INFO2M

2020 - 2021

UCLouvain

Master [120] in Computer Science and Engineering

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In English
Dissertation/Graduation Project : **YES** - Internship : **optional**
Activities in English: **YES** - Activities in other languages : **NO**
Activities on other sites : **NO**
Main study domain : **Sciences de l'ingénieur et technologie**
Organized by: **Louvain School of Engineering (EPL)**
Programme acronym: **INFO2M** - Francophone Certification Framework: 7

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INFO2M - Introduction

Introduction

Introduction

This Master's degree programme strikes a balance between "soft skills" and scientific/technical skills as well as between high quality research and practical field work. It offers

- the study of computer science based on fundamental concepts, the value of which goes beyond rapidly evolving technology;
- a programme taught entirely in English to improve students' language skills (technical written and spoken English);
- exchange programs and dual degrees in Belgium, Europe and throughout the world.

As with the Bachelor's degree in civil engineering, this programme seeks to train well-rounded engineers by offering majors in related disciplines such as applied math, or electronics and communication.

Your profile

You would like to

- **imagine, design and implement** computer systems that will shape the future;
- **focus on computer science and engineering** after having studied science and technology (math, mechanics, electricity, chemistry, etc.) as an undergraduate student;
- improve your **theoretical knowledge** and develop technical skills;
- increase your **interdisciplinary knowledge** in areas such as foreign languages, resource management, teamwork, autonomy and ethics;
- expand your training to include management and small and medium sized business creation;
- take advantage of a programme taught entirely in **English**.

Your future job

We train

- **scientists** who know how to investigate a sharp problematic using scientific literrature in the field;
- **professionals** who will design information systems that correspond to user needs;
- **innovators** who can master a wide range of technology and record its progress;
- **specialists** capable of implementing software solutions with particular attention to product quality and the development process.

Your programme

This Master's degree consists of:

- a **compulsory part** providing the knowledge necessary to model and design complex applications
- a major of your choice that allows you to acquire cutting edge knowledge in an area of interest
- at the heart of computer sciences: **artificial intelligence, computer networks, cryptography and information security, software engineering, and system programming**;
- at the frontier with other engineering sciences: **communication networks, applied mathematics and data science, biomedical engineering, and bioinformatics**;
- beyond computer science: **management and small and medium sized business creation**;
- **elective courses** that allow you to focus your training on your areas of interest, whether they be computer science or any other discipline (electricity, management, business creation, languages);
- a **graduation project** (representing half your workload during the last year) offers the possibility to discuss a subject in-depth. Due to its size and scope, this project allows for an initiation into the working life of computer scientists and/or researchers. The project's subject is selected in consultation with the programme heads and possibly a company.

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INFO2M - Teaching profile

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Learning outcomes

Designers and developers of tomorrow's computer systems are confronted with two major challenges:

- computer systems that are increasingly complex
- areas of application that are increasingly varied

To meet these challenges, the future Master's degree holder in computer science must:

- master current computer science technologies but also manage and ascertain their progress,
- innovate by integrating elements linked to artificial intelligence, software engineering and security networks into computer systems,
- work as a member of an multidisciplinary team and act as an interface between the development team and other participants involved in the scientific or technical issues of the project.

The future computer science engineer will acquire the skills and knowledge necessary to become:

- a professional engineer capable of integrating several scientific and technical disciplines in the area of information technology
- an individual with field experience, capable of putting his/her knowledge into practice and use ever evolving high performance tools (both in research and technology)
- a specialist having acquired cutting edge knowledge in his/her field of study, for example artificial intelligence, security networks, software engineering and programming systems
- a manager who manages team projects

Polytechnic and multidisciplinary, the training offered by the Louvain School of Engineering (EPL) emphasises a combination of theory and practice open to computer science in all its dimensions (analysis, design, development, implementation, maintenance, research and innovation) including those pertaining to ethics.

International possibilities:

English is the most widely used language in companies particularly those in the technical sector. This Master's degree programme is thus taught in English and provides its participants with the opportunity to acquire solid oral and written English language skills. Offering a Master's degree in English, is proof of our international status. The use of English allows us to welcome international students all the while allowing these students to be immersed in a francophone environment. It also includes exchange programs and dual diplomas with foreign universities.

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

1. demonstrate their mastery of a **solid body of knowledge and skills** in computer science allowing them to solve problems associated with their field of study

1.1. Confronted with a computer science problem, diploma holders **can identify concepts, algorithms, and applicable data structures** to find a solution and can break the problem down into its component parts in order to formulate computer-based problem solving methods.

1.2. Confronted with a problem in their field of study, diploma holders can **choose the proper problem solving tools** (for example, development environment, programming language, software and software packages) that will allow them to find the correct software solution to the problem in question.

1.3. Confronted with the results obtained through reasoning as well as the use of tools and concepts, diploma holders are able to step back and ascertain the relevance and the quality of their results. To do so, diploma holders develop tests and relevant checks to **ensure they have developed quality solutions**.

2. organise and **develop a computer system** that meets the complex needs of a client

2.1. Before working on a solution, **graduates explore and analyse all aspects of a problem** using the documentation at their disposal and consult with future system users. Graduates then will produce a specifications note that describes not only the system requirements but also its time constraints and ease of use for future users.

2.2. In the design phase, graduates will **imagine and model the computer system under development** in terms of functional components (subsystems) in such a way as to facilitate and optimise development. They will capitalise on the available technology and programme verification methods to ensure the quality of the software system from the very beginning of the design stage.

2.3. In the analysis phase, graduates will itemise, **evaluate and compare different technologies** (material, languages, algorithms, routing) with the goal of prioritising those that best correspond to different performance and quality criteria specified in the specifications note.

2.4. In the implementation stage, graduates will demonstrate *their mastery of the principles, techniques and development tools* at their disposal. They will create a software prototype in order to verify that the software corresponds to the clients' needs and will run a battery of tests to ensure that the proposed solution corresponds to the specifications note. By applying validation techniques and programme verifications, graduates can identify and locate bugs as well as their fixes.

2.5. On the basis of a prototype, **graduates design and ensure follow up through a quality control plan**: monitoring, optimisation, maintenance, detection of break downs, communication protocols and intervention in the case of failure. They can use metrics and tools to evaluate and validate the structural quality of a software system in terms of its security and maintainability.

3. organise and carry out a research project to **understand a new problem** in their area of study

3.1. Confronted with a new computer problem, graduates will **explore** the area in question and obtain the necessary information to **complete a situational analysis** using the various resources at their disposal (library, Internet, researchers, industry experts)

3.2. In the graduation project (possibly paired with a company internship) on a new problem, graduates **construct a model** of the underlying phenomenon from a computer science perspective. On the basis of this model, **graduates formulate and test different computer devices capable of solving the problem in question** (for example, computerised processing of an image by a scanner to facilitate medical diagnosis)

3.3. Once in possession of the experimental results, graduates summarise their conclusions in a report, where they also discuss **how key variables influenced the behaviour of the phenomenon being studied**. Based on their results, graduates will make recommendations about how to **develop and implement innovative technical solutions f**or the problems in question.

4. Participate in a group project

4.1. As a member of a team project, graduates will collaborate to study a problem and its context with the goal or itemising its different parts, issues and constraints. They will then collaborate **to draft a specifications note reiterating the key elements of the project framework:** problem and solution, objectives and performance indicators, risks, deadlines, resource limits, etc.

4.2. Once the project framework is defined, graduates **collaborate on a plan of action**. The team agrees to work collectively on a work schedule, the intermediary steps, the division of labour and project deadlines.

4.3. Team members share their knowledge and skills **to solve problems collectively** that are raised over the course of the project whether they are technical or not. Graduates are able to step back when necessary to overcome team difficulties or conflicts:

4.4. Mindful of the commitments made during the course of the project, graduates alert their teammates about decisions that need to be made in the event of a problem. Through steering committee meetings, graduates **make the necessary decisions** to organise or reorganise project objectives.

5. Communicate effectively orally and in writing with the goal of carrying out projects (in particular in English)

5.1. Faced with a computer development project, graduates are able to identify and question the relevant actors. **Through their exchanges with those involved in the project, graduates assess the project environment and relevant issues**, which requires them to specify their needs, expectations and limits in a specifications note while keeping in mind system functionalities as well as the conditions for use (interfaces with other applications, maintenance, progress, etc.)

5.2. By communicating, **graduates take into account the fact that their interlocutors have not necessarily mastered the language of computers** and do not have the same idea of the issues and solutions envisaged by computer science.

5.3. In certain critical phases of a project, there are collective choices to be made. To facilitate decision making, the graduate must **be capable of providing his/her interlocutors with a summary of the situation and its issues**. To this end, he/she is capable of communicating necessary information by using schemas or graphs of the computer system.

5.4. Graduates know how to use reference materials or computer language or software manuals in both English and French. They **understand technical reports written in English**.

5.5. During the development of a computer application, graduates **can ensure the tracking and documentation in a concise and precise language**: specifications note, software structures and their related data, operating modes. Graduates are also capable of drafting summary reports that describe their design and technology choices.

6. Demonstrate autonomy, rigor, openness, critical thinking as well as a sense of ethics when doing your job

6.1. In their fields of study, students **master the technical vocabulary and usage standards** that allow them to easily understand a scientific article or technical document or to communicate with specialists in their field.

6.2. Graduates will take into account the socio-economic aspects of a project in the specifications note, in particular the compatibility between technological progress and ethical standards

6.3. Regarding the development of an application that meets an industrial challenge or provides an important service (for example ambulance management), **graduates will ensure the robustness and feasibility** of the application for its users.

6.4. Confronted with a new problem**, graduates autonomously acquire and use information and computer tools that they need to solve the problem** even if they have not explicitly learned about them during their coursework.

Programme structure

The Master's degree programme consists of four parts:

- Core curriculum, focused on the graduation project (38 credits)
- Required final specialisation (30 credits)
- One or more majors (20 to 52 credits)
- Elective courses (0 to 52 credits)

The graduation project is normally completed during the 2nd year. Regarding required and elective courses, students may (depending on their major) take these courses in the 1st or 2nd year as long as they have completed the course prerequisites. This is particularly the case for students who completed part of their education abroad. The yearly distribution of activities as outlined in the detailed programme is subject to change.

Furthermore, students have the opportunity to broaden their education by enrolling in non-technical elective courses if they have a clear objective in mind.

For a programme-type, and regardless of the focus, options/or elective courses selected, this master will carry a minimum of 120 credits divided over two annual units, corresponding to 60 credits each.

> Core courses for the Master in computer science and engineering   *[en-prog-2020-info2m-tronc_commun]*

Liste au choix de finalités INFO2M

> Professional Focus   *[en-prog-2020-info2m-linfo220s]*

> List of electives   *[en-prog-2020-info2m-options]*

Majors for the Master's degree in computer science and engineering

> Major in Artificial Intelligence: big data, optimization and algorithms   *[en-prog-2020-info2m-linfo301o]*
> Major in software engineering and programming systems   *[en-prog-2020-info2m-linfo302o]*
> Major in Security and Networking   *[en-prog-2020-info2m-linfo303o]*
> Major in Data science and Applied Mathematics   *[en-prog-2020-info2m-linfo304o]*
> Option en Cryptography and information security   *[en-prog-2020-info2m-linfo305o]*
> Major in biomedical engineering   *[en-prog-2020-info2m-linfo307o]*

Majors for the Master's degree in computer science and engineering

> Major in small and medium sized business creation   *[en-prog-2020-info2m-linfo311o]*
> Major Business risks and opportunities   *[en-prog-2020-info2m-lfsa220o]*

Elective courses

> Elective courses: transversal skills and contacts with industry   *[en-prog-2020-info2m-linfo957o]*
> Elective courses available for Master students in Computer Science   *[en-prog-2020-info2m-linfo958o]*

Preparatory Module *(only for students who qualify for the course via complementary coursework)*

> Master [120] in Computer Science and Engineering   *[en-prog-2020-info2m-module_complementaire]*

INFO2M Detailed programme

Programme by subject

CORE COURSES

⦿ Mandatory	⧉ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

The student shall select

						Year	
						1	2
⦿ LINGI2990	Graduation project/End of studies project				28 Credits		x
⦿ LINGI2261	Artificial intelligence	Yves Deville	30h+30h	5 Credits	q2	x	x
⦿ LELEC2531	Design and Architecture of digital electronic systems	Jean-Didier Legat	30h+30h	5 Credits	q1	x	x

⦿ **Religion courses for students in exact sciences (2 credits)**
The students select one course between:
The student shall select

					Year	
					1	2
⚙ LTECO2100	Sociétés, cultures, religions : Biblical readings	Hans Ausloos	15h	2 Credits	q1	x x
⚙ LTECO2300	Societies, cultures, religions : Ethical questions	Marcela Lobo Bustamante	15h	2 Credits	q1	x x
⚙ LTECO2200	Societies-cultures-religions : Human Questions	Régis Burnet Dominique Martens	15h	2 Credits	q1 or q2	x x

o Computer science seminars

Students may choose 3 credits among
The student shall select 3 credits from amongst

					Year	
					1	2
⚙ LINGI2349	Networking and security seminar	Etienne Riviere Ramin Sadre	30h	3 Credits	q1	x
⚙ LINGI2359	Software engineering and programming systems seminar	Axel Legay	30h	3 Credits	q1	x
⚙ LINGI2369	Artificial intelligence and machine learning seminar	Pierre Dupont Siegfried Nijssen	30h	3 Credits	q1	x

PROFESSIONAL FOCUS [30.0]

○ Mandatory
△ Courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021

⌘ Optional
⊘ Periodic courses not taught during 2020-2021
🟨 Activity with requisites

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

The student may take all the specialisation courses

Year

1 2

○ Content:

○ Computer science courses

○ LINGI2132	Languages and translators	Nicolas Laurent	30h+30h	6 Credits	q2	x	x
○ LINGI2172	Databases	Siegfried Nijssen	30h+30h	6 Credits	q2	x	x
○ LINGI2241	Architecture and performance of computer systems	Ramin Sadre	30h+30h	6 Credits	q1	x	x
○ LINGI2255	Software engineering project	Axel Legay	30h+30h	6 Credits	q1	x	x
○ LINGI2262	Machine Learning :classification and evaluation	Pierre Dupont	30h+30h	6 Credits	q2	x	x

OPTIONS [52.0]

Students must complete their programme with a combination of major and/or elective courses. They may select:

Majors for the Master's degree in computer science and engineering

> Major in Artificial Intelligence: big data, optimization and algorithms   *[en-prog-2020-info2m-linfo301o]*
> Major in software engineering and programming systems   *[en-prog-2020-info2m-linfo302o]*
> Major in Security and Networking   *[en-prog-2020-info2m-linfo303o]*
> Major in Data science and Applied Mathematics   *[en-prog-2020-info2m-linfo304o]*
> Option en Cryptography and information security   *[en-prog-2020-info2m-linfo305o]*
> Major in biomedical engineering   *[en-prog-2020-info2m-linfo307o]*

Majors for the Master's degree in computer science and engineering

> Major in small and medium sized business creation   *[en-prog-2020-info2m-linfo311o]*
> Major Business risks and opportunities   *[en-prog-2020-info2m-lfsa220o]*

Elective courses

> Elective courses: transversal skills and contacts with industry   *[en-prog-2020-info2m-linfo957o]*
> Elective courses available for Master students in Computer Science   *[en-prog-2020-info2m-linfo958o]*

MAJORS FOR THE MASTER'S DEGREE IN COMPUTER SCIENCE AND ENGINEERING

Students have to choose one or several options among:

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 use methods and techniques that create software-based solutions to complex problems, Understand and put to good use the methods and techniques pertaining to artificial intelligence such as automated reasoning, heuristic research, knowledge acquisition, automated learning, problems related to constraint satisfaction, Identify a category of applications and how to use its methods and tools; understand specific categories of applications and their specific techniques-for example computer vision, scheduling, data mining, natural language processing, bioinformatics, big data processing; Formalise and structure a body of complex knowledge by using a systematic and rigorous approach to develop quality "intelligent" systems.

⚪ Mandatory	⊗ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

Students shall select 20 to 30 credits among

Year
1 2

⚪ Content:

⚪ Required courses in Artificial Intelligence: big data, optimization and algortihms

						Year 1	Year 2
⚪ LINGI2266	Advanced Algorithms for Optimization	Pierre Schaus	30h+15h	5 Credits	q1 △	x	x
⚪ LINGI2263	Computational Linguistics	Pierre Dupont Pierre Dupont (compensates Cédrick Fairon)	30h+15h	5 Credits	q1	x	x
⚪ LINGI2365	Constraint programming	Pierre Schaus Pierre Schaus (compensates Yves Deville)	30h+15h	5 Credits	q2	x	x
⚪ LINGI2364	Mining Patterns in Data	Siegfried Nijssen	30h+15h	5 Credits	q2	x	x

⊗ Elective courses in Artificial Itelligence
Student shall select 10 credits among

						Year 1	Year 2
⊗ LELEC2870	Machine learning : regression, deep networks and dimensionality reduction	John Lee Michel Verleysen	30h+30h	5 Credits	q1	x	x
⊗ LELEC2885	Image processing and computer vision	Christophe De Vleeschouwer (coord.) Laurent Jacques	30h+30h	5 Credits	q1	x	x
⊗ LGBIO2010	Bioinformatics	Pierre Dupont	30h+30h	5 Credits	q1	x	x
⊗ LINGI2145	Cloud Computing	Etienne Riviere	30h+15h	5 Credits	q1	x	x
⊗ LINMA1691	Discrete mathematics - Graph theory and algorithms	Vincent Blondel Jean-Charles Delvenne	30h +22.5h	5 Credits	q1	x	x
⊗ LINMA1702	Optimization models and methods I	François Glineur	30h +22.5h	5 Credits	q2	x	x
⊗ LINMA2450	Combinatorial optimization	Jean-Charles Delvenne Julien Hendrickx	30h +22.5h	5 Credits	q1	x	x
⊗ LINMA2472	Algorithms in data science	Jean-Charles Delvenne (coord.) Gautier Krings (compensates Vincent Blondel)	30h +22.5h	5 Credits	q1	x	x
⊗ LSINF2275	Data mining & decision making	Marco Saerens	30h+15h	5 Credits	q2	x	x

MAJOR IN SOFTWARE ENGINEERING AND PROGRAMMING SYSTEMS

Student completing the major in Software Engineering and Programming Systems will be able to: Understand and explain problems pertaining to large scale software projects as well as the critical impact of their solutions throughout the duration of the project (construction scope, validation, documentation, communication and large scale project management as well as expense limits and deadlines), Choose and apply engineering methods and tools related to complex software systems to meet strict quality control criteria: reliability, adaptability, upgradeability, performance, security, usability), Model products and processes necessary to obtain such systems and analyse the models in question, Design and create programmes to analyse, convert and optimise computer performance, Put to good use different programming language paradigms, in particular those that deal with competing functional and object oriented programmes, Understand the issues associated with different competing programming models and use the appropriate model, Define a new language (syntax and semantics) appropriate to a specific context.

⊘ Mandatory	⊗ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

Students shall select 20 to 30 credits among

Year
1 2

⬠ *Content:*

⬠ Required courses in software engineering and programming systems

⊘ LINGI2143	Concurrent systems : models and analysis	Charles Pecheur	30h+15h	5 Credits	q1	x	x
⊘ LINGI2251	Software Quality Assurance	Charles Pecheur	30h+15h	5 Credits	q2	x	x
⊘ LINGI2252	Software Maintenance and Evolution	Kim Mens	30h+15h	5 Credits	q1	x	x
⊘ LSINF2345	Languages and algorithms for distributed Applications	Peter Van Roy	30h+15h	5 Credits	q1	x	x

⊗ Elective courses in Software Engineering and Programming Systems
Students can select 10 credits among

⊗ LINGI2145	Cloud Computing	Etienne Riviere	30h+15h	5 Credits	q1	x	x
⊗ LINGI2347	Computer system security	Ramin Sadre	30h+15h	5 Credits	q2	x	x
⊗ LINGI2355	Multicore programming	Etienne Riviere	30h+15h	5 Credits	q2	x	x
⊗ LINGI2364	Mining Patterns in Data	Siegfried Nijssen	30h+15h	5 Credits	q2	x	x
⊗ LINGI2365	Constraint programming	Pierre Schaus Pierre Schaus (compensates Yves Deville)	30h+15h	5 Credits	q2	x	x
⊗ LSINF2335	Programming paradigms	Kim Mens	30h+15h	5 Credits	q2	x	x
⊗ LSINF2382	Computer supported collaborative work	Jean Vanderdonckt	30h+15h	5 Credits	q1	x	x

MAJOR IN SECURITY AND NETWORKING

O Mandatory	⌘ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

Students shall select 20 to 30 credits among

Year
1 2

⊙ Content:

O Required courses in Networking and Security

O LINGI2142	Computer networks: configuration and management	Olivier Bonaventure	30h+30h	5 Credits	q1	x	x	
O LINGI2145	Cloud Computing	Etienne Riviere	30h+15h	5 Credits	q1	x	x	
O LINGI2146	Mobile and Embedded Computing	Ramin Sadre	30h+15h	5 Credits	q2	x	x	
O LINGI2347	Computer system security	Ramin Sadre	30h+15h	5 Credits	q2	x	x	

⌘ Elective courses in Networking and Security
Student can select 10 credits among

⌘ LINGI2143	Concurrent systems : models and analysis	Charles Pecheur	30h+15h	5 Credits	q1	x	x	
⌘ LINGI2144	Secured systems engineering	Axel Legay	30h+15h	5 Credits	q2	x	x	
⌘ LINGI2315	Design of Embedded and real-time systems	Jean-Didier Legat	30h+30h	5 Credits	q2	x	x	
⌘ LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x	
⌘ LINMA2470	Stochastic modelling	Philippe Chevalier	30h +22.5h	5 Credits	q2	x	x	
⌘ LMAT2450	Cryptography	Olivier Pereira	30h+15h	5 Credits	q1	x	x	
⌘ LSINF2345	Languages and algorithms for distributed Applications	Peter Van Roy	30h+15h	5 Credits	q1	x	x	
⌘ LINGI2355	Multicore programming	Etienne Riviere	30h+15h	5 Credits	q2	x	x	
⌘ LELEC2770	Privacy Enhancing technology	Olivier Pereira (coord.) François-Xavier Standaert	30h+30h	5 Credits	q1	x	x	

MAJOR IN DATA SCIENCE AND APPLIED MATHEMATICS

This major is available only to students who majored or minored in Applied Mathematics during their bachelor's degree programme. Students completing the major Computing and Applied Mathematics will be able to: Understand both applied mathematics and computing including algorithms, scientific calculations, computer system modelling, optimisation, automated learning or data mining, Understand and use the methods and techniques related to advanced algorithms such as optimisation methods, constraint programming, algorithms of graphs, numerical algorithms or analysis and design of algorithms, Identify and use models and techniques relating to statistics, automated learning and data mining; understand categories of applications used for the processing of raw data as well as automatic forms used to mine information out of large data sets.

⭘ Mandatory	⍓ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

The student shall select 20 to 30 credits among

Year

1 2

⚙ *Content:*

⚙ Required courses in Computing and Applied Mathematics (20 credits)

							Year 1	Year 2
⭘ LINMA2472	Algorithms in data science		Jean-Charles Delvenne (coord.) Gautier Krings (compensates Vincent Blondel)	30h +22.5h	5 Credits	q1	x	x
⭘ LINMA2710	Scientific computing		Pierre-Antoine Absil (coord.) Karl Meerbergen (compensates Anthony Papavasiliou)	30h +22.5h	5 Credits	q2	x	x
⭘ LSINF2275	Data mining & decision making		Marco Saerens	30h+15h	5 Credits	q2	x	x
⭘ LINGI2364	Mining Patterns in Data		Siegfried Nijssen	30h+15h	5 Credits	q2	x	x

⍓ Elective courses in computing and applied mathematics
Student shall select max. 10 credits among

						Year 1	Year 2
⍓ LELEC2870	Machine learning : regression, deep networks and dimensionality reduction	John Lee Michel Verleysen	30h+30h	5 Credits	q1	x	x
⍓ LINGI2266	Advanced Algorithms for Optimization	Pierre Schaus	30h+15h	5 Credits	q1 △	x	x
⍓ LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x
⍓ LINGI2365	Constraint programming	Pierre Schaus Pierre Schaus (compensates Yves Deville)	30h+15h	5 Credits	q2	x	x
⍓ LINMA2450	Combinatorial optimization	Jean-Charles Delvenne Julien Hendrickx	30h +22.5h	5 Credits	q1	x	x
⍓ LINMA2470	Stochastic modelling	Philippe Chevalier	30h +22.5h	5 Credits	q2	x	x
⍓ LINMA2471	Optimization models and methods II	François Glineur	30h +22.5h	5 Credits	q1	x	x
⍓ LMAT2450	Cryptography	Olivier Pereira	30h+15h	5 Credits	q1	x	x
⍓ LMECA2170	Numerical Geometry	Vincent Legat Jean-François Remacle	30h+30h	5 Credits	q1	x	x

OPTION EN CRYPTOGRAPHY AND INFORMATION SECURITY

This major is available only to students who majored or minored in Electricity during their Bachelor's degree programme. Students completing the major Communication Networks will be able to: Understand and use different devices and protocols used in fixed and wireless networks, Design, configure and manage fixed and wireless networks while taking into account application needs (including multimedia), Understand and effectively use information coding techniques, Understand and design mobile wireless communication systems from start to finish.

⚙ Mandatory	✱ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

Year
1 2

⚙ *Content:*

✱ Elective courses
In order to validate this option INFO and MAP students have to take 20 credits at least and ELEC and DATA students 15 credits at least among:

✱ LELEC2760	Secure electronic circuits and systems	François-Xavier Standaert	30h+30h	5 Credits	q2	x	x
✱ LINGI2144	Secured systems engineering	Axel Legay	30h+15h	5 Credits	q2	x	x
✱ LINGI2347	Computer system security	Ramin Sadre	30h+15h	5 Credits	q2	x	x
✱ LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x
✱ LMAT2440	Number theory	Olivier Pereira Jean-Pierre Tignol	30h+15h	5 Credits	q1	x	x
✱ LMAT2450	Cryptography	Olivier Pereira	30h+15h	5 Credits	q1	x	x
✱ LELEC2770	Privacy Enhancing technology	Olivier Pereira (coord.) François-Xavier Standaert	30h+30h	5 Credits	q1	x	x

MAJOR IN BIOMEDICAL ENGINEERING

This major is available only to students who minored in biomedical engineering during their Bachelor's degree programme. The objective of the biomedical engineering major is to train engineers who are capable of meeting future technological challenges in the scientific and technical fields related to biomedical engineering. This major provides students with basic knowledge about bioinformatics as well as other biomedical engineering fields such as bioinstrumentation, biomaterials, medical imaging, mathematical modelling, artificial organs and rehabilitation and biomechanics. The collaboration between the Louvain School of Management and the School of Medicine provides an interdisciplinary curriculum where engineering is applied to the complex and varied biomedical field.

○ Mandatory	� Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

Students shall select 20 to 30 credits among:

Year
1 2

○ *Content:*

○ Required courses in biomedical engineering

						Year 1	Year 2
○ LGBIO2010	Bioinformatics	Pierre Dupont	30h+30h	5 Credits	q1	x	x
○ LGBIO2020	Bioinstrumentation	André Mouraux Michel Verleysen	30h+30h	5 Credits	q1	x	x
○ LGBIO2030	Biomaterials	Sophie Demoustier Christine Dupont	30h+30h	5 Credits	q1	x	x
○ LGBIO2040	Biomechanics	Greet Kerckhofs	30h+30h	5 Credits	q2	x	x
○ LGBIO2050	Medical Imaging	Greet Kerckhofs John Lee Benoît Macq Frank Peeters	30h+30h	5 Credits	q1	x	x
○ LGBIO2060	Modelling of biological systems	Philippe Lefèvre	30h+30h	5 Credits	q1	x	x

✣ Elective courses in biomedical engineering for students enrolled in the ELEC Master¿s degree programme

						Year 1	Year 2
✣ LELEC2870	Machine learning : regression, deep networks and dimensionality reduction	John Lee Michel Verleysen	30h+30h	5 Credits	q1	x	x
✣ LELEC2885	Image processing and computer vision	Christophe De Vleeschouwer (coord.) Laurent Jacques	30h+30h	5 Credits	q1	x	x

MAJORS FOR THE MASTER'S DEGREE IN COMPUTER SCIENCE AND ENGINEERING

MAJOR IN SMALL AND MEDIUM SIZED BUSINESS CREATION

In keeping with most of the EPL Masters' degrees, the goal of this major is to familiarize the student with the specifics of entrepreneurship and business development in order to develop the necessary abilities, knowledge and tools to create a business. It is a truly interdisciplinary initiative where students from different faculties are brought together in cross-disciplinary teams to create an entrepreneurial project.

The Interdisciplinary program in entrepreneurship (CPME) is spread over two years and is integrated into more than 30 Masters (9 faculties). The program includes a collective and interdisciplinary master thesis focused on an entrepreneurial project (start-up or spin-off) and realized in teams of 3 to 4 students from 3 to 4 different faculties. The access is reserved for a small number of students by a selection procedure. Additional information may be found at www.uclouvain.be/cpme.

This major is not available in English and may not be taken at the same time as the major "Business risks and opportunities".

O Mandatory	⌧ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

From 20 to 25 credits

Year

| | 1 | 2 |

o *Content:*

o Required courses for the major in small and medium sized businesses

						1	2
O LCPME2001	Entrepreneurship Theory (in French)	Frank Janssen	30h+20h	5 Credits	q1	x	x
O LCPME2002	Managerial, legal and economic aspects of the creation of a company (in French)	Yves De Cordt Marine Falize	30h+15h	5 Credits	q1	x	x
O LCPME2003	Business plan of the creation of a company (in French) *Les séances du cours LCPME2003 sont réparties sur les deux blocs annuels du master. L'étudiant doit les suivre dès le bloc annuel 1, mais ne pourra inscrire le cours que dans son programme de bloc annuel 2.*	Frank Janssen	30h+15h	5 Credits	q2	x	x
O LCPME2004	Advanced seminar on Entrepreneurship (in French)	Frank Janssen	30h+15h	5 Credits	q2	x	x

o Prerequisite CPME courses

Les étudiants qui n'ont pas suivi un cours de gestion durant leur formation antérieure doivent mettre au programme de cette option le cours CMPE2000

						1	2
O LCPME2000	Venture creation financement and management I	Yves De Rongé Olivier Giacomin	30h+15h	5 Credits	q1	x	x

MAJOR BUSINESS RISKS AND OPPORTUNITIES

O Mandatory	�֎ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

This Major is not available in English and cannot be taken simultaneously with the Major "Major in small and medium sized business creation".
From 17 to 20 credits

Year

1 2

o *Content:*

O LFSA1290	Introduction to financial and accounting management		Philippe Grégoire	30h+15h	4 Credits	q2	x	x
O LFSA2140	Elements of law for industry and research		Vincent Cassiers Werner Derijcke Bénédicte Inghels	30h	3 Credits	q1	x	x
O LFSA2210	Organisation and human resources		John Cultiaux Eline Jammaers	30h	3 Credits	q2	x	x
O LFSA2230	Introduction to management and to business economics		Benoît Gailly	30h+15h	4 Credits	q2	x	x
O LFSA2245	Environment and business		Jean-Pierre Tack	30h	3 Credits	q1	x	x

o One course between

From 3 to 5 credits

✖ LFSA2202	Ethics and ICT		Axel Gosseries Olivier Pereira	30h	3 Credits	q2	x	x
✖ LLSMS2280	Business Ethics and Compliance Management		Carlos Desmet	30h	5 Credits	q1	x	x

✖ Alternative to the major in business risks and opportunities for computer science students

Computer science students who have already taken courses in this field while pursuing their Bachelor's degree may choose between 16-20 credits from the courses offered in the management minor for computer sciences.

ELECTIVE COURSES

ELECTIVE COURSES: TRANSVERSAL SKILLS AND CONTACTS WITH INDUSTRY

○ Mandatory	⚹ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

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

The student selects between 3 and 22 credits (maximum 27 if the student selects the internship) in this list below or in the courses of the major "business risks and opportunities". An alternative is to select the Major in small and medium sized business creation.

Year

1 2

○ *Content:*

○ Transversal skills and contacts with industry
The student selects min 3 credits among the courses of the majors "business risks and opportunities", "small and medium sized business creation" and courses of professional integration activity specific to the program.

⚹ Internship

⚹ LFSA2995	Company Internship	Jean-Pierre Raskin	30h	10 Credits	q1+q2	x	x

⚹ Professional integration activity specific to the program

⚹ LINGI2399	Industrial seminar in computer science	Yves Deville Bernard Geubelle	30h	3 Credits	q2	x	x
⚹ LINGI2402	Open Source Project			5 Credits	q1+q2	x	x

⚹ Communication
Students may select max. 8 credits of languages courses or group dynamics :
Maximum 8 credits

⚹ Languages
Students may select from any language course offered at the ILV. Special attention is placed on the following seminars in professional development:

⚹ LALLE2500	Professional development seminar German	Caroline Klein (coord.)	30h	3 Credits	q1+q2	x	x
⚹ LALLE2501	Professional development seminar-German	Caroline Klein (coord.)	30h	5 Credits	q1+q2	x	x
⚹ LESPA2600	Vocational Induction Seminar - Spanish (B2.2/C1)	Paula Lorente Fernandez (coord.)	30h	3 Credits	q1	x	x
⚹ LESPA2601	Vocational Induction Seminar - Spanish (B2.2/C1)	Paula Lorente Fernandez (coord.)	30h	5 Credits	q1	x	x
⚹ LNEER2500	Seminar of Entry to professional life in Dutch - Intermediate level	Isabelle Demeulenaere (coord.) Marie-Laurence Lambrecht	30h	3 Credits	q1 or q2	x	x
⚹ LNEER2600	Seminar of entry to professional life in Dutch - Upper-Intermediate level	Isabelle Demeulenaere (coord.) Dag Houdmont	30h	3 Credits	q1 or q2	x	x

⚹ Group dynamics

⚹ LEPL2351	Dynamique des groupes - Q1	Christine Jacqmot Claude Oestges Benoît Raucent Vincent Wertz	15h+30h	3 Credits	q1	x	x
⚹ LEPL2352	Dynamique des groupes - Q2	Christine Jacqmot Claude Oestges Benoît Raucent Vincent Wertz	15h+30h	3 Credits	q2	x	x

⚹ Other non-disciplinary courses
The student may further select maximum 8 credits in other disciplines.

ELECTIVE COURSES AVAILABLE FOR MASTER STUDENTS IN COMPUTER SCIENCE

○ Mandatory	⊗ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	🟨 Activity with requisites

<p align="center">Click on the course title to see detailed informations (objectives, methods, evaluation...)</p>

In addition to the 2 UE below, student may add to their elective courses any other course in the program that was not taken as part of an option.

Year
1 2

○ *Content:*

⊗ LINGI2401	Open Source strategy for software development	Lionel Dricot	30h+15h	5 Credits	q1	x	x
⊗ LINGI2402	Open Source Project			5 Credits	q1+q2	x	x

Course prerequisites

There are no prerequisites between course units (CUs) for this programme, i.e. the programme activity (course unit, CU) whose learning outcomes are to be certified and the corresponding credits awarded by the jury before registration in another CU.

The programme's courses and learning outcomes

For each UCLouvain training programme, a reference framework of learning outcomes specifies the competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme's reference framework of learning outcomes in the document *"In which teaching units are the competences and learning outcomes in the programme's reference framework developed and mastered by the student?"*

INFO2M - Information

Access Requirements

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

Decree of 7 November 2013 defining the landscape of higher education and the academic organization of studies.

The admission requirements must be met prior to enrolment in the University.

SUMMARY

- > Specific access requirements
- > University Bachelors
- > Non university Bachelors
- > Holders of a 2nd cycle University degree
- > Access based on validation of professional experience
- > Access based on application
- > Admission and Enrolment Procedures for general registration

Specific access requirements

This programme is taught in English with no prerequisite in French. The student is supposed to have at least a B2 level in the European Framework of Reference. A certificate is required for the holders of a non-Belgian degree, see selection criteria of the "access on the file".

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
		Direct access	
Others Bachelors of the French speaking Community of Belgium			
		Direct access	
Bachelors of the Dutch speaking Community of Belgium			
		Access with additional training	
Foreign Bachelors			
		Direct access	
		Access based on application	

Non university Bachelors

> Find out more about links (https://uclouvain.be/fr/etudier/passerelles) to the university

Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
"Licenciés"			
Masters			
		Direct access	

Access based on validation of professional experience

> See the website Valorisation des acquis de l'expérience

It is possible to gain admission to all masters courses via the validation of professional experience procedure.

Access based on application

Reminder : all Masters (apart from Advanced Masters) are also accessible on file.

The first step of the admission procedure requires to submit an application online: https://uclouvain.be/en/study/inscriptions/futurs-etudiants.html
Selection criteria are summarized here (contact : epl-admission@uclouvain.be).

Admission and Enrolment Procedures for general registration

Access based on application

Teaching method

Active teaching strategies and non-technical skills

The teaching methods used in the Master's degree programme in civil engineering are consistent with those of the Bachelor's degree programme in engineering sciences: active learning, an equal mix of group work and individual work, and emphasis on the development of non-technical skills. In particular, our pedagogy prioritises projects (including a large scale project that puts student groups in a semi-professional situation).

Students will be exposed to various teaching methods: lectures, exercise sessions, problem solving sessions, case studies, industry or research internships, group work, individual work, seminars and conferences offered by the industrial sector. This variety of teaching techniques helps students to build their knowledge in an iterative and progressive manner while at the same time develop their autonomy as well as their organisation, time management and communication skills.

Use of Foreign Languages

Globalisation demands that all societies open up to foreign markets. In addition, the main language used in computer science is English. The use of English throughout the programme allows students to develop their mastery of this language, which will facilitate their integration into universities and foreign companies. Course materials as well as educational support are in English. However, students may express themselves in French during class or evaluations. Specifically, the Master's thesis or graduation project may be written and defended in English or French.

Furthermore, the programme foresees the possibility of taking language classes at the ILV and participating in study abroad programs.

Overall, the programme is taught in English with the exception of the biomedical engineering major and the majors in management and small and medium sized business creation.

Open to other disciplines

Students are encouraged to enlarge their training to include other engineering sciences and techniques, management as well as the humanities and social sciences. In fact, over the course of their careers, computer scientists must manage (team) projects and show an interest in the complex socio-economic context in which computer science takes place. They must dialogue with colleagues from different educational backgrounds who prioritise other aspects of a project. Thus it is imperative that students enlarge their field of vision beyond computer science.

Evaluation

The evaluation methods comply with the <u>regulations concerning studies and exams</u> (https://uclouvain.be/fr/decouvrir/ rgee.html). More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading "Learning outcomes evaluation method".

Student work is evaluated according to University rules (see the rules for evaluating coursework and exams) namely written and oral exams, laboratory exams, individual or group work, public presentations of projects and theses defences. For classes taught in English, questions are in English. Students may respond in French. For classes taught in French, questions are in French. Students may ask for help translating the questions into English and respond to them in English.

Certain activities completed during the semester and supervised by a teaching team in collaboration with students do not take place outside of the class session. Thus they are not re-evaluated in a future course session.

At the beginning of the semester, professors will explain their marking scheme, which is based on the learning outcomes of the course (that it frequently shares with those of the Master's degree programme).

For more information on evaluation methods, students may consult the relevant evaluation descriptions.

To obtain a passing grade, the marks received for the teaching units are offset by their respective credits.

Mobility and/or Internationalisation outlook

Outgoing students

Since its creation, the Louvain School of Engineering (EPL) has participated in diverse exchange programs that were put into place at the European level and beyond.

Students are informed about study abroad opportunities at the end of their Bachelor's degree programme, notably through intensive academic programmes like the BEST network. This network giives students an initial study abroad experience.

In addition, within the framework of the Erasmus/Mercator exchange programmes, students have the possibility of studying at a partner university for one year (two semesters) during the 1st year of the Master's degree programme or 5 months (first semester) in the 2nd year of the Master's degree programme. To this end, the EPL participates in different study abroad networks.

• In Belgium, the EPL has a partnership with the Faculteit Ingenieurswetenschappen de la Katholieke Universiteit Leuven.

- Within Europe, the EPL participates in the CLUSTER network, which provides quality training and accommodations for exchange students. Furthermore, the members of the CLUSTER network have signed an agreement that mutually recognises their Bachelor's degree programmes. This agreement means that all the Bachelor degree holders in the CLUSTER network are automatically admitted to the Master's degree programme in member institutions.
- Outside of Europe, the EPL is a member of the Magalhäes network that brings together 15 European universities with the best scientific and technological universities in Latin America.

In addition to these networks and partnerships, the EPL has signed a certain number of individual agreements with different universities in Europe, North America and elsewhere in the world. The list of these agreements is available at UCL's International Relations Administration website.

Joint degree programmes have also been put into place.

-Dual Masters degrees allow students to receive a diploma from two universities at the end of their two year Master's degree programme (one year at UCL and the other at a host university).

Students are informed about the different exchange programmes in the second year of their Bachelor's degree programme. They are encourage to prepare in advance, specifically their language skills through classes offered at the Institute for Living Languages (Institut des langues vivants) at UCL.

Beyond exchange programmes, students may intern in a research laboratory or a foreign company.

More information about mobility programmes (https://uclouvain.be/epl-international.html).

Incoming students

Thanks to the CLUSTER network, foreign students have the same status as local UCL students. UCL favours students coming from institutions that participate in the Socrates exchange network.

Overall the Master's degree programme is taught in English and does not require previous knowledge of French with the exception of the majors in biomedical engineering, management and small and medium sized business creation (CPME). Except for rare cases, all courses are taught in English. For non-francophone students, substitute courses may take the place of courses taught in French. These courses are suggested by the programme commission on a case by case basis and are based on the student's course curriculum.

More information about mobility programmes (https://uclouvain.be/epl-international.html).

Possible trainings at the end of the programme

Doctoral programmes

The Master's degree in civil engineering and computer science may be followed by a doctoral degree programme in engineering sciences. Doctoral degrees are offered by thematic doctoral degree granting schools.

UCL Master's degrees (about 60) are accessible to UCL Master's degree holders

For example:

- The Master's degree (120) in sciences and environmental management and the Master's degree (60) in sciences and environmental management (automatic admission with possible complementary coursework)
- Different Master's degree programmes in management (automatic admission based on written application): see this list
- The Master's degree (60) in information and communication at Louvain-la-Neuve or the Master's degree (60) in information and communication at Mons

Contacts

Curriculum Management

Entity

Structure entity	SST/EPL/INFO
Denomination	(INFO)
Faculty	Louvain School of Engineering (EPL)
Sector	Sciences and Technology (SST)
Acronym	INFO
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Jury

- Jean-Didier Legat
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