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**Course Catalogue**  
**2026-2027**

## **Modules common to all 5 years**

[G-INN-020] Free projects Hub – 3-6 ECTS

[G-CUS-20] Spanish language module – 2 ECTS

### **Semester 1**

[G-CPE-100] Unix & C Lab Seminar I – 5 ECTS

[G-CPE-101] Unix & C Lab Seminar II - 4 ECTS

[G-CPE-110] Elementary Programming in C – 6 ECTS

[G-CUS-100] KYT/CAT – IT Fundamentals – 1 ECTS

[G-CUS-101] KYT/CAT – Professional skills – 1 ECTS

[G-MAT-100] Mathematics – 3 ECTS

[G-MUL-100] C Graphical Programming – 5 ECTS

[G-NSA-100] Fundamentals of system installation – 3 ECTS

[G-PMP-100] Introduction to project management I – 1 ECTS

[G-PSU-100] UNIX system programming – 7 ECTS

### **Semester 2**

[G-AIA-200] Discovery of Data Analysis – 3 ECTS

[G-AIA-210] Introduction to Data Analysis – 5 ECTS

[G-CPE-200] Elementary programming in C – 10 ECTS

[G-CUS-200] KYT/CAT - Fundamentals of Artificial Intelligence – 1 ECTS

[G-CUS-201] KYT/CAT - Fundamentals of Cybersecurity – 1 ECTS

[G-DOP-200] Introduction to DevOps – 3 ECTS

[G-ING-200] Discovery of Software Engineering – 3 ECTS

[G-ING-210] Introduction to Software Engineering – 5 ECTS

[G-MAT-200] Mathematics – 3 ECTS

[G-PMP-200] Introduction to project management – 3 ECTS

[G-PSU-200] Shell programming – 10 ECTS

[G-SEC-200] Discovery of Cyber Security – 3 ECTS

[G-SEC-210] Introduction to Cyber Security – 5 ECTS

[G-WEB-200] Introduction to web development – 3 ECTS

### **Semester 4**

[G-PDG-300] Paradigms Seminar – 7 ECTS

- [G-CCP-400] Concurrent programming – 5 ECTS
- [G-CNA-400] Computer Numerical Analysis – 4 ECTS
- [G-CUS-400] KYT/CAT-Networks & communication – 1 ECTS
- [G-CUS-401] KYT/CAT - Processor Architecture – 1 ECTS
- [G-DOP-400] DevOps – 4 ECTS
- [G-NWP-400] Network programming – 6 ECTS
- [G-OOP-400] Object-oriented programming – 7 ECTS
- [G-PMP-400] Project management – 3 ECTS
- [G-SEC-400] Reverse Engineering & Exploitation – 4 ECTS
- [G-SEC-401] Web Security – 4 ECTS
- [G-AIA-400] Machine Learning – 4 ECTS
- [G-AIA-401] Reinforcement Learning – 4 ECTS
- [G-AIA-410] Prompt Engineering & Automation – 4 ECTS
- [G-ING-400] Legacy Code Management – 4 ECTS
- [G-ING-401] Embedded Programming – 4 ECTS
- [G-YEP-400] Year-end project Zappy – 7 ECTS

## **Semester 5**

- [B-AIA-500] Artificial intelligence – 4 ECTS
- [B-CNA-500] Computer Numerical Analysis – 4 ECTS
- [B-CPP-500] Advanced C++ - 9 ECTS
- [G-CUS-500] KYT/CAT-Algorithms – 1 ECTS
- [G-CUS-501] KYT/CAT-Video games – 1 ECTS
- [B-DEV-500] Application development – 9 ECTS
- [B-DOP-500] Advanced DevOps – 4 ECTS
- [B-FUN-500] Functional Programming – 9 ECTS
- [B-SEC-500] Advanced Security – 4 ECTS
- [B-SVR-500] Survivor seminar – 5 ECTS

## Modules common to all 5 years

### [G-INN-020] Free projects Hub

3-6 ECTS	Free projects Hub		
Duration in hours	Course : N/A	TP/TD : N/A	Project : 50-120
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Technical skills: Programming, web development, application development and use of new tools and technologies.</li> <li>• Teamwork: Collaborate with team members, communicate effectively and distribute tasks.</li> <li>• Problem solving: Develop creative solutions to challenges, think independently and solve problems.</li> <li>• Project management: Plan, organize and manage time and resources to meet deadlines.</li> <li>• Innovation and creativity: Think outside the box and experiment with new ideas.</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Students will need to demonstrate their ability to define a need and establish the technical and organizational steps required to produce a finished project.</li> <li>• Students will be encouraged to explore a technical field on their own, using an experimental approach to develop monitoring and self-learning mechanisms.</li> </ul>		

Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Support from the teaching team and mentors, depending on the project.</li> </ul>
Evaluation methods	<ul style="list-style-type: none"> <li>• Evaluation through regular presentations throughout the project</li> </ul>
Name(s) of person(s) in charge	Fabrice MARCO
Bibliography/ webography	<ul style="list-style-type: none"> <li>• <a href="https://www.epitech.eu/innovation/">https://www.epitech.eu/innovation/</a></li> </ul>

## Semester 1 Modules

### [G-CPE-100] Unix & C Lab Seminar I

5 ECTS	Unix & C Lab Seminar I		
Duration in hours	Course : 10	TP/TD : 4	Project : 90
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• A 3-week introduction to the fundamentals of programming using the C language</li> <li>• Basic use of git and GitHub</li> </ul>		

<p>ECUE content (Main points covered)</p>	<ul style="list-style-type: none"> <li>• Discovering the working environment (Linux, git, GitHub)</li> <li>• Discovering functions, parameters and returns</li> <li>• Conditions, loops and pointers</li> <li>• String manipulation</li> <li>• Compiling via Makefile and creating dynamic libraries</li> </ul>
<p>Teaching methods and/or resources</p>	<ul style="list-style-type: none"> <li>• 13 days, each with a series of exercises to introduce and deepen programming concepts and the C language.</li> <li>• Two one-week mini-projects to apply the concepts covered during the week</li> <li>• Two "rush" periods (short-term projects) in pairs to review the week's progress</li> </ul>
<p>Evaluation methods</p>	<ul style="list-style-type: none"> <li>• Continuous assessment, with each successful exercise contributing to the validation of one or more associated skills.</li> </ul>
<p>Name(s) of person(s) in charge</p>	<p>Leo Sarochar</p>
<p>Bibliography/Webography</p>	<ul style="list-style-type: none"> <li>• <a href="https://www.indeed.com/career-advice/career-development/c-programmingdevelopment/c-programming#:~:text=By%20learning%20C%20you%20can,overall%20concepts%20that%20drive%20programming">https://www.indeed.com/career-advice/career-development/c-programmingdevelopment/c-programming#:~:text=By%20learning%20C%20you%20can,overall%20concepts%20that%20drive%20programming</a></li> <li>• "The C Language - ANSI Standard" (2e edition, 2014) by Brian W. Kernighan and Dennis M. Ritchie</li> </ul>

### [G-CPE-101] Unix & C Lab Seminar II

4 ECTS	Unix & C Lab Seminar II		
Duration in hours	Course : 2	TP/TD : 5	Project : 70
ECUE prerequisites	Basic knowledge of C programming (provided by UE B-CPE100)		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Understand the classic project life cycle at Epitech.</li> <li>• Apply the basic C skills learned in Part 1.</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Creating a program from A to Z</li> <li>• Discovering variation functions</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• An introductory mini-project to lay the foundations for the final project</li> <li>• 1 2-week project to re-implement a current utility in C.</li> </ul>		
Evaluation methods	<ul style="list-style-type: none"> <li>• Competency-based assessment of projects</li> </ul>		
Name(s) of person(s) in charge	Leo Sarochar		

Bibliography/webography	<ul style="list-style-type: none"> <li>• "<i>The C Language - ANSI Standard</i>" (2e edition, 2014) by Brian W. Kernighan and Dennis M. Ritchie</li> </ul>
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### [G-CPE-110] Elementary Programming in C

6 ECTS	Elementary Programming in C		
Duration in hours	Course : 2	TP/TD : 13	Project : 110
ECUE prerequisites	Basic knowledge of C programming (provided by UE B-CPE100)		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Handling different data structures</li> <li>• Discovering sorting, compression and collision algorithms</li> <li>• Creating entire programs in C</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Dynamic programming</li> <li>• Tables and tables of tables</li> <li>• Sorting</li> <li>• Compression / decompression</li> <li>• Linked lists</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Realization of 3 projects to do on your own; each oriented to the understanding of a type of algorithm and data structure.</li> </ul>		
Evaluation methods	<p>Each project is evaluated by automated tests assessing 5 different skills for each project:</p> <ul style="list-style-type: none"> <li>• Algorithm application</li> </ul>		

	<ul style="list-style-type: none"> <li>• Data structure</li> <li>• Optimization</li> <li>• Syntax analysis</li> <li>• Robustness</li> </ul>
Name(s) of person(s) in charge	Clery Plassat
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://fr.wikipedia.org/wiki/Programmation_dynamique">https://fr.wikipedia.org/wiki/Programmation_dynamique</a></li> <li>• <a href="https://fr.wikipedia.org/wiki/Algorithme_de_tri">https://fr.wikipedia.org/wiki/Algorithme_de_tri</a></li> <li>• “The Art of Computer Programming” by Donald Knuth</li> </ul>

### [G-CUS-100] KYT/CAT – IT Fundamentals

1 ECTS	KYT/CAT – IT Fundamentals		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover concepts, big names and important dates around the theme of computing.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Computer basics: Understanding hardware (computers, servers, networks) and software (operating systems, applications).</li> <li>• Networks: Principles of computer networks, including the Internet, network protocols (TCP/IP)</li> </ul>		

	<p>and network security.</p> <ul style="list-style-type: none"><li>• Operating systems: Understand the different operating systems (Windows, Linux, macOS), their architecture and management.</li></ul>
Teaching methods and/or resources	<ul style="list-style-type: none"><li>• Self-paced learning in MOOC format</li></ul>
Evaluation methods	<ul style="list-style-type: none"><li>• Evaluation via multiple-choice questionnaire</li></ul>
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="https://en.wikiversity.org/wiki/IT_Fundamentals">https://en.wikiversity.org/wiki/IT_Fundamentals</a></li><li>• <a href="https://www.ninjaone.com/blog/information-technologyhttps://www.ninjaone.com/blog/information-technology-it-fundamentals-core-concepts/it-fundamentals-core-concepts/">https://www.ninjaone.com/blog/information-technologyhttps://www.ninjaone.com/blog/information-technology-it-fundamentals-core-concepts/it-fundamentals-core-concepts/</a></li></ul>

### [G-CUS-101] KYT/CAT – Professional skills

1 ECTS	KYT/CAT – Profesional skills		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover the concepts, great names and important dates around the theme of software development.		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Algorithms and data structures: Study problem-solving algorithms and data structures for efficient data storage, retrieval and manipulation.</li> <li>• Computational theory: Exploration of computational theory, including automata theory, complexity theory and computational limits (P vs. NP).</li> <li>• Programming languages and paradigms: Understanding of various programming languages, their syntax, semantics and paradigms (object-oriented, functional, procedural).</li> <li>• Software engineering: Principles and practices of software design, development, testing and maintenance, including methodologies such as Agile and DevOps.</li> </ul>		

Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Self-paced learning in MOOC format</li> </ul>
Evaluation methods	<ul style="list-style-type: none"> <li>• Evaluation via multiple-choice questionnaire</li> </ul>
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	<a href="https://medium.com/geekculture/the-fundamentals-ofhttps://medium.com/geekculture/the-fundamentals-of-software-development-the-core-process-9ffaa6f8fabfsoftware-development-the-core-process-9ffaa6f8fabf">https://medium.com/geekculture/the-fundamentals-ofhttps://medium.com/geekculture/the-fundamentals-of-software-development-the-core-process-9ffaa6f8fabfsoftware-development-the-core-process-9ffaa6f8fabf</a> <a href="https://oncoredevit.com/news-and-insights/softwarehttps://oncoredevit.com/news-and-insights/software-development/software-development-fundamentals-what-you-need-to-know/development/software-development-fundamentals-whathttps://oncoredevit.com/news-and-insights/software-development/software-development-fundamentals-what-you-need-to-know/you-need-to-know/">https://oncoredevit.com/news-and-insights/softwarehttps://oncoredevit.com/news-and-insights/software-development/software-development-fundamentals-what-you-need-to-know/development/software-development-fundamentals-whathttps://oncoredevit.com/news-and-insights/software-development/software-development-fundamentals-what-you-need-to-know/you-need-to-know/</a>

### [G-MAT-100] Mathematics

3 ECTS	Mathematics		
Duration in hours	Course : 4	TP/TD : 10	Project : 35

ECUE prerequisites	Know the basics of programming.
Objectives of the ECUE	<ul style="list-style-type: none"><li>• Learn to code mathematical tools and functions within the framework of scientific programming.</li></ul>
ECUE content (Main points covered)	<ul style="list-style-type: none"><li>• Linear algebra (vector analysis, matrix calculus)</li><li>• Geometry (geometric transformations and coordinate systems)</li><li>• Solving non-linear equations (polynomials of degrees 2 and 4)</li></ul>
Teaching methods and/or resources	5 2-week projects to be carried out in pairs.
Evaluation methods	Each project is evaluated using automated tests to determine the ability to implement mathematical notions within an IT project. In addition, there are 2 reviews to assess understanding of the mathematical concepts themselves.
Name(s) of person(s) in charge	Ilias GROSY
Bibliography/webograp y	<ul style="list-style-type: none"><li>• <a href="https://fr.wikipedia.org/wiki/Produit_matriciel#Produit_matriciel_ordinaire">https://fr.wikipedia.org/wiki/Produit_matriciel#Produit_matriciel_ordinaire</a></li></ul>

### [G-MUL-100] C Graphical Programming

5 ECTS	C Graphical Programming		
Duration in hours	Course : 2	TP/TD : 13	Project : 85
ECUE prerequisites	C language fundamentals (B-CPE-100)		
Objectives of the ECUE	Acquire the fundamentals of graphic and event development. Learn to use an external library, and understand its documentation.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Use and understanding of an external C graphics library (CSFML)</li> <li>• Event graphics management</li> <li>• Sprite animation management</li> <li>• Graphic multi-entity management</li> <li>• Crash system calculation</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• 2 projects. Each focusing on different aspects (event, sprite animation then collision, multi-entity).</li> <li>• Practical sessions on each project</li> <li>• Project follow-up sessions for progress</li> </ul>		
Evaluation methods	<ul style="list-style-type: none"> <li>• An automatic game</li> <li>• Part manual correction, code review</li> <li>• An oral presentation section</li> </ul>		

Name(s) of person(s) in charge	Tom KLEIN
Bibliography/webography	• <a href="#">CSFML (SFML / Download / Bindings) (SFML-DEV.ORG)</a>

### [G-NSA-100] Fundamentals of system installation

3 ECTS	Fundamentals of System Installation		
Duration in hours	Course : 1	TP/TD : 6	Project : 45
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Discover how virtual machines work</li> <li>• Understand the difference between different operating systems</li> <li>• Basic administration of a Linux installation</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Virtual machine creation</li> <li>• Dual-boot installation of different operating systems</li> <li>• System configuration</li> <li>• Installation of essential utilities</li> <li>• Account and group creation (rights management)</li> <li>• File sharing between operating systems</li> </ul>		

Teaching methods and/or resources	1 3-week project to be carried out in pairs
Evaluation methods	<p>The project is evaluated during a presentation in which group members must demonstrate that they have acquired the following skills (on a Linux system):</p> <ul style="list-style-type: none"> <li>• Installing and configuring an exploitation system on the command line</li> <li>• Managing users and their rights and permission</li> <li>• Configuring a graphic environment</li> <li>• Basic cybersecurity skill</li> </ul>
Name(s) of person(s) in charge	Jordan BANKOLE & Théodore GOZARD
Bibliography/webography	• <a href="https://gbp.resinfo.org/?p=261">https://gbp.resinfo.org/?p=261</a>

### [G-PMP-100] Introduction to project management I

1 ECTS	Introduction to project management I		
Duration in hours	Course : 1	TP/TD : 4	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Get people thinking about how to work on a project on their own and in a group.		

	<ul style="list-style-type: none"> <li>• Collaborate as part of a team, sharing values and pooling knowledge, resources, tools and skills with a view to production.</li> <li>• Work independently.</li> <li>• Take the initiative.</li> </ul>
<p>ECUE content (Main points covered)</p>	<ul style="list-style-type: none"> <li>• Work methodology</li> <li>• Group conflict management</li> <li>• Task management tools</li> </ul>
<p>Teaching methods and/or resources</p>	<p>Oral presentations by the students, in which they explain the project management methods used in the concrete case of their project (from another E.U.). Feedback and advice from teaching staff and peers.</p>
<p>Evaluation methods</p>	<p>Reviews are evaluated on the following points:</p> <ul style="list-style-type: none"> <li>• Breaking down the project into tasks</li> <li>• Distribution of work among group members</li> <li>• Implementation of work organization processes (time and task management tools, etc.)</li> </ul>
<p>Name(s) of person(s) in charge</p>	<p>Gildas VINSON</p>
<p>Bibliography/webography</p>	<ul style="list-style-type: none"> <li>• <a href="https://asana.com/fr/resources/it-project-management">https://asana.com/fr/resources/it-project-management</a></li> </ul>

### [G-PSU-100] UNIX system programming

7 ECTS	UUnix system programming		
Duration in hours	Course : 2	TP/TD : 13	Project : 110
ECUE prerequisites	Fundamentals of C programming.		
Objectives of the ECUE	Discover the fundamentals of Unix programming through system calls using the C language.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• File management and rights</li> <li>• Advanced terminal management (signals)</li> <li>• Discovering and using a library (Ncurses)</li> </ul>		
Teaching methods and/or resources	• Completion of 3 projects (2 on their own, and one in pairs)		
Evaluation methods	Automated tests on each project.		

Name(s) of person(s) in charge	Christophe Sundas
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://man7.org/linux/man-pages/man1/ls.1.html">https://man7.org/linux/man-pages/man1/ls.1.html</a></li> <li>• <a href="https://man7.org/linux/man-pages/man7/signal.7.html">https://man7.org/linux/man-pages/man7/signal.7.html</a></li> </ul>

## Semester 2 modules

### [G-AIA-200] Discovery of Data Analysis

3 ECTS	Discovery of Data Analysis		
Duration in hours	Course : 1	TP/TD : 3	Project : 45
ECUE prerequisites	<ul style="list-style-type: none"> <li>• Fundamentals of C programming.</li> <li>• Basic understanding of algorithmic principles</li> </ul>		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Introduce the principles of "artificial intelligence" through data analysis</li> <li>• Create a library to facilitate data analysis</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Recreate a library for reading and analyzing data in CSV format</li> <li>• Pandas discovery</li> </ul>		
Teaching methods and/or resources	1 2-week project to be carried out in groups of 2, consisting of recoding a light version of Pandas in C. Retrieve data from a CSV file, identify the columns and their type, filter and order the data and analyze it using mathematical tools.		

Evaluation methods	The project is evaluated by automated tests and a presentation.
Name(s) of person(s) in charge	Julien CALENGE & Léo SAROCHAR
Bibliography/webography	• <a href="https://pandas.pydata.org/">https://pandas.pydata.org/</a>

### [G-AIA-210] Introduction to Data Analysis

5 ECTS	Introduction to Data Analysis		
Duration in hours	Course : 1	TP/TD : 6	Project : 90
ECUE prerequisites	<ul style="list-style-type: none"> <li>• Fundamentals of C programming.</li> <li>• Basic understanding of algorithmic principles</li> </ul>		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Use data analysis tools to select, clean and analyze data</li> <li>• Discovering how to use Jupyter</li> <li>• Using data with an A.I. model</li> </ul>		
Teaching methods and/or resources	1 6-week project to be carried out in groups of 3.		

Evaluation methods	The project is evaluated by automated tests and a presentation.
Name(s) of person(s) in charge	Julien CALENGE & Léo SAROCHAR
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://pandas.pydata.org/">https://pandas.pydata.org/</a></li> <li>• <a href="https://jupyter.org/">https://jupyter.org/</a></li> </ul>

### [G-CPE-200] Elementary programming in C

10 ECTS	Elementary programming in C		
Duration in hours	Course : 2	TP/TD : 15	Project : 185
ECUE prerequisites	Programming fundamentals. Understanding basic algorithms.		
Objectives of the ECUE	Pushing the student's algorithmic thinking through complex elementary programming projects. Learn about new types of data structures.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Shortest path search algorithm</li> <li>• Graph theory</li> </ul>		

Teaching methods and/or resources	<ul style="list-style-type: none"><li>• 3 projects, each focused on understanding a different type of algorithm and data structure.</li><li>• The final project is an "assessment" project, applying the concepts learned during the course of the year.</li></ul>
Evaluation methods	<p>Each project is evaluated by automated tests assessing 5 different skills for each project:</p> <ul style="list-style-type: none"><li>• Algorithm application</li><li>• Data structure</li><li>• Optimization</li><li>• Syntax analysis</li><li>• Robustness</li></ul>
Name(s) of person(s) in charge	Kevin SPEGT
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="http://sdz.tdct.org/sdz/le-pathfinding-avec-dijkstra.html">http://sdz.tdct.org/sdz/le-pathfinding-avec-dijkstra.html</a></li><li>• <a href="https://fre.myservername.com/graph-implementation-https://fre.myservername.com/graph-implementation-c-using-adjacency-listusing-adjacency-list">https://fre.myservername.com/graph-implementation-https://fre.myservername.com/graph-implementation-c-using-adjacency-listusing-adjacency-list</a></li><li>• <a href="https://www.techiedelight.com/fr/implement-graph-datahttps://www.techiedelight.com/fr/implement-graph-data-structure-c/structure-c/">https://www.techiedelight.com/fr/implement-graph-datahttps://www.techiedelight.com/fr/implement-graph-data-structure-c/structure-c/</a></li></ul>

1 ECTS	<b>Fundamentals of Artificial Intelligence</b>		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover concepts, big names and important dates around the theme of computing.		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Machine Learning: supervised, unsupervised and reinforcement learning</li> <li>• Neural networks</li> <li>• Automatic natural language processing</li> <li>• Ethics and Bias</li> </ul>		
Teaching methods and/or resources	Self-paced learning in MOOC format		
Evaluation methods	Evaluation via multiple-choice questionnaire		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://learn.microsoft.com/fr-fr/credentials/certifications/azure-ai-fundamentals/fr/credentials/certifications/azure-ai-">https://learn.microsoft.com/fr-fr/credentials/certifications/azure-ai-fundamentals/fr/credentials/certifications/azure-ai-</a></li> </ul>		

	<a href="#">fundamentals/</a>
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**[G-CUS-201] KYT/CAT - Fundamentals of Cybersecurity**

1 ECTS	Fundamentals of Cybersecurity		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover the concepts, great names and important dates around the theme of software development.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Triad CIA: Confidentiality, Integrity and Availability</li> <li>• Cryptography</li> <li>• Risk management</li> <li>• Network security</li> </ul>		
Teaching methods and/or resources	Self-paced learning in MOOC format		
Assessment methods	Evaluation via multiple-choice questionnaire		
Name(s) of person(s) in charge	Jonathan NAU		

Bibliography/webography	
	<ul style="list-style-type: none"> <li>• <a href="https://learn.microsoft.com/en-us/credentials/certifications/security-compliance-and-identity-fundamentals">https://learn.microsoft.com/en-us/credentials/certifications/security-compliance-and-identity-fundamentals</a></li> <li>• <a href="https://learn.microsoft.com/en-us/credentials/certifications/security-compliance-and-identity-fundamentals">https://learn.microsoft.com/en-us/credentials/certifications/security-compliance-and-identity-fundamentals</a></li> <li>• <a href="https://learn.microsoft.com/en-us/training/paths/describe-basic-concepts-of-cybersecurity/">https://learn.microsoft.com/en-us/training/paths/describe-basic-concepts-of-cybersecurity/</a></li> </ul>

### [G-DOP-200] Introduction to DevOps

3 ECTS	Introduction to DevOps		
Duration in hours	Course : 1	TP/TD : 11	Project : 35
ECUE prerequisites	No		
Objectives of the ECUE	Discover DevOps practices and related fundamental concepts		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Containerization with Docker</li> <li>• Basic orchestration with Docker Compose</li> <li>• Task automation with GitHub Actions</li> </ul>		
Teaching methods and/or	<ul style="list-style-type: none"> <li>• 1 project to deploy an existing application using containers.</li> </ul>		

resources	<ul style="list-style-type: none"> <li>• 1 second project focusing on the principles of process automation via Github Actions</li> </ul>
Evaluation methods	<ul style="list-style-type: none"> <li>• The first project is evaluated via automated tests, and the second via a presentation.</li> <li>• The module concludes with a review in which students demonstrate their understanding of specific principles.</li> </ul>
Name(s) of person(s) in charge	Hugo PEREZ
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://www.docker.com/">https://www.docker.com/</a></li> <li>• <a href="https://docs.docker.com/compose/">https://docs.docker.com/compose/</a></li> <li>• <a href="https://github.com/features/actions">https://github.com/features/actions</a></li> </ul>

### [G-ING-200] Discovery of Software Engineering

3 ECTS	Discovery of Software Engineering		
Duration in hours	Course : 1	TP/TD : 3	Project : 45
ECUE prerequisites	C language fundamentals (B-CPE-100) Fundamentals of graphic and event development (B-MUL-100)		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Learn to use an external library and understand its documentation.</li> <li>• Learn how to design and create a user interface</li> </ul>		

<p>ECUE content (Main points covered)</p> <p>Teaching methods and/or resources</p> <p>Evaluation methods</p> <p>Name(s) of person(s) in charge</p> <p>Bibliography/webography</p>	<ul style="list-style-type: none"> <li>• Learn the basics of game and level design</li> </ul>		
	<ul style="list-style-type: none"> <li>• Use and understanding of an external C graphics library (SFML)</li> <li>• Graphical visualization of raw data</li> </ul>		
	<ul style="list-style-type: none"> <li>• Group synthesis project</li> <li>• Practical work sessions on each project</li> <li>• Project follow-up sessions for progress</li> </ul>		
	<ul style="list-style-type: none"> <li>• An automatic game</li> <li>• Part manual correction, code review</li> <li>• A keynote</li> </ul>		
	Tom KLEIN		
<ul style="list-style-type: none"> <li>• <a href="http://sfml-dev.org">CSFML (SFML / Download / Bindings) (sfml-dev.org)</a></li> <li>• <a href="http://wikipedia.org">Level design - Wikipedia (wikipedia.org)</a></li> <li>• <a href="#">Game design</a></li> </ul>			

**[G-ING-210] Introduction to Software Engineering**

5 ECTS	Introduction to Software Engineering		
Duration in hours	Course : 1	TP/TD : 6	Project : 90

ECUE prerequisites	C language fundamentals (B-CPE-100) Fundamentals of graphic and event development (B-MUL-100)
Objectives of the ECUE	<ul style="list-style-type: none"><li>• Learn to use an external library and understand its documentation.</li><li>• Learn how to design and create a user interface</li><li>• Learn the basics of game and level design</li></ul>
ECUE content (Main points)	<ul style="list-style-type: none"><li>• Use and understanding of an external C graphics library (SFML)</li><li>• Design and create a video game by thinking about game design and level design</li></ul>
Teaching methods and/or resources	<ul style="list-style-type: none"><li>• Group synthesis project</li><li>• Practical work sessions on each project</li><li>• Project follow-up sessions for progress</li></ul>
Evaluation methods	<ul style="list-style-type: none"><li>• An automatic game</li><li>• Part manual correction, code review</li><li>• A keynote</li></ul>
Name(s) of person(s) in charge	Tom KLEIN
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="https://sfml-dev.org/">CSFML (SFML / Download / Bindings) (SFML-dev.org)</a></li><li>• <a href="https://en.wikipedia.org/wiki/Level_design">Level design - Wikipedia (wikipedia.org)</a></li><li>• <a href="https://en.wikipedia.org/wiki/Game_design">Game design - Wikipedia (wikipedia.org)</a></li></ul>

### [G-MAT-200] Mathematics

3 ECTS	MaMathematics		
Duration in hours	Course : 4	TP/TD : 10	Project : 35
ECUE prerequisites	Know the basics of programming.		
Objectives of the ECUE	Learn to code mathematical tools and functions for scientific programming.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Numerical sequences</li> <li>• Calculation and analysis of functions (derivatives, integrals)</li> </ul>		
Teaching methods and/or resources	5 2-week projects to be carried out in pairs.		
Evaluation methods	Each project is evaluated using automated tests to determine the ability to implement mathematical concepts within an IT		
	project. In addition, there are 2 reviews to assess understanding of the mathematical concepts themselves.		
Name(s) of person(s) in charge	Ilias GROSY		

Bibliography/webograpy	
	<ul style="list-style-type: none"> <li>• <a href="https://fr.wikipedia.org/wiki/D%C3%A9rivation_num%C3%A9rique">https://fr.wikipedia.org/wiki/D%C3%A9rivation_num%C3%A9rique</a></li> </ul>

### [G-PMP-200] Introduction to project management

3 ECTS	Introduction to project management		
Duration in hours	Course : 1	TP/TD : 5	Project : 50
ECUE prerequisites	No		
Objectives of the ECUE	<p>Deepen your knowledge of project and group management.</p> <ul style="list-style-type: none"> <li>• Developing test policies</li> <li>• Collaborate within a team, sharing values and pooling knowledge, resources, tools and skills with a view to production.</li> <li>• Work independently.</li> <li>• Take the initiative.</li> <li>• Manage a project (design, steering, team coordination, implementation and management, evaluation, dissemination) that can mobilize multidisciplinary skills within a collaborative framework.</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Work methodology</li> <li>• Group conflict management</li> <li>• Task management tools</li> <li>• Unit testing</li> <li>• Integration tests</li> </ul>		

Teaching methods and/or resources	Oral presentations by the students, in which they explain the project management methods used in the concrete case of their project (from another E.U.). Feedback and advice from teaching staff and peers.
Evaluation methods	Reviews are evaluated on the following points: <ul style="list-style-type: none"> <li>• Breaking down the project into tasks</li> <li>• Distribution of work among group members</li> <li>• Implementation of work organization processes (time and task management tools, etc.)</li> <li>• Setting up a test policy</li> <li>• Unit test coverage rate</li> </ul>
Name(s) of person(s) in charge	Gildas VINSON
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://asana.com/fr/resources/it-project-management">https://asana.com/fr/resources/it-project-management</a></li> <li>• <a href="https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022">https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022</a></li> </ul>

### [G-PSU-200] Shell programming

10 ECTS	Shell programming		
Duration in hours	Course : 2	TP/TD : 15	Project : 185
ECUE prerequisites	Fundamentals of C programming.		
Objectives of the ECUE	Discover process management on a Unix system.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Create your own shell (command interpreter)</li> <li>• Writing a complex parser</li> <li>• Environment context management</li> <li>• Running processes in the background</li> </ul>		

	<ul style="list-style-type: none"> <li>• Group work</li> </ul>
	<p>Teaching methods and/or resources</p> <p>The creation of a command interpreter is divided into 3 successive parts (projects):</p> <ul style="list-style-type: none"> <li>• Minishell1, command line interpretation and process execution</li> <li>• Minishell2, more complex command line and management of I/O redirection between processes (piping)</li> <li>• 42sh, full-featured command interpreter</li> </ul>
	<p>Evaluation methods</p> <p>Automated tests to validate the knowledge acquired on each project, plus a keynote session for students to present their final results.</p>
	<p>Name(s) of person(s) in charge</p> <p>Joffrey RIELA &amp; Johan Tay-Nam</p>
<p>Bibliography/webography</p> <ul style="list-style-type: none"> <li>• <a href="https://fr.wikipedia.org/wiki/Bourne-Again_shell">https://fr.wikipedia.org/wiki/Bourne-Again_shell</a></li> <li>• <a href="https://fr.wikipedia.org/wiki/Analyse_LL">https://fr.wikipedia.org/wiki/Analyse_LL</a></li> </ul>	

### [G-SEC-200] Discovery of Cyber Security

3 ECTS	Discovery of Cyber Security		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	No		
Objectives of the ECUE	Discover standard hacking, enumeration and privilege elevation techniques.		
ECUE content	<ul style="list-style-type: none"> <li>• Command injection</li> <li>• SQL injection</li> </ul>		

(Main points covered)	<ul style="list-style-type: none"> <li>• SSTI (Server Side Template Injection) operation</li> <li>• SUID vulnerability exploitation</li> <li>• Exploiting vulnerabilities Capabilities</li> </ul>
	<ul style="list-style-type: none"> <li>• Exploitation of CVEs (Common Vulnerabilities Exposures)</li> </ul>
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability.</li> <li>• Capture The Flag project to be carried out in pairs</li> </ul>
Evaluation methods	<p>Assessment is based on the number of flags found (each flag corresponding to a technical skill expected in the module). The assessment is completed by an oral presentation in which students present their methodology and the application of acquired skills.</p>
Name(s) of person(s) in charge	Théo CAMPOS
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://tryhackme.com/">https://tryhackme.com/</a></li> <li>• <a href="https://www.root-me.org/fr/Capture-The-Flag/">https://www.root-me.org/fr/Capture-The-Flag/</a></li> </ul>

### [G-SEC-210] Introduction to Cyber Security

5 ECTS	Introduction to Cyber Security		
Duration in hours	Course : 1	TP/TD : 6	Project : 90
ECUE prerequisites	No		
Objectives of the ECUE	Discover binary security and how to exploit		

	vulnerabilities to gain access.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Buffer overflow</li> <li>• Exploiting formatting chains</li> <li>• Integer overflow/underflow</li> <li>• Access to uninitialized memory</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• A project to be carried out in a group, representing a simulation of a program from which information is to be obtained.</li> <li>• Report on vulnerabilities and their exploitation</li> </ul>		
Evaluation methods	Assessment is by oral presentation.		
Name(s) of person(s) in charge	Théo CAMPOS		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://ctf101.org/binary-exploitation/what-is-binary">https://ctf101.org/binary-exploitation/what-is-binary</a><a href="https://ctf101.org/binary-exploitation/what-is-binary-security/security/">https://ctf101.org/binary-exploitation/what-is-binary-security/security/</a></li> </ul>		

### [G-WEB-200] Introduction to web development

3 ECTS	Introduction to web development		
Duration in hours	Course : 1	TP/TD : 5	Project : 40
ECUE	Programming fundamentals		

prerequisites	
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Understand the basic principles of web development</li> </ul>
	<ul style="list-style-type: none"> <li>• Discovering the back-end/front-end difference</li> <li>• Discover how to use a database</li> <li>• Introduction to NodeJS and REST APIs</li> </ul>
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Creating a to-do list application</li> <li>• Communication between back-end and front-end via an API</li> <li>• SQL database</li> <li>• http protocol (verbs, response code, authentication, etc.)</li> </ul>
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• 1 project for a group of 2 or 3 people to create an API for managing a to-do list.</li> </ul>
Evaluation methods	<p>The project is evaluated during a presentation in which the group members must demonstrate that their project works on the following points:</p> <ul style="list-style-type: none"> <li>• Project architecture</li> <li>• Authentication implementation</li> <li>• Persistence through a database</li> <li>• How the API works</li> <li>• Respecting REST conventions</li> </ul>
Name(s) of person(s) in charge	Enes KOC & Jonathan NAU
Bibliography/w	<ul style="list-style-type: none"> <li>• <a href="https://blog.logrocket.com/build-rest-api-node-express/">https://blog.logrocket.com/build-rest-api-node-express/</a> <a href="https://blog.logrocket.com/build-rest-api-node-express/">https://blog.logrocket.com/build-rest-api-node-express/</a></li> </ul>

bibliography	<p><a href="https://express-mysql/mysql/">express-mysql/mysql/</a></p> <ul style="list-style-type: none"> <li>• <a href="https://developer.mozilla.org/fr/docs/Learn/Server-side/Express_Nodejs/Introduction">https://developer.mozilla.org/fr/docs/Learn/Server-side/Express_Nodejs/Introduction</a></li> </ul>
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## Semester 4 Modules

### [G-PDG-300] Paradigms Seminar

7 ECTS	Paradigms Seminar		
Duration in hours	Course : 15	TP/TD : 5	Project : 130
ECUE prerequisites	Imperative programming in C		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Acquire the technical tools needed to carry out advanced projects in the 2nd year.</li> <li>• Preparation for module B-OOP-400, B-FUN-400</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Introduction to 3 programming paradigms :</li> <li>• Functional programming in Haskell</li> <li>• Modular programming in Object-oriented programming in C++</li> <li>• Multi-paradigms with Rust</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• 1 introductory session on the paradigms addressed</li> <li>• 13 days of intensive tutored exercises, discovering each paradigm through a series of progressive exercises</li> <li>• 3 group projects applying the paradigms studied during the week</li> <li>• 3 project presentations</li> </ul>		
Evaluation methods	<p>Identification of validated skills based on :</p> <ul style="list-style-type: none"> <li>• Exercise day results</li> </ul>		

	<ul style="list-style-type: none"> <li>• Group project presentations enabling each student to showcase the skills acquired in the course of the project</li> <li>• Final keynote</li> </ul>
Name(s) of person(s) in charge	Guillaume DEVOILLE, Léo FORNES and Mattéo VOLPI
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://wiki.haskell.org/Functional_programming">https://wiki.haskell.org/Functional_programming</a></li> <li>• <a href="https://en.wikipedia.org/wiki/Modular_programming">https://en.wikipedia.org/wiki/Modular_programming</a></li> <li>• <a href="https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Objects/Objectoriented_programming">https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Objects/Objectoriented_programming</a></li> </ul>

### [G-CCP-400] Concurrent programming

5 ECTS	Concurrent programming		
Duration in hours	Course : 1	TP/TD : 10	Project : 85
ECUE prerequisites	Knowledge of C programming and fundamentals of C++ programming (B-PDG-300).		
Objectives of the ECUE	Discover parallelism and concurrent programming		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Discover threads, mutexes and conditional variables</li> <li>• Implementation of a parallel producer/consumer diagram.</li> <li>• Managing competition between multiple processes and threads</li> </ul>		
Teaching methods and/or resources	1 introductory project on parallelism to be done on your own, followed by a group project asking you to implement		

	a more complex concurrency program.
Evaluation methods	Assessment by automated tests, supplemented by a defense.
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/ webography	<p style="text-align: center;">•</p> <p><a href="https://blog.engineering.publicissapient.fr/2008/08/13/programmation-concurrentielle-notions-fondamentales/">https://blog.engineering.publicissapient.fr/2008/08/13/programmation-concurrentielle-notions-fondamentales/</a></p>

### [G-CNA-400] Computer Numerical Analysis

4 ECTS	Computer Numerical Analysis		
Duration in hours	Course : 5	TP/TD : 20	Project : 50
ECUE prerequisites	Programming knowledge		
Objectives of the ECUE	Learn to code mathematical tools and functions for scientific programming		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Probability (random variables, random experiments, events, binomial law, Poisson's law)</li> <li>• Combinatorial calculation</li> <li>• Statistics (descriptive statistics, correlations,</li> </ul>		

	sampling) <ul style="list-style-type: none"><li>• Expectation, variance, standard deviation</li></ul>
Teaching methods and/ or resources	9 2-week projects to be carried out in pairs
Evaluation methods	Each project is evaluated using automated tests to determine the ability to implement mathematical concepts within an IT project.  There are also 2 reviews to assess understanding of the mathematical concepts themselves.
Name(s) of person(s) in charge	Ilias GROSY
Bibliography/webography	

**[G-CUS-400] KYT/CAT-Networks & communication**

1 ECTS	KYT/CAT-Networks & communication
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Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover concepts, big names and important dates around the theme of networks and digital communication.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• OSI model</li> <li>• Network devices (router, switch, gateway)</li> <li>• History of telecommunications</li> <li>• Internet</li> </ul>		
Teaching methods and/or resources	Autonomous learning on a corpus of resources provided		
Evaluation methods	3 Q.C.M.		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://fr.wikipedia.org/wiki/Mod%C3%A8le_OSI">https://fr.wikipedia.org/wiki/Mod%C3%A8le_OSI</a></li> <li>• <a href="https://www.oreilly.com/library/view/routing-and-switching/9780133476200/switching/9780133476200/">https://www.oreilly.com/library/view/routing-and-switching/9780133476200/switching/9780133476200/</a></li> </ul>		

**[G-CUS-401] KYT/CAT - Processor Architecture**

1 ECTS	KYT/CAT - Processor Architecture
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Duration in hours			
	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover the concepts, great names and important dates around the theme of video games.		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• The professions behind video games</li> <li>• Working conditions in the video game industry</li> <li>• How a "game loop" works</li> <li>• The societal challenges of video games</li> </ul>		
Teaching methods and/or resources	Independent learning on a corpus of provided resources		
Evaluation methods	3 Q.C.M.		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="http://snjv.org/wp-content/uploads/2021/09/Barometrehttp://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdfSNJV-2021-1.pdf">http://snjv.org/wp-content/uploads/2021/09/Barometrehttp://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdfSNJV-2021-1.pdf</a></li> <li>• <a href="https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women">https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women</a></li> </ul>		

4 ECTS	DevOps		
Duration in hours	Course : 5	TP/TD : 10	Project : 60
ECUE prerequisites	Basic knowledge of Docker and automation is recommended (B-DOP-200)		
Objectives of the ECUE	Continued learning of DevOps practices and a deeper understanding of automation.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Task automation with Jenkins</li> <li>• Configuration management with Ansible</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• 1 project to discover the concept of "configuration-ascode" and deploy an instance of Jenkins</li> <li>• 1 project discovering task automation via Ansible</li> </ul>		
Evaluation methods	<ul style="list-style-type: none"> <li>• The first project is evaluated via automated tests, and the second via a presentation.</li> <li>• The module concludes with a review, enabling students to demonstrate their understanding of specific principles.</li> </ul>		
Name(s) of person(s) in charge	Hugo PEREZ		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://www.jenkins.io/">https://www.jenkins.io/</a></li> <li>• <a href="https://www.ansible.com/">https://www.ansible.com/</a></li> </ul>		

6 ECTS	Network programming		
Duration in hours	Course : 1	PT/DT : 11	Project : 110
ECUE prerequisites	Knowledge of C programming.		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Discover network programming using TCP/IP sockets</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Creating a client/server architecture</li> <li>• Manage several customers in parallel</li> <li>• Using TCP packets</li> <li>• Implementing an existing protocol</li> <li>• Create and document an "in-house" protocol</li> </ul>		
Teaching methods and/or resources	1 project to be carried out on your own, enabling you to learn about sockets by implementing an existing protocol, and a more substantial project to be carried out in a group, where the protocol has to be invented and documented.		
Evaluation methods	Projects are assessed automatically to validate the skills associated with the module.		
Name(s) of person(s) in charge	Jérémy ANDREY & Gildas VINSON		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="http://manpagesfr.free.fr/man/man2/socket.2.html">http://manpagesfr.free.fr/man/man2/socket.2.html</a></li> <li>• <a href="https://www.cnetfrance.fr/news/le-monde-est-plushttps://www.cnetfrance.fr/news/le-monde-est-plus-connecte-que-jamais-495-milliards-de-personnes-utilisent-internet-en-2022-39946508.htmconnecte-que-jamais-495-milliards-de-personneshttps://www.cnetfrance.fr/news/le-monde-est-plus-connecte-que-jamais-495-milliards-de-personnes-utilisent-internet-en-2022-39946508.htm">https://www.cnetfrance.fr/news/le-monde-est-plushttps://www.cnetfrance.fr/news/le-monde-est-plus-connecte-que-jamais-495-milliards-de-personnes-utilisent-internet-en-2022-39946508.htmconnecte-que-jamais-495-milliards-de-personneshttps://www.cnetfrance.fr/news/le-monde-est-plus-connecte-que-jamais-495-milliards-de-personnes-utilisent-internet-en-2022-39946508.htm</a></li> </ul>		

## [G-OOP-400] Object-oriented programming

7 ECTS	Object-oriented programming		
Duration in hours	Course : 2	TP/TD : 19	Project : 130
ECUE prerequisites	Fundamentals of object-oriented programming (B-PDG-300)		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Application of object-oriented programming concepts discovered in the previous module.</li> <li>• Group work methodology.</li> </ul>		
ECUE content (Main points)	<p>Through 3 projects, acquire or reinforce the following concepts:</p> <ul style="list-style-type: none"> <li>• Interfaces, abstract classes, polymorphism.</li> <li>• Encapsulation.</li> </ul> <p>Constructing and solving graphs.</p>		
Teaching methods and/or resources	<p>3 projects using object-oriented programming concepts:</p> <ul style="list-style-type: none"> <li>• 1 introductory session to the project</li> <li>• 1 design follow-up</li> <li>• 1 implementation follow-up</li> <li>• 1 defense</li> </ul>		
Evaluation methods	Identification of student skills based on project presentations.		
Name(s) of person(s) in charge	Guillaume DEVOILLE & Mattéo VOLPI		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://isocpp.org/">https://isocpp.org/</a></li> </ul>		

**[G-PMP-400] Project management**

3 ECTS	Project management		
Duration in hours	Course : 1	TP/TD : 5	Project : 50
ECUE prerequisites	Know the basics of managing short single and small group projects.		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Deepen your knowledge of project and group management.</li> <li>• Developing test policies</li> <li>• Collaborate within a team, sharing values and pooling knowledge, resources, tools and skills with a view to production.</li> <li>• Work independently.</li> <li>• Take the initiative.</li> <li>• Manage a project (design, steering, team coordination, implementation and management, evaluation, dissemination) that can mobilize multidisciplinary skills within a collaborative framework.</li> <li>• Deploy IT applications, manage test phases and upgrades.</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Work methodology</li> <li>• Group conflict management</li> <li>• Task management tools</li> <li>• Unit testing</li> <li>• Integration tests</li> </ul>		
Teaching methods and/or	Oral presentations by the students, in which they		

resources	explain the project management methods used in the concrete case of their project (from another E.U). Feedback and advice from teaching staff and peers.
Evaluation methods	Evaluation of organizational quality reviews.
Name(s) of person(s) in charge	Gildas VINSON
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="https://asana.com/fr/resources/it-project-management">https://asana.com/fr/resources/it-project-management</a></li><li>• <a href="https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022">https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022</a></li></ul>

## [G-SEC-400] Reverse Engineering & Exploitation

4 ECTS	Reverse Engineering & Exploitation		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	Basic knowledge of cyber security (G-SEC-200)		
Objectives of the ECUE	<p>By the end of the module, students will be able to:</p> <ol style="list-style-type: none"> <li>1. Explain common memory vulnerabilities (stack overflow, format-string, simple heap corruption) and why they arise in C programs.</li> <li>2. Use interactive debuggers and static tools (GDB with pwndbg, Ghidra / radare2) to read a binary, locate interesting code paths and plan a stepwise exploitation approach.</li> <li>3. Build reliable, reproducible exploits for guided 32-bit exercises and adapt approaches to basic 64-bit constraints.</li> <li>4. Automate exploit steps with small Python scripts (pwntools) and produce a reproducible reproduction recipe.</li> <li>5. Describe standard mitigations (ASLR, NX, stack canaries) and argue practical hardening measures for code and deployment.</li> <li>6. Respect legal and ethical boundaries: operate only in isolated labs, document tests, and practice disclosure/mitigation thinking.</li> </ol>		
ECUE content (Main points)	A hands-on, scaffolded module where students set up an isolated lab, learn binary fundamentals (ELF,		

	symbols), and progress through memory vulnerabilities (info leaks, format-strings, stack/heap overflows), developing reproducible exploits (32→64-bit), automating them with pwntools, and studying common mitigations and ethical practices; each exercise finishes with a short reproducible deliverable (exploit script + brief report).		
Teaching methods and/or resources	Learning-by-doing: students complete progressively harder challenges—analyze a binary, design and automate a reproducible exploit, and write a short report on the vulnerability and mitigations—receiving scaffolded hints and instructor feedback at each step.		
Name(s) of person(s) in charge	Gabriel Toublanc		
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://exploit.education/">https://exploit.education/</a></li> </ul>		

### [G-SEC-401] Web Security

4 ECTS	Web Security		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	Basic knowledge of cyber security (G-SEC-200)		
Objectives of the ECUE	Discover advanced hacking, enumeration and privilege		

	elevation techniques.
ECUE content (Main points)	<ul style="list-style-type: none"><li>• Command injection</li><li>• SQL injection</li><li>• SSTI (Server Side Template Injection) operation</li><li>• SUID vulnerability exploitation</li><li>• Exploiting vulnerabilities Capabilities</li><li>• Exploitation of CVEs (Common Vulnerabilities Exposures)</li></ul>
Teaching methods and/or resources	<ul style="list-style-type: none"><li>• Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability.</li><li>• Capture The Flag project to be carried out in pairs</li></ul>
Evaluation methods	Assessment is based on the flags found (each linked to a module skill). The assessment is completed by an oral presentation in which students present their methodology and the application of acquired skills.
Name(s) of person(s) in charge	Gabriel Toublanc
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="https://www.root-me.org/fr/Capture-The-Flag/">https://www.root-me.org/fr/Capture-The-Flag/</a></li><li>• <a href="https://owasp.org/">https://owasp.org/</a></li></ul>

## [G-AIA-400] Machine Learning

4 ECTS	Machine Learning		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	None		
Objectives of the ECUE	<p>This module introduces students to the core concepts and techniques of machine learning, focusing on supervised and unsupervised learning methods, model evaluation, and practical applications. Through hands-on projects, students will learn how to build and optimize predictive models using real-world data.</p>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Understand the main machine learning paradigms and algorithms.</li> <li>• Preprocess and analyze datasets for model training.</li> <li>• Implement and evaluate machine learning models using appropriate metrics.</li> <li>• Apply ML techniques to solve practical problems in various domains.</li> <li>• Recognize ethical considerations and limitations in machine learning.</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• A group project</li> </ul>		
Evaluation methods	<p>Projects are assessed automatically and during a defense to validate the skills associated with the module.</p>		

## [G-AIA-401] Reinforcement Learning

4 ECTS	Reinforcement Learning		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	None		
Objectives of the ECUE	<p>This module explores the principles and methods of reinforcement learning (RL), where agents learn to make decisions by interacting with an environment to maximize rewards. Students will study key RL algorithms, such as Q-learning and policy gradients, and apply them to simulated and real-world problems.</p>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Understand the fundamentals of reinforcement learning, including agents, environments, states, actions, and rewards.</li> <li>• Implement basic RL algorithms and evaluate their performance.</li> <li>• Explore concepts such as exploration vs. exploitation and value functions.</li> <li>• Apply RL techniques to solve control and decision-making problems.</li> <li>• Analyze the challenges and limitations of RL in complex environments.</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• A group project</li> </ul>		
Evaluation methods	<p>Projects are assessed automatically and during a defense to validate the skills associated with the module.</p>		

### [G-AIA-410] Prompt Engineering & Automation

4 ECTS	Prompt Engineering & Automation		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	None		
Objectives of the ECUE	<p>This module introduces students to the art and science of prompt engineering for large language models and the automation of workflows using AI-powered tools. Students will learn how to design effective prompts, integrate AI into real-world applications, and build automated pipelines to streamline tasks.</p>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Understand the principles of prompt engineering and the role of context in AI-generated outputs.</li> <li>• Design and refine prompts to achieve accurate and relevant results.</li> <li>• Explore techniques for chaining prompts and combining AI tools for automation.</li> <li>• Build simple automation workflows using APIs and AI models.</li> <li>• Evaluate the efficiency, reliability, and ethical considerations of AI-powered automation systems.</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Two group projects</li> </ul>		
Evaluation methods	<p>Projects are assessed automatically and during a defense to validate the skills associated with the module.</p>		

### [G-ING-400] Legacy Code Management

4 ECTS	Prompt Engineering & Automation		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	None		
Objectives of the ECUE	<p>This module introduces students to the challenges and best practices of maintaining and improving legacy software systems. Students will learn techniques for understanding, refactoring, and documenting existing codebases to ensure reliability, scalability, and long-term maintainability.</p>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Analyze and understand the structure and dependencies of legacy codebases.</li> <li>• Apply refactoring techniques to improve code quality without altering functionality.</li> <li>• Use version control, testing, and documentation tools effectively in legacy projects.</li> <li>• Identify technical debt and propose strategies for gradual modernization.</li> <li>• Collaborate in teams to maintain and enhance legacy systems following industry best practices.</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• One group projects</li> </ul>		

Evaluation methods	Projects are assessed automatically and during a defense to validate the skills associated with the module.
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### [G-ING-401] Embedded Programming

4 ECTS	Embedded Programming		
Duration in hours	Course : 1	TP/TD : 4	Project : 45
ECUE prerequisites	None		
Objectives of the ECUE	<p>This module introduces students to embedded systems programming with a strong focus on resource-constrained environments. Students will learn how to develop efficient, reliable, and low-level software for microcontrollers and embedded devices while managing limited computing power, memory, and energy resources.</p>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Understand the architecture and constraints of embedded systems.</li> <li>• Write low-level programs for microcontrollers using C/C++ or similar languages.</li> <li>• Optimize memory usage, processing power, and energy consumption.</li> <li>• Implement real-time constraints and handle hardware-software interactions.</li> <li>• Apply debugging, testing, and performance profiling techniques in embedded environments.</li> </ul>		
Teaching methods and/or	<ul style="list-style-type: none"> <li>• One group projects</li> </ul>		

resources	
Evaluation methods	Projects are assessed automatically and during a defense to validate the skills associated with the module.

### [G-YEP-400] Year-end project Zappy

7 ECTS	[B-YEP-400] Year-end project Zappy		
Duration in hours	Course : 1	TP/TD : 8	Project : 120
ECUE prerequisites	<ul style="list-style-type: none"> <li>• C++ object-oriented programming</li> <li>• Knowledge of C programming</li> <li>• C/C++ network implementation skills</li> <li>• Basic skills in using a graphics library (SFML)</li> </ul>		
Objectives of the ECUE	Apply the year's key concepts to a substantial project		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Programming a graphical interface in C++ using SFML</li> <li>• C server capable of managing multiple clients</li> <li>• Implementing game logic</li> <li>• Development of small artificial intelligences capable of coordinating to win the game</li> <li>• Teamwork</li> </ul>		
Teaching methods and/or resources	A major project at the end of the second year (called "Zappy"), bringing together all the essential points of the year.		
Evaluation methods	Assessment of the various skills via a defense and an		

	oral presentation in keynote format
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	• <a href="https://fr.wikipedia.org/wiki/Zaphod_Beeblebrox">https://fr.wikipedia.org/wiki/Zaphod_Beeblebrox</a>

## Semester 5 Modules

### [B-AIA-500] Artificial intelligence

4 ECTS	Artificial intelligence		
Duration in hours	Course : 2	TP/TD : 8	Project : 65
ECUE prerequisites	Create programs and implement algorithms.		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Discover game theory</li> <li>• Deepen your knowledge of A.I.</li> </ul>		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Game theory</li> <li>• Min/max and alpha-beta pruning</li> <li>• Technical constraints (memory, speed)</li> </ul>		
Teaching methods and/or resources	Creation of a program capable of playing gomoku ninuki against humans and other artificial intelligences in groups.		
Evaluation methods	Evaluation via automated tests.		

Name(s) of person(s) in charge	Jérémy ANDREY
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://www.jeu-de-go.com/gomoku-ninuki.html">https://www.jeu-de-go.com/gomoku-ninuki.html</a></li> <li>• <a href="https://www.economie.gouv.fr/facileco/john-nash">https://www.economie.gouv.fr/facileco/john-nash</a></li> <li>• <a href="https://www.universalis.fr/encyclopedie/theorie-des-jeux/">https://www.universalis.fr/encyclopedie/theorie-des-jeux/</a></li> </ul>

### [B-CNA-500] Computer Numerical Analysis

4 ECTS	Computer Numerical Analysis		
Duration in hours	Course : 3	TP/TD : 15	Project : 70
ECUE prerequisites	Knowledge of programming and basic algorithms		
Objectives of the ECUE	Implement some advanced tools and algorithms used for scientific calculations		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Cryptography</li> <li>• Neural network</li> </ul>		
Teaching methods and/or resources	2 projects tackling two different themes through the use of digital and mathematical tools.		
Evaluation methods	Each project is evaluated at a		

Name(s) of person(s) in charge	Ilias GROSY		
Bibliography/webography			

### [B-CPP-500] Advanced C++

9 ECTS	Advanced C++		
Duration in hours	Course : 2	TP/TD : 8	Project : 165
ECUE prerequisites	Knowledge of object-oriented programming, proficiency in C++ language		
Objectives of the ECUE	Development of a multiplayer game engine, and implementation of a game using this engine		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Network programming</li> <li>• Software architecture</li> <li>• Software engineering (dependency management, crossplatform, source code management, etc.)</li> <li>• Technical documentation</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Discovery of ECS architecture through a TD</li> <li>• In "project mode" for the course of the module</li> <li>• Intermediary points to validate project progress</li> </ul>		

Evaluation methods	Evaluation of a minimum implementation after one month, then evaluation of the whole project after 2 months of development.
Name(s) of person(s) in charge	Gabriel CADET & Gabriel CUVILLIER
Bibliography/webography	<ul style="list-style-type: none"> <li>• <i>Game Engine Architecture - Jason Gregory - ISBN-13: 9781138035454</i></li> <li>• <a href="https://fabiensanglard.net/quake3/index.php">https://fabiensanglard.net/quake3/index.php</a></li> </ul>

### [G-CUS-500] KYT/CAT-Algorithms

1 ECTS	KYT/CAT-Algorithms		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover concepts, great names and important dates around the theme of algorithms		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Theoretical discovery of data structures</li> <li>• The big names in algorithms</li> <li>• Different paradigms</li> <li>• Asymptotic comparison</li> <li>• Algorithmic complexity</li> </ul>		
Teaching methods and/or resources	Independent learning on a corpus of provided resources		
Evaluation	3 Q.C.M.		

methods	
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="https://en.wikipedia.org/wiki/Donald_Knuth">https://en.wikipedia.org/wiki/Donald_Knuth</a></li> <li>• <a href="https://www.101computing.net/heuristic-approaches-tohttps://www.101computing.net/heuristic-approaches-to-problem-solving/problem-solving/">https://www.101computing.net/heuristic-approaches-tohttps://www.101computing.net/heuristic-approaches-to-problem-solving/problem-solving/</a></li> <li>• <a href="https://www.pnas.org/doi/pdf/10.1073/pnas.1418680112">https://www.pnas.org/doi/pdf/10.1073/pnas.1418680112</a></li> </ul>

### [G-CUS-501] KYT/CAT-Video games

1 ECTS	KYT/CAT-Video games		
Duration in hours	Course : 1	TP/TD : 3	Project : 20
ECUE prerequisites	No		
Objectives of the ECUE	Discover the concepts, great names and important dates around the theme of video games		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• The professions behind video games</li> <li>• Working conditions in the video game industry</li> <li>• How a "game loop" works</li> <li>• The societal challenges of video games</li> </ul>		
Teaching methods and/or resources	Independent learning on a corpus of provided resources		
Evaluation methods	3 Q.C.M.		

Name(s) of person(s) in charge	Jonathan NAU		
	Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="http://snjv.org/wp-content/uploads/2021/09/Barometrehttp://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdfSNJV-2021-1.pdf">http://snjv.org/wp-content/uploads/2021/09/Barometrehttp://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdfSNJV-2021-1.pdf</a></li> <li>• <a href="https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women">https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women</a></li> </ul>	

### [B-DEV-500] Application development

9 ECTS	Application development		
Duration in hours	Course : 2	TP/TD : 8	Project : 165
ECUE prerequisites	Programming knowledge		
Objectives of the ECUE	See a complete project management cycle, from the research phase to the Minimum Viable Product and final implementation.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Exploring languages and technologies</li> <li>• Project planning</li> <li>• Using REST APIs</li> <li>• Oauth2</li> </ul>		

	<ul style="list-style-type: none"><li>• Software engineering (dependency management, crossplatform, source code management, etc.)</li><li>• Technical documentation</li></ul>
Teaching methods and/or resources	A 5-student group project divided into 3 phases: <ul style="list-style-type: none"><li>• Planning</li><li>• Minimum Viable Product</li><li>• Final product</li></ul>
Evaluation methods	<ul style="list-style-type: none"><li>• 3 presentations, each concluding a phase of the project.</li><li>• The first will assess the group's ability to plan and choose its technology stack, as well as its ability to set up a form of work organization.</li><li>• The second focuses on the realization of a Minimum Viable Product and the updating of the initial plan to reflect the reality of progress and the students' ability to analyze and step back from the difference between what was initially planned and what has been achieved to date.</li><li>• The last evaluates the technical aspect of the final project and the students' ability to make a post-mortem of one of their projects (both technically and in terms of group organization).</li><li>• All the students in a group take part in the defense and are questioned to ensure that the whole group has acquired (or not) the necessary skills.</li></ul>
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	<ul style="list-style-type: none"><li>• <a href="https://ifttt.com/">https://ifttt.com/</a></li><li>• <a href="https://fr.smartsheet.com/content/it-project-plan">https://fr.smartsheet.com/content/it-project-plan</a></li></ul>

## [B-DOP-500] Advanced DevOps

4 ECTS	Advanced DevOps		
Duration in hours	Course : 1	TP/TD : 10	Project : 65
ECUE prerequisites	Familiarity with docker and docker-compose and automation via ansible (B-DOP-200 and B-DOP-400 recommended)		
Objectives of the ECUE	Continued learning of DevOps practices and joint application of the 4 concepts and technologies seen above.		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>Orchestration with Kubernetes</li> <li>Use Docker, Jenkins, Ansible, and Kubernetes in a single project</li> </ul>		
Teaching methods and/or resources	2 group projects, the first exploring orchestration via Kubernetes, and the second applying all the skills explored in the DevOps courses to a real-life project.		
Evaluation methods	<ul style="list-style-type: none"> <li>The first project is evaluated via automated tests, and the second via a presentation.</li> <li>The module concludes with a review in which students demonstrate their understanding of specific principles.</li> </ul>		
Name(s) of person(s) in charge	Hugo PEREZ		

Bibliography/webography	
	• <a href="https://kubernetes.io/">https://kubernetes.io/</a>

### [B-FUN-500] Functional Programming

9 ECTS	Functional Programming		
Duration in hours	Course : 2	TP/TD : 8	Project : 165
ECUE prerequisites	Functional programming in Haskell (B-FUN-400)		
Objectives of the ECUE	Syntax analysis, interpretation and compilation in Haskell		
ECUE content (Main points covered)	<ul style="list-style-type: none"> <li>• Syntax analysis using top-down recursion and combinators.</li> <li>• Techniques for implementing this parser in Haskell.</li> <li>• Syntax analysis of symbolic expressions (LISP)</li> <li>• Abstract syntax tree</li> <li>• Interpretation by syntax tree traversal</li> <li>• Stack-machine virtual machine</li> <li>• Compilation</li> </ul>		
Teaching methods and/or resources	<ul style="list-style-type: none"> <li>• Implementation of a LISP interpreter using environment passing and syntax tree traversal, in Haskell.</li> <li>• Implementation of a combinatorial parsing library in Haskell.</li> <li>• Implementing a compiler</li> <li>• Virtual machine implementation (optional)</li> </ul>		

Evaluation methods	Intermediate and final defense
Name(s) of person(s) in charge	Marc PLANARD and Gabriel TOUBLANC
Bibliography/webography	<ul style="list-style-type: none"> <li>• <a href="http://languagelog.ldc.upenn.edu/myl/llog/jmc.pdf">http://languagelog.ldc.upenn.edu/myl/llog/jmc.pdf</a></li> <li>• <a href="https://www.aosabook.org/en/500L/a-python-interpreter">https://www.aosabook.org/en/500L/a-python-interpreter</a><a href="https://www.aosabook.org/en/500L/a-python-interpreter-written-in-python.html">https://www.aosabook.org/en/500L/a-python-interpreter-written-in-python.html</a><a href="https://www.aosabook.org/en/500L/a-python-interpreter-written-in-python.html">written-in-python.html</a></li> </ul>

### [B-SEC-500] Advanced Security

4 ECTS	Advanced Security		
Duration in hours	Course : 1	TP/TD : 4	Project : 70
ECUE prerequisites	UE B-SEC-200 and B-SEC-400 are recommended.		
Objectives of the ECUE	Discover advanced notions of hacking, enumeration and elevation of privileges.		
ECUE content	<ul style="list-style-type: none"> <li>• Command injection</li> </ul>		

<p>(Main points covered)</p>	<ul style="list-style-type: none"> <li>• SQL injection</li> <li>• SSTI (Server Side Template Injection) operation</li> <li>• SUID vulnerability exploitation</li> <li>• Exploiting vulnerabilities Capabilities</li> <li>• Exploitation of CVEs (Common Vulnerabilities Exposures)</li> <li>• Exploiting vulnerabilities with SSH Tunneling</li> <li>• Exploiting vulnerabilities using reverse port forwarding</li> </ul>
<p>Teaching methods and/or resources</p>	<p>Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability.</p>
<p>Evaluation methods</p>	<p>Assessment is based on the flags found (each linked to a module skill). The assessment is completed by an oral presentation in which students present their methodology and the application of acquired skills.</p>
<p>Name(s) of person(s) in charge</p>	<p>Gabriel TOUBLANC &amp; Julien CHASSARD</p>
<p>Bibliography/webography</p>	<ul style="list-style-type: none"> <li>• <a href="https://book.hacktricks.xyz/generic-methodologies-and-resources/tunneling-and-port-forwarding">https://book.hacktricks.xyz/generic-methodologies-and-resources/tunneling-and-port-forwarding</a></li> </ul>

**[B-SVR-500] Survivor seminar**

<p>5 ECTS</p>	<p>Survivor Seminar</p>
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Duration in hours	Course : 2	TP/TD : 3	Project : 95
	Solid programming skills.		
ECUE prerequisites	Solid programming skills.		
Objectives of the ECUE	<ul style="list-style-type: none"> <li>• Talking with customers to meet their needs</li> <li>• Adapting to any situation</li> </ul>		
ECUE content (Main points)	<ul style="list-style-type: none"> <li>• Know how to communicate professionally</li> <li>• Developing a project within constraints</li> <li>• Anticipating the unpredictable</li> <li>• Saying "no"</li> </ul>		
Teaching methods and/or resources	A two-week project using web technologies, but with a lot going on that requires constant adaptation.		
Evaluation methods	Evaluation is based on 2 presentations on the progress of the functionalities, and a keynote analyzing the group's adaptability and professionalism.		
Name(s) of person(s) in charge	Jonathan Nau		

Bibliography/w  
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- <https://www.myconnecting.fr/articles/adaptabilitehttps://www.myconnecting.fr/articles/adaptabilite-professionnelle-soft-skill/professionnelle-soft-skill/#:~:text=La%20meilleure%20fa%C3%A7on%20de%20s,sadapt%20%C3%A0%20the%20situation.>