**At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In english**

Dissertation/Graduation Project : YES - Internship : optional

Activities in other languages : YES
Activities on other sites : NO

Main study domain : Sciences

Organized by: Ecole Polytechnique de Louvain (EPL)
Programme acronym: sinf2m - Francophone Certification Framework: 7

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SINF2M - Introduction

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 litterature 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, UCL 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.
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:

UCL 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.

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

The programme consists of four parts:
- a common curriculum, mainly the graduation project (36 credits).
- a final specialisation, required (30 credits).
- one or more majors allowing for specialisation in a field of computer science (20-54 credits).
- elective courses (0-54 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).

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’s degree in computer science engineering [en-prog-2019-sinf2m-lsinf220t.html]

> Professional focus [en-prog-2019-sinf2m-lsinf220s]

Options courses

> Options en sciences informatiques [en-prog-2019-sinf2m-lsinf103g.html]  
> Major in Artificial Intelligence: big data, optimization and algorithms [en-prog-2019-sinf2m-lsinf223o.html]  
> Major in Security and Networking [en-prog-2019-sinf2m-lsinf226o.html]  
> Data science and Applied Mathematics [en-prog-2019-sinf2m-lsinf226o.html]  
> Major in business creation and management [en-prog-2019-sinf2m-lsinf1107g.html]  
> Major: Business risks and opportunities [en-prog-2019-sinf2m-lsinf223o.html]  
> Interfaculty major in small and medium sized business creation [en-prog-2019-sinf2m-lsinf227o.html]  
> Cours aux choix accessibles aux étudiants du master en sciences informatiques [en-prog-2019-sinf2m-lsinf105g.html]  
> Elective courses: transversal skills and contacts with industry [en-prog-2019-sinf2m-lsinf922o.html]  
> Elective courses available for Master students in Computer Science [en-prog-2019-sinf2m-lsinf923o.html]
## CORE COURSES

### Final thesis (28 credits)
- **LSINF2990** Graduation project/End of studies project

### Societies, Cultures, Religions (2 credits)

The students select one course between:

- LTECO2100 Sociétés, cultures, religions : Biblical readings
  - Hans Ausloos
  - 15h
  - 2 Credits
  - 1q

- LTECO2300 Sociétés, cultures, religions : Ethical questions
  - Marcela Lobo Bustamante
  - 15h
  - 2 Credits
  - 1q

- LTECO2200 Sociétés-cultures-religions : Human Questions
  - Régis Burnet
  - Dominique Martens
  - 15h
  - 2 Credits
  - 1 ou 2q

### Human Sciences
- **LFSA2210** Organisation and human resources
  - John Cultiaux
  - Eline Jammaers
  - 30h
  - 3 Credits
  - 2q

### Computer science seminars

Students may choose 3 credits among

- **LINGI2349** Networking and security seminar
  - Etienne Riviere
  - Ramin Sadre (coord.)
  - 30h
  - 3 Credits
  - 1q

- **LINGI2359** Software engineering and programming systems seminar
  - Axel Legay
  - 30h
  - 3 Credits
  - 1q

- **LINGI2369** Artificial intelligence and machine learning seminar
  - Pierre Dupont
  - Siegfried Nijssen
  - 30h
  - 3 Credits
  - 1q

## PROFESSIONAL FOCUS [30.0]

### Computer science courses

- **LINGI2132** Languages and translators
  - Pierre Schaus
  - 30h + 30h
  - 6 Credits
  - 2q

- **LINGI2172** Databases
  - Siegfried Nijssen
  - 30h + 30h
  - 6 Credits
  - 2q
<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Time</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2241</td>
<td>Architecture and performance of computer systems</td>
<td>Ramin Sadre</td>
<td>6</td>
<td>30h+30h</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2261</td>
<td>Artificial intelligence: representation and reasoning</td>
<td>Yves Deville</td>
<td>6</td>
<td>30h+30h</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2255</td>
<td>Software engineering project</td>
<td>Kim Mens</td>
<td>6</td>
<td>30h+30h</td>
<td>1q</td>
</tr>
</tbody>
</table>
OPTIONS

Students must complete their programme with major and or elective courses. They may select 54 credits from among the following courses:

Options en sciences informatiques

- Major in Artificial Intelligence: big data, optimization and algorithms [en-prog-2019-sinf2m-lsinf223o]
- Major in Security and Networking [en-prog-2019-sinf2m-lsinf225o]
- Data science and Applied Mathematics [en-prog-2019-sinf2m-lsinf226o]

Major in business creation and management

- Major: Business risks and opportunities [en-prog-2019-sinf2m-lsinf230o]
- Interfaculty major in small and medium sized business creation [en-prog-2019-sinf2m-lsinf227o]

Elective courses: transversal skills and contacts with industry [en-prog-2019-sinf2m-lsinf922o]

Elective courses available for Master students in Computer Science [en-prog-2019-sinf2m-lsinf923o]

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.

The student shall select
De 20 à 30 credits parmi

**Contenu:**

- **Required courses in Artificial Intelligence: big data, optimization and algorithms**
  - LINGI2262 Machine Learning: classification and evaluation
    - Pierre Dupont
    - 30h+30h Credits: 5
    - 2q
  - LINGI2263 Computational Linguistics
    - Pierre Dupont
    - 30h+15h
    - 5 Credits
    - 1q
  - LINGI2266 Advanced Algorithms for Optimization
    - Pierre Schaus
    - 30h+15h
    - 5 Credits
    - 1q
  - LINGI2365 Constraint programming
    - Yves Deville
    - 30h+15h
    - 5 Credits
    - 2q

- **Elective courses in Artificial Intelligence**
  The student select 10 credits among
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LELEC2870</td>
<td>Machine Learning : regression, dimensionality reduction and data visualization</td>
<td>John Lee (compensates Michel Verleysen)</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LELEC2885</td>
<td>Image processing and computer vision</td>
<td>Christophe De Vleeschouwer (coord.) Laurent Jacques</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LGBIO2010</td>
<td>Bioinformatics</td>
<td>Pierre Dupont</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA1691</td>
<td>Discrete mathematics - Graph theory and algorithms</td>
<td>Vincent Blondel Jean-Charles Delvenne</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA1702</td>
<td>Optimization models and methods I</td>
<td>François Glineur</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2450</td>
<td>Combinatorial optimization</td>
<td>Jean-Charles Delvenne (coord.) Julien Hendrickx</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel Jean-Charles Delvenne (coord.) Gautier Krings (compensates Vincent Blondel)</td>
<td>5</td>
<td>1q</td>
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<tr>
<td>LSINF2275</td>
<td>Data mining &amp; decision making</td>
<td>Marco Saerens</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>
# MAJOR IN SOFTWARE ENGINEERING AND PROGRAMMING SYSTEMS

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.

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses not taught during 2019-2020</td>
<td>Periodic courses not taught during 2019-2020</td>
</tr>
<tr>
<td>Periodic courses taught during 2019-2020</td>
<td>Activity with requisites</td>
</tr>
</tbody>
</table>

The student shall select

De 20 à 30 credits parmi

## Required courses in software engineering and programming systems

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Time</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2143</td>
<td>Concurrent systems : models and analysis</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2251</td>
<td>Software Quality Assurance</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2252</td>
<td>Software Maintenance and Evolution</td>
<td>Kim Mens</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
<tr>
<td>LSINF2345</td>
<td>Languages and algorithms for distributed Applications</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
</tbody>
</table>

## Elective courses in Software Engineering and Programming Systems

The student can select 10 credits among

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Time</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2347</td>
<td>Computer system security</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2355</td>
<td>Multicore programming</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2365</td>
<td>Constraint programming</td>
<td>Yves Deville, Pierre Schaus</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(compensates Yves Deville)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSINF2335</td>
<td>Programming paradigms</td>
<td>Kim Mens</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LSINF2382</td>
<td>Computer supported collaborative work</td>
<td>Jean Vanderdonckt</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
</tbody>
</table>
### MAJOR IN SECURITY AND NETWORKING

Students completing the major “Security and Networking” will be able to: Understand and explain different devices and protocols used in computer networking; Design, configure and manage computer networks while taking into account application needs; Identify large scale distributed and parallel applications, the problems occurring with these applications and propose solutions; Carry out distributed applications by implementing the appropriate techniques; Understand the characteristics of distributed systems: parallelism, synchronisation, communication, error and threat models; Use appropriate techniques, algorithms and languages to design, model and analyse distributed applications; Understand and implement mechanisms (cryptography, protocols) to secure networks and distributed systems.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2142</td>
<td>Computer networks: configuration and management</td>
<td>Olivier Bonaventure</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2146</td>
<td>Mobile and Embedded Computing</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2347</td>
<td>Computer system security</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2143</td>
<td>Concurrent systems : models and analysis</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2144</td>
<td>Secured systems engineering</td>
<td>Axel Legay</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2315</td>
<td>Design of Embedded and real-time systems</td>
<td>Jean-Didier Legat</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2348</td>
<td>Information theory and coding</td>
<td>Jérôme Louveaux, Benoît Macq, Olivier Pereira</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modelling</td>
<td>Philippe Chevalier, Raphaël Jungers (compensates Philippe Chevalier)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LMAT2450</td>
<td>Cryptography</td>
<td>Olivier Pereira</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LSINF2345</td>
<td>Languages and algorithms for distributed Applications</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2355</td>
<td>Multicore programming</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LELEC2770</td>
<td>Privacy Enhancing technology</td>
<td>Olivier Pereira (coord.), François-Xavier Standaert</td>
<td>5</td>
<td>1q</td>
</tr>
</tbody>
</table>

**The student shall select**

De 20 à 30 credits parmi

### Contenu:

#### Required courses in Networking and Security

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2142</td>
<td>Computer networks: configuration and management</td>
<td>Olivier Bonaventure</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2146</td>
<td>Mobile and Embedded Computing</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2347</td>
<td>Computer system security</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>

#### Elective courses in Networking and Security

The student can select 10 credits amongst

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2143</td>
<td>Concurrent systems : models and analysis</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2144</td>
<td>Secured systems engineering</td>
<td>Axel Legay</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2315</td>
<td>Design of Embedded and real-time systems</td>
<td>Jean-Didier Legat</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2348</td>
<td>Information theory and coding</td>
<td>Jérôme Louveaux, Benoît Macq, Olivier Pereira</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modelling</td>
<td>Philippe Chevalier, Raphaël Jungers (compensates Philippe Chevalier)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LMAT2450</td>
<td>Cryptography</td>
<td>Olivier Pereira</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LSINF2345</td>
<td>Languages and algorithms for distributed Applications</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2355</td>
<td>Multicore programming</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LELEC2770</td>
<td>Privacy Enhancing technology</td>
<td>Olivier Pereira (coord.), François-Xavier Standaert</td>
<td>5</td>
<td>1q</td>
</tr>
</tbody>
</table>
DATA SCIENCE AND APPLIED MATHEMATICS

Students completing the major “Data science and Applied Mathematics” must be able to:

- Understand engineering fields requiring synergy between applied mathematics and computer science such as algorithms, scientific calculations, modelling computer systems, optimisation, machine learning or data mining;
- Understand and put to good use algorithms and techniques used in data science;
- Identify and implement models and techniques relating to statistics, machine learning and data mining;
- Learn classes of applications such as the treatment of noisy data, pattern recognition or automatic extraction in large data collections.

This option is limited to students who have taken the INFO/MAP major/minor pairing or the SINF Bachelor’s degree program with the equivalent of a minor in mathematics. The student shall select

De 20 à 30 credits parmi

### Required courses in Computing and Applied Mathematics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title &amp; Classification and evaluation</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2262</td>
<td>Machine Learning : classification and evaluation</td>
<td>Pierre Dupont</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel, Jean-Charles Delvenne (coord.), Gautier Kriings (compensates Vincent Blondel)</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2710</td>
<td>Scientific computing</td>
<td>Pierre-Antoine Ablal (coord.), Anthony Papavasiliou, Dirk Roose (compensates Anthony Papavasiliou)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LSINF2275</td>
<td>Data mining &amp; decision making</td>
<td>Marco Saerens</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>

### Elective courses in computing and applied mathematics

The student can select 10 credits amongst

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title &amp; Classification and evaluation</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIELE2670</td>
<td>Machine Learning : regression, dimensionality reduction and data visualization</td>
<td>John Lee (compensates Michel Verleysen)</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2266</td>
<td>Advanced Algorithms for Optimization</td>
<td>Pierre Schaus</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2348</td>
<td>Information theory and coding</td>
<td>Jérôme Louveaux, Benoit Maq, Olivier Pereira</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2365</td>
<td>Constraint programming</td>
<td>Yves Deville, Pierre Schaus, Pierre Schaus (compensates Yves Deville)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2450</td>
<td>Combinatorial optimization</td>
<td>Jean-Charles Delvenne (coord.), Julien Hendrickx</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modelling</td>
<td>Philippe Chevalier, Raphael Jungers (compensates Philippe Chevalier)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2471</td>
<td>Optimization models and methods II</td>
<td>François Glineur</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LMECA2170</td>
<td>Cryptography</td>
<td>Olivier Pereira</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LMECA2170</td>
<td>Numerical Geometry</td>
<td>Vincent Legat, Jean-François Remacle</td>
<td>5</td>
<td>1q</td>
</tr>
</tbody>
</table>
**MAJOR: BUSINESS RISKS AND OPPORTUNITIES**

This major is not available in English and may not be taken at the same time as the major "Interdisciplinary program in entrepreneurship - CPME"

*De 16 à 20 credits parmi*

### Contenu:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFSA1290</td>
<td>Introduction to financial and accounting management</td>
<td>Philippe Grégoire</td>
<td>4</td>
<td>2q</td>
</tr>
<tr>
<td>LFSA2140</td>
<td>Elements of law for industry and research</td>
<td>Vincent Cassiers, Werner Derijcke, Bénédicte Ingels</td>
<td>3</td>
<td>1q</td>
</tr>
<tr>
<td>LFSA2210</td>
<td>Organisation and human resources</td>
<td>John Cultiaux, Eline Jammaers</td>
<td>3</td>
<td>2q</td>
</tr>
<tr>
<td>LFSA2230</td>
<td>Introduction to management and to business economics</td>
<td>Benoît Gailly</td>
<td>4</td>
<td>2q</td>
</tr>
<tr>
<td>LFSA2245</td>
<td>Environment and business</td>
<td>Jean-Pierre Tack</td>
<td>3</td>
<td>1q</td>
</tr>
</tbody>
</table>

### One course between

*De 3 à 5 credits parmi*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFSA2202</td>
<td>Ethics and ICT</td>
<td>Axel Gosseries, Olivier Pereira</td>
<td>3</td>
<td>2q</td>
</tr>
<tr>
<td>LLSMS2280</td>
<td>Business Ethics and Compliance Management</td>
<td>Carlos Desmet</td>
<td>5</td>
<td>1q</td>
</tr>
</tbody>
</table>

### 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.
### INTERFACULTY MAJOR IN SMALL AND MEDIUM SIZED BUSINESS CREATION

In keeping with most of the Masters’ degrees in civil engineering, the goal of this major is to familiarize the civil engineering 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 20 Masters (8 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](http://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”.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title (in French)</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Hours</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2001</td>
<td>Entrepreneurship Theory</td>
<td>Blanche Havenne &lt;br&gt; (compensates Frank Janssen) Frank Janssen</td>
<td>5</td>
<td>30h+20h</td>
<td>1q x</td>
</tr>
<tr>
<td>LCPME2002</td>
<td>Managerial, legal and economic aspects of the creation of a company (in French)</td>
<td>Yves De Cordt &lt;br&gt; Marine Falize</td>
<td>5</td>
<td>30h+15h</td>
<td>1q x</td>
</tr>
<tr>
<td>LCPME2003</td>
<td>Business plan of the creation of a company (in French)</td>
<td>Frank Janssen</td>
<td>5</td>
<td>30h+15h</td>
<td>2q x</td>
</tr>
<tr>
<td>LCPME2004</td>
<td>Advanced seminar on Entrepreneurship (in French)</td>
<td>Frank Janssen</td>
<td>5</td>
<td>30h+15h</td>
<td>2q x</td>
</tr>
</tbody>
</table>

**Prerequisite CPME courses**

Student who have not taken management courses during their previous studies must enroll in LCPME2000.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Hours</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2000</td>
<td>Venture creation financement and management I</td>
<td>Yves De Rongé &lt;br&gt; Olivier Giacomin</td>
<td>5</td>
<td>30h+15h</td>
<td>1q x</td>
</tr>
</tbody>
</table>
ELECTIVE COURSES: TRANSVERSAL SKILLS AND CONTACTS WITH INDUSTRY

- **Mandatory**
- **Optional**
- **Courses not taught during 2019-2020**
- **Periodic courses not taught during 2019-2020**
- **Activity with requisites**

The student chooses between 3 and 21 credits (max 26 if the student chooses the internship) in this list below or in the courses of the major "business risks and opportunities". An alternative is to choose the Major in small and medium sized business creation.

### Year 1

**Contenu:**

#### Transversal skills and contacts with industry

The student chooses 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
  - Period: 30h
  - Credits: 10
  - Instructor: Jean-Pierre Raskin

**Professional integration activity specific to the program**

- **LINGI2399** Industrial seminar in computer science
  - Period: 30h
  - Credits: 3
  - Instructor: Yves Deville, Bernard Geubelle

- **LINGI2402** Open Source Project
  - Period: 30h
  - Credits: 5

**Communication**

- **max=8 credits parmi**

#### 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
  - Period: 30h
  - Credits: 3
  - Instructor: Caroline Klein, Ann Rinder (coord.)

- **LALLE2501** Professional development seminar-German
  - Period: 30h
  - Credits: 5
  - Instructor: Caroline Klein, Ann Rinder (coord.)

- **LESPA2600** Vocational Induction Seminar - Spanish (B2.2/C1)
  - Period: 30h
  - Credits: 3
  - Instructor: Paula Lorente Fernandez (coord.), Alicia Maria Tirado Fernandez (compensates Paula Lorente Fernandez)

- **LESPA2601** Vocational Induction Seminar - Spanish (B2.2/C1)
  - Period: 30h
  - Credits: 5
  - Instructor: Paula Lorente Fernandez (coord.), Alicia Maria Tirado Fernandez (compensates Paula Lorente Fernandez)

- **LNEER2500** Seminar of Entry to professional life in Dutch - Intermediate level
  - Period: 30h
  - Credits: 3
  - Instructor: Isabelle Demeulenaere (coord.), Marie-Laurence Lambrecht

- **LNEER2600** Seminar of entry to professional life in Dutch - Upper-intermediate level
  - Period: 30h
  - Credits: 3
  - Instructor: Isabelle Demeulenaere (coord.)

**Group dynamics**

- **LEPL2351** Dynamique des groupes - Q1
  - Period: 15h+30h
  - Credits: 3
  - Instructor: Christine Jacqmot, Benoît Raucanet, Vincent Wertz (coord.)

- **LEPL2352** Dynamique des groupes - Q2
  - Period: 15h+30h
  - Credits: 3
  - Instructor: Christine Jacqmot, Benoît Raucanet, Vincent Wertz (coord.)

**Other non-disciplinary courses**

The student may further select maximum 8 credits in other disciplines.
ELECTIVE COURSES AVAILABLE FOR MASTER STUDENTS IN COMPUTER SCIENCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Mandatory</th>
<th>Optional</th>
<th>Periodic courses not taught during 2019-2020</th>
<th>Activity with requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contenu:

- **LINGI2401**: Open Source strategy for software development
  - Farmer: Lionel Dricot
  - 30h+15h
  - 5 Credits
  - 1q

- **LINGI2402**: Open Source Project
  - 5 Credits
  - 1 + 2q

Course prerequisites

A document entitled en-prerequis-2019-sinf2m.pdf specifies the activities (course units - CU) with one or more pre-requisite(s) within the study programme, that is the CU whose learning outcomes must have been certified and for which the credits must have been granted by the jury before the student is authorised to sign up for that activity.

These activities are identified in the study programme: their title is followed by a yellow square.

As the prerequisites are a requirement of enrolment, there are none within a year of a course.

The prerequisites are defined for the CUs for different years and therefore influence the order in which the student can enrol in the programme's CUs.

In addition, when the panel validates a student’s individual programme at the beginning of the year, it ensures the consistency of the individual programme:

- It can change a prerequisite into a corequisite within a single year (to allow studies to be continued with an adequate annual load);
- It can require the student to combine enrolment in two separate CUs it considers necessary for educational purposes.

For more information, please consult regulation of studies and exams.

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?”

The document is available by clicking this link after being authenticated with UCL account.
Admission

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

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

SUMMARY

• > Specific Admission Requirements
• > University Bachelors
• > Non university Bachelors
• > Holders of a 2nd cycle University degree
• > Holders of a non-University 2nd cycle degree
• > Adults taking up their university training
• > Access on the file
• > Admission and Enrolment Procedures for general registration

Specific Admission 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 personalized access.

University Bachelors

<table>
<thead>
<tr>
<th>Diploma</th>
<th>Special Requirements</th>
<th>Access</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLouvain Bachelors</td>
<td>(unknown URL)</td>
<td>Direct Access</td>
<td></td>
</tr>
<tr>
<td>(unknown URL)</td>
<td>Minor in computer science</td>
<td>Access with additional training</td>
<td>maximum 60 additional credits integrated into their Master’s degree programme</td>
</tr>
<tr>
<td>(unknown URL)</td>
<td>(unknown URL)</td>
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<td></td>
</tr>
<tr>
<td>(unknown URL)</td>
<td>(unknown URL)</td>
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</tr>
</tbody>
</table>

Others Bachelors of the French speaking Community of Belgium

Bachelor in computer science

Bachelors of the Dutch speaking Community of Belgium

Bachelor in de informatica

Foreign Bachelors

Bachelor in computer science

Based on application: accepted, conditional on further training, or refusal

See "Personalized Access"

Non university Bachelors

> Find out more about links to the university

<table>
<thead>
<tr>
<th>Diploma</th>
<th>Access</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA en informatique de gestion - EPS - crédits supplémentaires entre 30 et 60</td>
<td>Les enseignements supplémentaires éventuels peuvent être consultés dans le module complémentaire.</td>
<td></td>
</tr>
<tr>
<td>BA en informatique de gestion - HE - crédits supplémentaires entre 30 et 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA en informatique et systèmes (informatique industrielle) - EPS - crédits supplémentaires entre 30 et 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA en informatique et systèmes (informatique industrielle) - HE - crédits supplémentaires entre 30 et 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA en informatique et systèmes (réseaux et télécommunications) - EPS - crédits supplémentaires entre 30 et 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA en informatique et systèmes (réseaux et télécommunications) - HE - crédits supplémentaires entre 30 et 60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type court
Holders of a 2nd cycle University degree

<table>
<thead>
<tr>
<th>Diploma</th>
<th>Special Requirements</th>
<th>Access</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Licenciés&quot;</td>
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<td></td>
</tr>
<tr>
<td>&quot;Licencié en informatique&quot;</td>
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<td>-</td>
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<tr>
<td>Masters</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Master in computer science</td>
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<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Holders of a non-University 2nd cycle degree

Adults taking up their university training

> 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 on the file

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.

Admission and Enrolment Procedures for general registration
To enrol for this Masters, the student must have a good command of certain subjects. If this is not the case, they must add preparatory modules to their Master’s programme.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBIR1212</td>
<td>Probabilities and statistics (I)</td>
<td>Patrick Bogaert</td>
<td>4</td>
<td>1q</td>
</tr>
<tr>
<td>LBIR1315</td>
<td>Probability and statistics II</td>
<td>Patrick Bogaert</td>
<td>3</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI1101</td>
<td>Discrete mathematics: logical foundations of computing science</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI1122</td>
<td>Program conception methods</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI1123</td>
<td>Computability and complexity</td>
<td>Yves Deville</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI1131</td>
<td>Computer language concepts</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI1341</td>
<td>Computer networks</td>
<td>Olivier Bonaventure</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LSINF1121</td>
<td>Algorithmics and data structures</td>
<td>Pierre Schaus</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINFO1114</td>
<td>Mathématiques discrètes</td>
<td>Marco Saerens</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>

Courses for students coming from bachelor in "informatique de gestion" or "informatique et systèmes". These students will have to take at least 150 credits to obtain the master in computer science.
Teaching method

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 complex socio-economic environment in which computer science belongs. It is therefore suggested that students learn about disciplines through elective courses or certain major courses such as the interfaculty major "small and medium sized business creation".

Evaluation

The evaluation methods comply with the regulations concerning studies and exams. More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading “Learning outcomes evaluation method”.

The learning activities are assessed according to the rules of the University (see exam regulations), that is through written and oral exams, personal or group assignments, public presentation of projects and defence of the graduation thesis. For the courses given in English, questions will be expressed in English by the teacher, but the student may choose to answer in French. For the courses given in French, the questions will be expressed in French by the teacher, but the student may ask for help in translation and choose to answer in English.

Some activities such as projects during the semester under the supervision of the teaching staff and in collaboration with other students are not reorganized outside the period prescribed for the course. They are not re-evaluated at a later session.

Evaluation methods specific to each course are communicated to students by teachers at the beginning of the semester.

Possible trainings at the end of the programme

- Accessible supplementary masters : not applicable.
- Accessible doctoral programmes:
  The master in computer science engineering opens access to a Doctorate in Engineering (doctorat en sciences appliquées). In this context, doctoral students are enrolled in one of the thematic doctoral schools.

Contacts

Curriculum Management

Entity
Structure entity: SST/EPL/INFO
Denomination: (INFO)
Faculty: Louvain School of Engineering (EPL)
Sector: Sciences and Technology (SST)
Acronym: INFO
Postal address: Place Sainte Barbe 2 - bte L5.02.01
1348 Louvain-la-Neuve
Tel: +32 (0)10 47 31 50 - Fax: +32 (0)10 45 03 45

Academic supervisor: Charles Pecheur
Jury

• Président du Jury: Jean-Didier Legat
• Secrétaire du Jury: Ramin Sadre

Usefull Contact(s)

• Conseillère aux études: Sofie De Pauw