



## SINF2M - Introduction

### Introduction

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#### Introduction

This Master's degree programme tries to strike a **balance between “soft skills” and scientific and technical knowledge, between excellence in research and the pragmatism of field work.** It offers:

- an approach to computer science based on fundamental **concepts** that keep up with the rapid pace of technological progress;
- a programme taught **entirely in English** in order to improve students' language skills, especially in technical English (both written and spoken);
- **exchange programmes** and dual degrees in Belgium, Europe and across the world.

#### Your profile

You would like to

- **Imagine, design, and implement** computer science systems that will shape the future;
- continue your education beyond the Bachelor's degree with a major in computer sciences (or the equivalent);
- improve your **theoretical knowledge** and develop your technical expertise in fields like artificial intelligence, computer networks, information security, software engineering and programming systems;
- improve your **interdisciplinary knowledge** in areas such as foreign languages, resource management, teamwork, autonomy and ethics.

#### Your future job

We train

- **scientists** who know how to investigate a sharp problematic using scientific literature in the field;
- **professionals** who will design computer systems that meet users' needs;
- **innovators** who can master a wide range of constantly evolving technologies;
- **specialists** capable of implementing software solutions with particular attention paid to product quality and its development process.

#### Your programme

This Master's degree programme consists of

- **required coursework** that seeks to give students the necessary skills to model and design complex applications (which is an indispensable part of the education of all university-trained computer scientists);
- **a major** selected by students that allows them to gain cutting edge knowledge in a field of their interest: software engineering and programming systems, artificial intelligence and big data, networks and security;
- **elective courses** that allow students to explore their interests whether it be computer science or another discipline (management, business creation, languages). As a comprehensive university, UCLouvain has numerous courses of study;
- a **graduation project** that makes up half of the programme during the last year. It offers students the possibility to study a subject in-depth and thanks to its size, introduces students to the professional life of a computer scientist or researcher; the topic of this project is selected in consultation with the programme supervisors and possibly a company.

## SINF2M - Teaching profile

### Learning outcomes

#### The computer science developers and designers of tomorrow face two major challenges:

- increasingly complex computer science systems
- increasingly varied areas of application

#### In order to meet these challenges, future diploma holders should

- master real computer science technologies but also keep up with their constant progress
- innovate by integrating in computer systems elements linked to artificial intelligence, software engineering, and security networks
- work as part of multidisciplinary teams that take into account non-technical issues, be open to social sciences and the humanities to help with this task.

#### This programme is based on research:

UCLouvain is a research university. The computer science research conducted at the institute ICTEAM is internationally recognised. Through the major courses offered in this Master's degree programme, students will be able to take advantage of cutting edge knowledge. In addition to providing fundamental knowledge, this programme is based on the in-depth understanding of concepts and the ability to think abstractly. These tools allow students to quickly adapt to the needs of companies. Moreover, this research may be continued through projects carried out at the doctoral level.

#### Applying concepts:

The application of concepts is a key part of this Master's degree programme. It is inconceivable that students can master theoretical concepts but not know how to apply them to a concrete problem. Thus, the programme includes a number of projects and studies, a large-scale graduation project and the possibility of completing an internship in a company.

#### International openness:

English is de facto the most used language in companies and those in the technical field in particular. This Master's degree programme is thus taught in English, which gives our students good speaking and writing skills. By offering a Master's degree in English, this programme demonstrates its international openness. The use of English allows the programme to welcome international students while at the same time immersing them in a French-speaking environment. It also increases the possibility of exchanges and dual diplomas with other (non-Belgian) universities.

On successful completion of this programme, each student is able to :

#### 1. demonstrate mastery of a solid body of knowledge in computer science allowing them to solve problems raised in their field of study

This Master's degree programme aims to provide students with advanced knowledge. A diversity of subjects are offered in the common curriculum and students specialise via a major:

- security networks
- programming systems
- software engineering
- artificial intelligence
- Data Science and Applied Mathematics
- Business issues

#### 2. organise and carry out the development of a computer system that meets the complex demands of a client

- 2.1. Analyse a problem to solve or the functional needs to be met and formulate a corresponding specifications note.
- 2.2. Model a problem and design one or more technical solutions in line with the specifications note.
- 2.3. Evaluate and classify the solutions in light of all the criteria included in the specifications note: efficiency, feasibility, quality, ergonomics and environmental security.
- 2.4. Implement and test the chosen solution.
- 2.5. Come up with recommendations to improve the operational nature of the solution.

#### 3. organise and carry out a study to understand a new problem in the field

- 3.1. Document and summarize the existing body of knowledge in the area under consideration
- 3.2. Propose a model and/or an experimental device in order to simulate or test a hypotheses relating to the phenomenon being studied
- 3.3. Write a cumulative report that explains the potential of the theoretical or technical innovations resulting from the research project

#### 4. contribute as part of a team to the planning and completion of a project while taking into account its objectives, allocated resources, and constraints

- 4.1. Frame and explain the project's objectives (in terms of performance indicators) while taking into account its issues and constraints
- 4.2. Collaborate on a work schedule, deadlines and roles
- 4.3. Work in a multidisciplinary environment with peers holding different points of view; manage any resulting disagreement or conflicts
- 4.4. Make team decisions and assume the consequences of these decisions (whether they are about technical solutions or the division of labour to complete a project)

**5. communicate effectively (orally or in writing) with the goal of carrying out assigned projects in the workplace (in English in particular)**

- 5.1. Identify the needs of the client or the user: question, listen and understand all aspects of their request and not just the technical aspects.
- 5.2. Present your arguments and adapt to the language of your interlocutors: technicians, colleagues, clients, superiors
- 5.3. Communicate through graphics and diagrams: interpret a diagram, present project results, structure information
- 5.4. Read and analyse different technical documents (rules, plans, specification notes)
- 5.5. Draft documents that take into account contextual requirements and social conventions
- 5.6. Make a convincing oral presentation using modern communication techniques.

**6. Demonstrate rigor, openness and critical thinking as well as a sense of ethics in your work**

- 6.1. Rigorously apply the standards of your discipline (terminology, measurement units, quality standards and security)
- 6.2. Find solutions that go beyond strictly technical issues by considering sustainable development and the socio-economic ethics of a project
- 6.3. Demonstrate critical awareness of a technical solution in order to verify its robustness and minimize the risks that may occur during implementation.
- 6.4. Evaluate oneself and independently develop necessary skills to remain knowledgeable in the field.

## Programme structure

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The programme consists of four parts:

- a common curriculum, mainly the graduation project (30 credits).
- a final specialisation, required (30 credits).
- one or more majors allowing for specialisation in a field of computer science (20-40 credits).
- elective courses (20-40 credits).

The graduation project is normally carried out in the last year. However, students may, depending on their training, conduct other courses in either the first or second year so long as they have completed the prerequisite courses. This is especially the case for students who have completed a portion of their studies abroad. The yearly allocation of course activities found in the detailed programme description is for information purposes only.

In general, this Master's degree will consist of a minimum of 120 credits spread over two years with 60 credits taken per year (regardless of the focus, major or elective courses selected).

## SINF2M Programme

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## PROFESSIONAL FOCUS [30.0]

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- Mandatory
- ✘ Optional
- △ Not offered in 2023-2024
- ⊙ Not offered in 2023-2024 but offered the following year
- ⊕ Offered in 2023-2024 but not the following year
- △ ⊕ Not offered in 2023-2024 or the following year
- Activity with requisites
- 🌐 Open to incoming exchange students
- 🚫 Not open to incoming exchange students
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

Year

1 2

## OPTIONS EN SCIENCES INFORMATIQUES

## MAJOR IN ARTIFICIAL INTELLIGENCE: BIG DATA, OPTIMIZATION AND ALGORITHMS

## Students completing the major in Artificial Intelligence: big data, optimization and algorithms will be able to:

- Identify and implement methods and techniques that allow software to solve complex problems that when solved by humans require "intelligence",
- Understand and put to good use methods and techniques relating to artificial intelligence such as automatic reasoning, research and heuristics, acquisition and representation of knowledge, automatic learning, problems associated with overcoming constraints,
- Identify applications and its methods and tools; understand a particular category of applications and its related techniques, for example robotics, computer vision, planning, data mining, computational linguistics and bioinformatics, big data processing,
- Formalise and structure a body of complex knowledge and use a systematic and rigorous approach to develop quality "intelligence" systems.

- Mandatory
- ⊗ Optional
- △ Not offered in 2023-2024
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- △ ⊕ Not offered in 2023-2024 or the following year
- Activity with requisites
- 🌐 Open to incoming exchange students
- 🚫 Not open to incoming exchange students
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

From 20 to 30credit(s)

Year

1 2

## o Content:



## o Required courses in Artificial Intelligence: big data, optimization and algorithms

○ LINFO2263	Computational Linguistics	Pierre Dupont	FR [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2266	Advanced Algorithms for Optimization	Pierre Schaus	FR [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2365	Constraint programming	Pierre Schaus	FR [q2] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2364	Mining Patterns in Data	Siegfried Nijssen	FR [q2] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X

## ⊗ Elective courses in Artificial Intelligence

The student select 10 credits among

⊗ LELEC2870	Machine learning : regression, deep networks and dimensionality reduction	John Lee John Lee (compensates Michel Verleysen) Michel Verleysen	FR [q1] [30h+30h] [5 Credits] 🌐 > French-friendly	X	X
⊗ LELEC2885	Image processing and computer vision	Christophe De Vleeschouwer (coord.) Laurent Jacques	FR [q1] [30h+30h] [5 Credits] 🌐 > French-friendly	X	X
⊗ LGBIO2010	Bioinformatics	Vincent Branders (compensates Pierre Dupont)	FR [q1] [30h+30h] [5 Credits] 🌐 > French-friendly	X	X
⊗ LINFO2145	Cloud Computing	Etienne Riviere	FR [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
⊗ LINMA1691	Discrete mathematics - Graph theory and algorithms	Vincent Blondel Jean-Charles Delvenne	FR [q1] [30h+22.5h] [5 Credits] 🌐	X	X
⊗ LINMA1702	Optimization models and methods I	François Glineur	FR [q2] [30h+22.5h] [5 Credits] 🌐	X	X
⊗ LINMA2450	Combinatorial optimization	Julien Hendrickx Geovani Nunes Grapiglia	EN [q1] [30h+22.5h] [5 Credits] 🌐 > French-friendly	X	X

				Year	
				1	2
⌘ LINMA2472	Algorithms in data science	Jean-Charles Delvenne (coord.) Gautier Krings (compensates Vincent Blondel)	EN [q1] [30h+22.5h] [5 Credits]  > French-friendly	x	x
⌘ LINFO2275	Data mining & decision making	Marco Saerens	EN [q2] [30h+15h] [5 Credits]  > French-friendly	x	x
⌘ LINFO2381					



**MAJOR IN SOFTWARE ENGINEERING AND PROGRAMMING SYSTEMS**

Cloud Computing

**Students completing the major “Software engineering and programming systems” will be able to:**

- Understand and explain problems that come up during large scale software projects as well as the long-term critical impact that their choice of solutions may have (construction dimensions as well as validation, documentation, communication and management of a project involving large teams as well as costs and deadlines),
- Select and apply methods and tools of software engineering to develop complex software systems and meet strict quality standards: reliability, adaptability, scalability, performance, security, usefulness,
- Model the products and processes necessary to obtain such systems and analyse these models,
- Develop and implement analytical programmes focused on conversion and optimisation as well as computer representations,
- Put to good use different programming paradigms and languages, in particular those that deal with functional, object-oriented and competing programmes,
- Understand the issues associated with different and competing programming models and use the appropriate model,
- Define a new language (syntax and semantics) suitable to a specific context.

○ Mandatory

⊗ Optional

△ Not offered in 2023-2024

⊙ Not offered in 2023-2024 but offered the following year

⊕ Offered in 2023-2024 but not the following year

△ ⊕ Not offered in 2023-2024 or the following year

■ Activity with requisites

🌐 Open to incoming exchange students

🚫 Not open to incoming exchange students

[FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

From 20 to 30 credit(s)

Year

1 2

**o Content:****o Required courses in software engineering and programming systems**

○ LINFO2143	Concurrent systems : models and analysis	Charles Pecheur	30 [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2251	Software Quality Assurance	Charles Pecheur	30 [q2] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2252	Software Maintenance and Evolution	Kim Mens	30 [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
○ LINFO2345	Languages and algorithms for distributed Applications	Peter Van Roy	30 [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X

**⊗ Elective courses in Software Engineering and Programming Systems**

The student can select 10 credits among

⊗ LINFO2145	Cloud Computing	Etienne Riviere	30 [q1] [30h+15h] [5 Credits] 🌐 > French-friendly	X	X
⊗ LINFO2347					









## OPTION NETWORKS AND SYSTEMS

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Students who have completed the "Networks and Systems" track should be able to:

- Understand and explain different devices and protocols used in computer and cellular networks;
- Design, configure and manage computer networks while taking into account application needs;
- Understand the operation of IoT and cellular networks;
- Explain the problems that affect cellular and IoT networks and develop solutions to cope with them;
- Understand how to optimise applications to efficiently use parallel cores;
- Understand, implement and use lock-free data structures;
- Understand the interactions between real-time operating systems and hardware;
- Design and implement applications running on embedded systems

○ Mandatory

⊗ Optional

△ Not offered in 2023-2024

⊙ Not offered in 2023-2024 but offered the following year

⊕ Offered in 2023-2024 but not the following year

△ ⊕ Not offered in 2023-2024 or the following year

■ Activity with requisites

🌐 Open to incoming exchange students

🚫 Not open to incoming exchange students

(FR) Teaching language (FR, EN, ES, NL, DE, ...)

[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

Students shall select 20 to 30 credits among:

Year

1 2

### o Content:

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#### o Required courses in Networks and systems

○ LINFO2142

Computer networks: configuration and management

Olivier Bonaventure

EN

## OPTION EN INFORMATIQUE MÉDICALE

Students completing the major in "Health informatics" will be able to:

- Identify and use methods and techniques that provide software-based solutions to complex problems encountered in hospitals, in bio-pharmaceutical environments, in life sciences, or in digital health.
- Take part in multidisciplinary projects bringing together medical, biological and engineering expertise to the benefit of patient health.
- Understand and put to good use the methods and techniques pertaining to medical informatics and bioinformatics, such as artificial intelligence, health interoperability, clinical knowledge structuring, applied statistics, information security, software quality, as well as the effective management and processing of large volumes of data.
- Understand specific categories of applications where these methods and techniques can be applied, such as diagnostic support, therapeutic assistance, hospital information systems, medical and biomedical imaging, smart devices, clinical trials, health data mining, as well as automated processing of the medical language.
- Formalize and structure a body of complex knowledge by using a systematic and rigorous approach to the development of high-quality medical and biomedical information systems.

- Mandatory
- ✂ Optional
- △ Not offered in 2023-2024
- ⊙ Not offered in 2023-2024 but offered the following year
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- △ ⊕ Not offered in 2023-2024 or the following year
- Activity with requisites
- 🌐 Open to incoming exchange students
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- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Students shall select 20 to 30 credits among:

Year

1 2

### o Content:

#### o Cours obligatoires en Informatique médicale

○ LGBIO2050	Medical Imaging	Greet Kerckhofs John Lee Benoît Macq Frank Peeters	[FR] [q1] [30h+30h] [5 Credits] 🌐 > French-friendly	x	x
○ LGBIO2010	Bioinformatics	Vincent Branders (compensates)			





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- Activity with requisites
- 🌐 Open to incoming exchange students
- 🚫🌐 Not open to incoming exchange students

[FR]

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				Year	
				1	2
⌘ MLSMM2134	e-Consumer Behavior 🇯🇵	Nicolas Kervyn (compensates Karine Charry)	PK [q2] [30h] [5 Credits] 🌐		x

⌘ Cours en Sourcing and Procurement

⌘ LLSMS2036	Supply Chain Procurement	Per Joakim Agrell Antony Paulraj			
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## MAJOR IN INTERDISCIPLINARY PROGRAM IN ENTREPRENEURSHIP - INEO

Commune à la plupart des masters de l'EPL, cette option a pour objectif de familiariser l'étudiant-e avec les spécificités de l'entrepreneuriat et de la création d'entreprise afin de développer chez lui les aptitudes, connaissances et outils nécessaires à la création d'entreprise.

Cette option rassemble des étudiants de différentes facultés en équipes interdisciplinaires afin de créer un projet entrepreneurial. La formation interdisciplinaire en entrepreneuriat (INEO) est une option qui s'étend sur 2 ans et s'intègre dans plus de 30 Masters de 9 facultés/écoles de l'UCLouvain. Le choix de l'option INEO implique la réalisation d'un mémoire interfacultaire (en équipe) portant sur un projet de création d'entreprise. L'accès à cette option, ainsi qu'à chacun des cours, est limité aux étudiant-es sélectionnés sur dossier. Toutes les informations sur <https://uclouvain.be/fr/etudier/ineo> (<https://uclouvain.be/fr/etudier/ineo>).

L'étudiant.e qui choisit de valider cette option doit sélectionner au minimum 20 crédits et au maximum 25 crédits. Cette option n'est pas accessible en anglais et ne peut être prise simultanément avec l'option « Enjeux de l'entreprise ».

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- Activity with requisites
- 🌐 Open to incoming exchange students
- 🚫 Not open to incoming exchange students
- (FR) Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Year

1 2

### Content:

#### Required courses

● LINEO2001	<a href="#">Théorie de l'entrepreneuriat</a>	Frank Janssen	(FR) [q1] [30h+20h] [5 Credits] 🌐	x
● LINEO2002	<a href="#">Aspects Q 0 0 1 265997 353.274994   W n 0 52500tc e choinom2500t200</a>			

## COURS AU CHOIX EN CONNAISSANCES SOCIO-ÉCONOMIQUES

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- Mandatory
- ✂ Optional
- △ Not offered in 2023-2024
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

Year

1 2

### o Content:

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## Supplementary classes

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**To access this Master, students must have a good command of certain subjects. If this is not the case, students must take supplementary classes chosen by the faculty to satisfy course prerequisites.**

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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

*Courses for students coming from bachelor in "informatique de gestion" or "informatique et systèmes". These students will have to take*







## SINF2M - Information

### Access Requirements

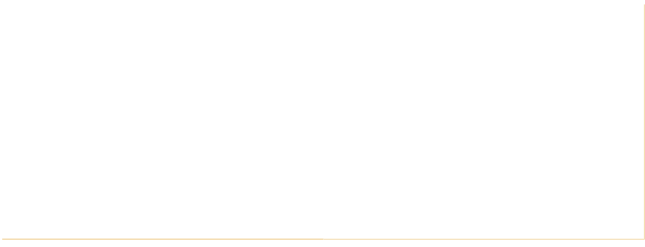
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*Master course admission requirements are defined by the French Community of Belgium Decree of 7 November 2013 defining the higher education landscape and the academic organisation of courses.*

*General and specific admission requirements for this programme must be satisfied at the time of enrolling at the university.*

*Unless explicitly mentioned, the bachelor's, master's and licentiate degrees listed in this table or on this page are to be understood as those issued by an institution of the French, Flemish or German-speaking Community, or by the Royal Military Academy.*

***In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.***



## Teaching method

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### Active learning and non-technical skills

You will play an active role in your training. The pedagogical approach is a well-balanced mix of lectures, exercises, and projects to be carried out alone or in a group. The teaching methods vary. Sometimes, you will discover concepts and techniques independently. At these times, the teaching team acts as a resource in the learning process. At other times, the pedagogy focuses on transmitting the knowledge necessary to complete future tasks.

Special emphasis is placed on non-technical skills (autonomy, organisation, time management, different modes of communication, etc.) In particular, by emphasising project-based activities (including a large scale project that puts students in a semi-professional situation), this programme develops students' critical thinking skills, which allows them to design, model, implement, and validate complex computing systems.

### Languages

The lingua franca of computer science is English. The use of English in the programme allows students to develop their mastery of this language, which facilitates their integration into professional life. All course material and course supervision are in English. However, students may always ask or respond to exam questions in French if desired.

Moreover, the programme allows students to attend language courses at the university's Language Institute (ILV) and to take part in exchange programmes.

### Interdisciplinary approach

Over the course of their careers, computer scientists are expected to manage projects as well as teams and show interest in the



