SINF2M
2017 - 2018

Master [120] in Computer Science

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 code: 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-2017-sinf2m-lsinf220t.html ]
> Professional focus [ en-prog-2017-sinf2m-lsinf220s ]

Options courses

> Options en sciences informatiques [ en-prog-2017-sinf2m-lsinf920r.html ]
  > Major in Artificial Intelligence: big data, optimization and algorithms [ en-prog-2017-sinf2m-lsinf9230.html ]
  > Major in Security and Networking [ en-prog-2017-sinf2m-lsinf2250.html ]
  > Data science and Applied Mathematics [ en-prog-2017-sinf2m-lsinf2260.html ]
  > Major: Business creation and management [ en-prog-2017-sinf2m-lsinf910r.html ]
  > Major: Business risks and opportunities [ en-prog-2017-sinf2m-lsinf2300.html ]
  > Interfaculty major in small and medium sized business creation [ en-prog-2017-sinf2m-lsinf2270.html ]
> Cours aux choix [ en-prog-2017-sinf2m-lsinf930r.html ]
  > Elective courses [ en-prog-2017-sinf2m-lsinf9220.html ]
  > Cours au choix en sciences informatiques [ en-prog-2017-sinf2m-lsinf9230.html ]
### Programme by subject

#### CORE COURSES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Period</th>
<th>Coordinator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSINF2990</td>
<td>Graduation project/End of studies project</td>
<td>28</td>
<td>2</td>
<td>Charles Pecheur (coord.)</td>
</tr>
</tbody>
</table>

#### Religion courses for students in natural sciences (2 credits)

For students who did their bachelor at UCL

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Period</th>
<th>Coordinator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTECO2100</td>
<td>Questions of religious sciences: Biblical readings</td>
<td>2</td>
<td>1q</td>
<td>Hans Ausloos</td>
</tr>
<tr>
<td>LTECO2200</td>
<td>Questions of religious sciences: reflections about Christian faith</td>
<td>2</td>
<td>2q</td>
<td>Dominique Martens</td>
</tr>
<tr>
<td>LTECO2300</td>
<td>Questions of religious sciences: questions about ethics</td>
<td>2</td>
<td>1q</td>
<td>Marcela Lobo Bustamante</td>
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</table>

#### Human Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Period</th>
<th>Coordinator(s)</th>
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<tbody>
<tr>
<td>LFSA2210</td>
<td>Organisation and human resources</td>
<td>3</td>
<td>2q</td>
<td>John Cultiaux</td>
</tr>
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</table>

#### Computer science seminars

Students may choose 3 credits among

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Period</th>
<th>Coordinator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2349</td>
<td>Networking and security seminar</td>
<td>3</td>
<td>1q</td>
<td>Etienne Riviere Ramin Sadre (coord.)</td>
</tr>
<tr>
<td>LINGI2359</td>
<td>Software engineering and programming systems seminar</td>
<td>3</td>
<td>1q</td>
<td>Kim Mens</td>
</tr>
<tr>
<td>LINGI2369</td>
<td>Artificial intelligence and machine learning seminar</td>
<td>3</td>
<td>1q</td>
<td>Pierre Dupont Siegfried Nijssen (compensates Pierre Schaus) Pierre Schaus</td>
</tr>
</tbody>
</table>
**PROFESSIONAL FOCUS [30.0]**

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Courses not taught during 2017-2018</th>
<th>Mandatory</th>
<th>Courses not taught during 2017-2018</th>
<th>Periodic courses taught during 2017-2018</th>
<th>Activity with requisites</th>
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</thead>
</table>

- Students must take all final specialisation courses.

### Computer science courses

<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>LINGI2132</td>
<td>Languages and translators</td>
<td>Pierre Schaus</td>
<td>36</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2172</td>
<td>Databases</td>
<td>Siegfried Nijssen</td>
<td>36</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2241</td>
<td>Architecture and performance of computer systems</td>
<td>Ramin Sadre</td>
<td>36</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2261</td>
<td>Artificial intelligence: representation and reasoning</td>
<td>Yves Deville</td>
<td>36</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2255</td>
<td>Software engineering project</td>
<td>Kim Mens</td>
<td>36</td>
<td>1q</td>
</tr>
</tbody>
</table>

Click on the course title to see detailed informations (objectives, methods, evaluation...).
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-2017-sinf2m-lsinf223o]
> Major in Security and Networking [en-prog-2017-sinf2m-lsinf225o]
> Data science and Applied Mathematics [en-prog-2017-sinf2m-lsinf226o]

Major in business creation and management

> Major: Business risks and opportunities [en-prog-2017-sinf2m-lsinf230o]
> Interfaculty major in small and medium sized business creation [en-prog-2017-sinf2m-lsinf227o]

Cours aux choix

> Elective courses [en-prog-2017-sinf2m-lsinf922o]
> Cours au choix en sciences informatiques [en-prog-2017-sinf2m-lsinf923o]

OPTIONS EN SCIENCES INFORMATIQUES

MAJOR IN ARTIFICIAL INTELLIGENCE: BIG DATA, OPTIMIZATION AND ALGORITHMS

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

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</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>LINGI2263</td>
<td>Computational Linguistics</td>
<td>Pierre Dupont Cédric Faión</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>LINGI2365</td>
<td>Constraint programming</td>
<td>Yves Deville Pierre Schaus (compensates Yves Deville)</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>

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

The student shall select

De 20 à 30 credits parmi
### Elective courses in Artificial Intelligence

The student selects 10 credits among

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>LELEC2870</td>
<td>Machine Learning: regression, dimensionality reduction and data visualization</td>
<td>John Lee (compensates Michel Verleysen) 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>LGBIO22010</td>
<td>Bioinformatics</td>
<td>Pierre Dupont Michel Ghislain</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Niessen</td>
<td>5</td>
<td>1q</td>
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<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>
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<tr>
<td>LINMA1702</td>
<td>Optimization models and methods I</td>
<td>François Glineur</td>
<td>5</td>
<td>2q</td>
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<tr>
<td>LINMA2450</td>
<td>Combinatorial optimization</td>
<td>Jean-Charles Delvenne (coord.) Julien Hendrickx</td>
<td>5</td>
<td>1q</td>
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<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel Jean-Charles Delvenne (coord.) Gautier Krings</td>
<td>5</td>
<td>1q</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>
# 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>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
<th>Quartier</th>
<th>Exemption</th>
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</thead>
<tbody>
<tr>
<td>LINGI2143</td>
<td>Concurrent systems : models and analysis</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>1</td>
<td>x</td>
<td>x</td>
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<tr>
<td>LINGI2251</td>
<td>Software Quality Assurance</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>2</td>
<td>x</td>
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<tr>
<td>LINGI2252</td>
<td>Software Maintenance and Evolution</td>
<td>Kim Mens</td>
<td>5</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LSINF2345</td>
<td>Languages and algorithms for distributed Applications</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>2</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

The student shall select
De 20 à 30 credits parmi

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
<th>Quartier</th>
<th>Exemption</th>
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<tbody>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>2</td>
<td>x</td>
<td>x</td>
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<tr>
<td>LINGI2347</td>
<td>Computer system security</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2</td>
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<td>x</td>
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<tr>
<td>LINGI2355</td>
<td>Advanced questions in software engineering</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>5</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LINGI2365</td>
<td>Constraint programming</td>
<td>Yves Deville, Pierre Schaus</td>
<td>5</td>
<td>2</td>
<td>x</td>
<td>x</td>
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<tr>
<td>LSINF2335</td>
<td>Programming paradigms</td>
<td>Kim Mens</td>
<td>5</td>
<td>2</td>
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<td>x</td>
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<tr>
<td>LSINF2382</td>
<td>Computer supported collaborative work</td>
<td>Jean Vanderdonckt</td>
<td>5</td>
<td>2</td>
<td>x</td>
<td>x</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.

#### Mandatory Courses

- **LINGI2142** Computer networks: configuration and management
  - Olivier Bonaventure
  - 30h+30h
  - 5 Credits
  - 2q
- **LINGI2145** Cloud Computing
  - Etienne Riviere
  - 30h+15h
  - 5 Credits
  - 2q
- **LINGI2146** Mobile and Embedded Computing
  - Ramin Sadre
  - 30h+15h
  - 5 Credits
  - 2q
- **LINGI2347** Computer system security
  - Ramin Sadre
  - 30h+15h
  - 5 Credits
  - 2q

#### Mandatory Courses

- **LINGI2143** Concurrent systems : models and analysis
  - Charles Pecheur
  - 30h+15h
  - 5 Credits
  - 1q
- **LINGI2144** Secured systems engineering
  - Gildas Avoine
  - 30h+15h
  - 5 Credits
  - 1q
- **LINGI2315** Design of Embedded and real-time systems
  - Jean-Didier Legat
  - 30h+30h
  - 5 Credits
  - 2q
- **LINGI2348** Information theory and coding
  - Jérôme Louveaux (coord.) Benoît Macq Olivier Pereira
  - 30h+15h
  - 5 Credits
  - 2q
- **LINMA2470** Stochastic modelling
  - Philippe Chevalier
  - 30h+22.5h
  - 5 Credits
  - 2q
- **LMAT2450** Cryptography
  - Olivier Pereira
  - 30h+15h
  - 5 Credits
  - 1q
- **LSINF2345** Languages and algorithms for distributed Applications
  - Peter Van Roy
  - 30h+15h
  - 5 Credits
  - 2q

The student shall select

De 20 à 30 credits parmi

#### Required courses in Networking and Security

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Duration</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2142</td>
<td>Computer networks: configuration and management</td>
<td>Olivier Bonaventure</td>
<td>5</td>
<td>30h+30h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2146</td>
<td>Mobile and Embedded Computing</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</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>
</tbody>
</table>

#### Elective courses in Networking and Security

The student can select 10 credits amongst

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Duration</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>LINGI2144</td>
<td>Secured systems engineering</td>
<td>Gildas Avoine</td>
<td>5</td>
<td>30h+15h</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2315</td>
<td>Design of Embedded and real-time systems</td>
<td>Jean-Didier Legat</td>
<td>5</td>
<td>30h+30h</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2348</td>
<td>Information theory and coding</td>
<td>Jérôme Louveaux (coord.) Benoît Macq Olivier Pereira</td>
<td>5</td>
<td>30h+15h</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modelling</td>
<td>Philippe Chevalier</td>
<td>5</td>
<td>30h+22.5h</td>
<td>2q</td>
</tr>
<tr>
<td>LMAT2450</td>
<td>Cryptography</td>
<td>Olivier Pereira</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>2q</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.

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Optional</th>
</tr>
</thead>
</table>

**Courses not taught during 2017-2018**

- **Periodic courses not taught during 2017-2018**
- **Activity with requisites**

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</th>
<th>Instructor</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2262</td>
<td>Machine Learning :classification and evaluation</td>
<td>Pierre Dupont</td>
<td>30h+30h</td>
<td>5</td>
</tr>
<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel, Jean-Charles Delvenne (coord.), Gautier Krings</td>
<td>30h +22.5h</td>
<td>5</td>
</tr>
<tr>
<td>LINMA2710</td>
<td>Scientific computing</td>
<td>Pierre-Antoine Absil (coord.), Anthony Papavasiliou</td>
<td>30h +22.5h</td>
<td>5</td>
</tr>
<tr>
<td>LSINF2275</td>
<td>Data mining &amp; decision making</td>
<td>Marco Saerens</td>
<td>30h+15h</td>
<td>2</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</th>
<th>Instructor</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>30h+30h</td>
<td>5</td>
</tr>
<tr>
<td>LINGI2266</td>
<td>Advanced Algorithms for Optimization</td>
<td>Pierre Schaus</td>
<td>30h+15h</td>
<td>5</td>
</tr>
<tr>
<td>LINGI2348</td>
<td>Information theory and coding</td>
<td>Jérôme Louveaux (coord.), Benoit Macq, Olivier Pereira</td>
<td>30h+15h</td>
<td>5</td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>30h+15h</td>
<td>5</td>
</tr>
<tr>
<td>LINGI2365</td>
<td>Constraint programming</td>
<td>Yves Deville, Pierre Schaus (compensates Yves Deville)</td>
<td>30h+15h</td>
<td>5</td>
</tr>
<tr>
<td>LINMA2450</td>
<td>Combinatorial optimization</td>
<td>Jean-Charles Delvenne (coord.), Julien Hendrickx</td>
<td>30h +22.5h</td>
<td>5</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modeling</td>
<td>Philippe Chevalier</td>
<td>30h +22.5h</td>
<td>5</td>
</tr>
<tr>
<td>LINMA2471</td>
<td>Optimization models and methods II</td>
<td>François Glineur</td>
<td>30h +22.5h</td>
<td>5</td>
</tr>
<tr>
<td>LMAT2450</td>
<td>Cryptography</td>
<td>Olivier Pereira</td>
<td>30h+15h</td>
<td>5</td>
</tr>
<tr>
<td>LMECA2170</td>
<td>Numerical Geometry</td>
<td>Vincent Legat, Jean-François Remacle</td>
<td>30h+30h</td>
<td>5</td>
</tr>
</tbody>
</table>
# MAJOR IN BUSINESS CREATION AND MANAGEMENT

## MAJOR: BUSINESS RISKS AND OPPORTUNITIES

This major is not open to students enrolled in the major in small and medium sized business creation. This major is not offered in English.

The purpose of this major is to familiarise engineering students with the basic principles of business management.

<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>LFSA1290</td>
<td>Introduction to financial and accounting management</td>
<td>André Nsabimana (compensates Gerrit Sarens) Gerrit Sarens</td>
<td>4</td>
<td>2q</td>
</tr>
<tr>
<td>LFSA2140</td>
<td>Elements of law for industry and research</td>
<td>Werner Derijcke Bénédicte Inghels Christophe Lazaro</td>
<td>3</td>
<td>1q</td>
</tr>
<tr>
<td>LFSA2210</td>
<td>Organisation and human resources</td>
<td>John Cultiaux</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>3</td>
<td>2q</td>
</tr>
<tr>
<td>LFSA2245</td>
<td>Environment and business</td>
<td>Thierry Bréchet Jean-Pierre Tack</td>
<td>3</td>
<td>2q</td>
</tr>
</tbody>
</table>

### The student who chooses this option shall select

De 16 à 20 credits parmi

<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>LFSA2202</td>
<td>Ethics and ICT</td>
<td>Axel Gossieres Olivier Pereira</td>
<td>3</td>
<td>2q</td>
</tr>
<tr>
<td>LLMS2280</td>
<td>Business Ethics and Compliance Management</td>
<td>Carlos Desmet</td>
<td>5</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 Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFSA2202</td>
<td>Ethics and ICT</td>
<td>Axel Gossieres Olivier Pereira</td>
<td>3</td>
<td>2q</td>
</tr>
<tr>
<td>LLMS2280</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

This major is not open to students enrolled in the business risks and opportunities major. This major is not offered in English.

The goal of this major is to familiarise the civil engineering student with the specifics of small and medium sized businesses, entrepreneurship, and business development in order to develop the necessary abilities, knowledge and tools to create a business. This major is reserved for a small number of students and selection is based on a written application and individual interview. The written application must be submitted before the start of the academic year for Master’s 1.

Applications may be sent to:
Secrétariat CPME-Place des Doyens, 1
1348 Louvain-la-Neuve (tel. 010/47 84 59)

Selected students will replace their Master’s thesis in the common core curriculum with a thesis related to business creation (the number of credits remaining the same).

Further information about this major may be found at http://www.uclouvain.be/cpme. This major may not be taken at the same time as a major in management. Students in this major may choose 20-25 credits from the following courses:

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title (in French)</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2001</td>
<td>Entrepreneurship Theory</td>
<td>Frank Janssen</td>
<td>5</td>
<td>1q</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, Marine Falize</td>
<td>5</td>
<td>1q</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>2q</td>
</tr>
<tr>
<td>LCPME2004</td>
<td>Advanced seminar on Entrepreneurship (in French)</td>
<td>Roxane De Hoe (compensates Frank Janssen)</td>
<td>5</td>
<td>2q</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>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2000</td>
<td>Venture creation financement and management</td>
<td>Yves De Rongé, Olivier Giacomin</td>
<td>5</td>
<td>1q</td>
</tr>
</tbody>
</table>

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

**Mandatory Courses not taught during 2017-2018**

- Courses not taught during 2017-2018
- Periodic courses not taught during 2017-2018

**Optional Courses**

- Activity with requisites

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

#### De 3 à 21 credits parmi

- **Compétences transversales et contact avec l’entreprise**

L’étudiant choisit minimum 3 crédits parmi un stage, un ou plusieurs cours de l’option “Enjeux de l’entreprise”, l’option “CPME”, une UE d'activité professionnelle liée à la discipline

min=3 credits parmi

<table>
<thead>
<tr>
<th>Internship</th>
<th>Company Internship</th>
<th>Jean-Pierre Raskin</th>
<th>10 Credits</th>
<th>1 + 2q</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFSA2995</td>
<td>Company Internship</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LFSA2996</td>
<td>Company Internship</td>
<td></td>
<td>5 Credits</td>
<td>1 + 2q</td>
<td>x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Professional integration activity specific to the program</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2399 Industrial seminar in computer science</td>
</tr>
<tr>
<td>LINGI2402 Open Source Project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
</tr>
</thead>
</table>

L’étudiant choisit maximum 8 crédits visant le développement de ses compétences de communication

max=8 credits parmi

<table>
<thead>
<tr>
<th>Languages</th>
</tr>
</thead>
</table>

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

- Professional development seminar German
- Professional development seminar-German
- Vocational Induction Seminar - Spanish (B2.2/C1)
- Vocational Induction Seminar - Spanish (B2.2/C1)
- Seminar of Entry to professional life in Dutch - Intermediate level
- Seminar of entry to professional life in Dutch - Upper-Intermediate level

<table>
<thead>
<tr>
<th>Group dynamics</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Group dynamics</th>
<th>Group dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFS2351A</td>
<td>LFS2351B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Autre UE non disciplinaires</th>
</tr>
</thead>
</table>

L’étudiant peut proposer maximum 8 crédits d'ouverture vers d’autres disciplines (maximum un cours BEST ou des UE hors EPL).

max=8 credits parmi
COURS AU CHOIX EN SCIENCES INFORMATIQUES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Teacher</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINGI2401</td>
<td>Open Source strategy for software development</td>
<td>Lionel Dricot</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINGI2402</td>
<td>Open Source Project</td>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Course prerequisites

A document entitled en-prerequis-2017-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 UCL 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

Erreur de transformation xhtml vers fo pour 'cond_admission' erreur=org.xml.sax.SAXParseException; lineNumber: 285; columnNumber: 90; The prefix "o" for element "o:p" is not bound.
Supplementary classes

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.

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.

<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>LBIR1121</td>
<td>Probabilities and statistics (I)</td>
<td>Patrick Bogaert</td>
<td>4</td>
<td>1q</td>
</tr>
<tr>
<td>LBIR1304</td>
<td>Probability and statistics (II)</td>
<td>Patrick Bogaert</td>
<td>3</td>
<td>1q</td>
</tr>
<tr>
<td>LING1101</td>
<td>Discrete mathematics: logical foundations of computing science</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LING1122</td>
<td>Program conception methods</td>
<td>Charles Pecheur</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LING1123</td>
<td>Computability and complexity</td>
<td>Yves Deville</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LING1131</td>
<td>Computer language concepts</td>
<td>Peter Van Roy</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LING1341</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>LSINF1250</td>
<td>Mathematics for computer science</td>
<td>Marco Saerens</td>
<td>7</td>
<td>1q</td>
</tr>
</tbody>
</table>
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.

Mobility and/or Internationalisation outlook

Outgoing Students
Since their creation, the Louvain School of Engineering (EPL) has participated in various exchange programmes in Europe and worldwide.

Students may first become interested in such exchanges at the end of their Bachelor’s degree programme mainly through intensive courses offered as part of the ATHENS or BEST networks. These networks are also open to students in the Master’s degree programme and provide an initial experience in international education.

In addition, in the context of the Erasmus and Mercator exchange programmes, students have the possibility of studying at a partner university typically for one year (two semesters) in the first year of the Master’s degree programme or five months (first semester) in the second year of the Master’s degree programme. As a result, the EPL is a member of different networks.

- In Belgium, the EPL maintains a privileged partnership with the Faculteit Ingenieurswetenschappen of the Katholieke Universiteit Leuven with which it has developed an exchange programme covering the first year of the Master’s degree.
- At the European level, the EPL is especially involved in the CLUSTER network. This network guarantees quality both in terms of education and in terms of hosting exchange students. Moreover, the CLUSTER partners have signed an agreement to recognize the Bachelor degree programmes of their members. This agreement implies that all Bachelor degree holders from CLUSTER member institutions are subject to the same admission criteria to CLUSTER Master’s degree programmes as local students.
- Outside of Europe, the EPL is a member of the Magalhaes network that joins together around fifteen European universities with the best science and technology universities in Latin America.

In addition to these network partnerships, the EPL has signed a number of individual agreements with various universities in Europe, North America and elsewhere in the world. The list of these agreements can be found on UCL’s International Relations Administration website.

Moreover, several dual degree programmes have also been set up.
Dual Master’s degree agreements allow students to obtain engineering degrees from two universities after they have completed one year at UCL and the other at a host university. In computer science engineering, such agreements have been established with UPC (Barcelona, Spain) and Grenoble (France). Others are currently being negotiated.
Students are informed about the various exchange programmes at the start of the second year of their Bachelor’s degree programme. It is recommended that they prepare for these exchanges well in advance, most notably at the linguistic level through courses at the university’s Language Institute (ILV).

Beyond exchange programmes, students may participate in an internship in a research laboratory or in a company abroad.

More information about exchange programmes at EPL.

Incoming students

As part of the CLUSTER network, foreign students may benefit from exactly the same status and conditions as UCL students, which favours Erasmus exchanges for students coming from network member institutions.

The entire programme is offered in English and can be taken without prior knowledge of French, except for the majors in biomedical engineering, business management and small and medium sized business creation. All courses, except for a few rare exceptions, are given in English. For non-francophone students, alternatives to the courses in French will be proposed by the programme commission on a case-by-case basis according to the student's curriculum.

For more information about exchange programmes at EPL

Possible training 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: Louvain School of Engineering (EPL)
Faculty: Sciences and Technology (SST)
Sector: INFO
Acronym: INFO
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Jury
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- Secrétaire du Jury:

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