLE (Coordinator)
 ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 📅 second term 🗨 English

Module 1.4 Algorithms

- INFO-F413 (optional) **Randomized algorithms** | Jean CARDINAL (Coordinator)
 ⌚ 5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] 📅 first term 🗨 English

INFO-F420 (optional) **Computational geometry** | Stefan LANGERMAN F. SWARZBERG (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] first term English

INFO-F521 (optional) **Graph theory** | Gwenaël JORET (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] first term English

Module 1.5 Data Science

INFO-H415 (optional) **Advanced databases** | Esteban ZIMANYI (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] first term English

INFO-H417 (optional) **Database systems architecture** | Mahmoud SAKR (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] first term English

One course chosen from the following

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] second term English

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] second term English

Module 2.1 Software and critical systems

INFO-H503 (optional) **GPU computing** | Gauthier LAFRUIT (Coordinator) and Jan LEMEIRE
5 credits [lecture: 24h, practical work: 24h, project: 24h] second term English

INFO-Y082 (optional) **Distributed and mobile programming paradigms**
6 credits [lecture: 26h, tutorial classes: 26h, project: 30h] first term English

INFO-Y085 (optional) **Functional programming** | Wolfgang DE MEUTER (Coordinator)
6 credits [lecture: 26h, tutorial classes: 26h] second term English

INFO-Y099 (optional) **Multicore programming**
6 credits [lecture: 26h, tutorial classes: 26h] second term English

INFO-Y110 (optional) **Higher Order Programming**
6 credits [lecture: 26h, tutorial classes: 26h] first term

Module 2.2 Computational Intelligence

INFO-F439 (optional) **Methods in Bioinformatics** | Matthieu DEFRANCE (Coordinator) and Wim VRANKEN
5 credits [lecture: 24h, project: 90h] second term English

INFO-H414 (optional) **Swarm Intelligence** | Marco DORIGO (Coordinator) and Mauro BIRATTARI
5 credits [lecture: 12h, practical work: 48h] second term English

One course chosen from the following

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] second term English

INFO-H515 (optional) **Big Data: Distributed Data Management and Scalable Analytics** | Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] second term English

INFO-Y004 (optional) **Natural language processing** | VAN EECKE Paul
6 credits [lecture: 26h, tutorial classes: 26h] first term English



INFO-Y087
(optional) **Declarative programming**
6 credits [lecture: 26h, tutorial classes: 26h] first term English

Module 2.3 Optimization

Module 2.4 Algorithms

INFO-F440
(optional) **Algorithms for big data** | John IACONO (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, project: 60h] second term English

INFO-H514
(optional) **Quantum information and computation** | Ognyan Oreshkov (Coordinator)
5 credits [lecture: 24h, tutorial classes: 36h] first term English

Module 2.5 Data Science

INFO-H419
(optional) **Data warehouses** | Esteban ZIMANYI (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] first term English

INFO-H420
(optional) **Management of Data Science and Business Workflows** | Dimitrios SACHARIDIS (Coordinator)
5 credits [lecture: 24h, tutorial classes: 36h] first term English

INFO-H423
(optional) **Data Mining** | Mahmoud SAKR (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] first term English

INFO-H509
(optional) **Geo-Spatial and web technologies** | Mahmoud SAKR (Coordinator)
5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] second term English

INFO-Y528
(optional) **Information visualisation**
6 credits [lecture: 26h, tutorial classes: 26h] second term English

Module 2.6 Internship

GEST-S483
(optional) **Digital and IT Governance** | Georges ATAYA (Coordinator)
5 credits [lecture: 24h] second term English

TRAN-F501
(optional) **Internship** | Gianluca BONTEMPI (Coordinator) and Maarten JANSEN
15 credits [project: 200h] first term English

or

Variante Master ORO - Université de Nantes

Students attending one or two semesters at the University of Nantes in the framework of the double diploma register to the 30 or 60 ECTS corresponding to their stay in Nantes in Block 2.

INFO-Y515
(optional) **Large Scale Optimisation**
3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y516
(optional) **Discrete Constraint Programming**
3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y517
(optional) **Global Optimization**
3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y518
(optional) **Black-box Optimization**
3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y519
(optional) **Multi-Objective Optimization**
3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y520
(optional) **Cloud Artificial Intelligence Services**
3 credits [lecture: 13h, tutorial classes: 13h] academic year English

INFO-Y521
(optional) **Transportation and Logistics**
3 credits [lecture: 13h, tutorial classes: 13h] academic year



INFO-Y522
(optional)

Planning and Scheduling

3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y523
(optional)

Bioinformatics

3 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y524
(optional)

OR Special Topic II

2 credits [lecture: 13h, tutorial classes: 13h] academic year

INFO-Y525
(optional)

Conferences

1 credit [tutorial classes: 26h] academic year

INFO-Y526
(optional)

Master Thesis (track research)

20 credits academic year

INFO-Y527
(optional)

Internship (track application)

10 credits academic year

