

EPITECH course Catalogue

Modules common to all 5 years

- [\[G-INN-001\] Conferences & Talks](#)
- [\[G-INN-010\] Hackathon](#)
- [\[G-INN-020\] Exploration project](#)
- [\[G-INN-020\] Technical interest groups](#)

Semester 1 Modules

- [\[B-CPE-100\] Introduction to C programming I](#)
- [\[B-CPE-101\] Introduction to C programming II](#)
- [\[B-CPE-110\] Basics of algorithms](#)
- [\[G-CUS-100\] Computer literacy - Fundamentals of computing](#)
- [\[G-CUS-101\] Computer literacy - Fundamentals of software development](#)
- [\[B-ENG-100\] English](#)
- [\[B-MAT-100\] Mathematics I](#)
- [\[B-MUL-100\] Graphic programming I](#)
- [\[B-NSA-100\] Introduction to system and network administration](#)
- [\[B-PMP-100\] Introduction to project management I](#)
- [\[B-PRO-100\] Professional communication I](#)
- [\[B-PSU-100\] UNIX system programming](#)

Semester 2 Modules

- [\[G-AIA-200\] Introduction to data analysis](#)
- [\[G-AIA-201\] Data analysis & A.I.](#)
- [\[B-CPE-200\] Elementary programming](#)
- [\[G-CUS-200\] Computer literacy - A.I. fundamentals](#)
- [\[G-CUS-201\] Computer literacy - Fundamentals of cybersecurity](#)
- [\[B-DOP-200\] Introduction to DevOps](#)
- [\[B-ENG-200\] English](#)
- [\[G-ING-200\] Software engineering](#)
- [\[G-ING-201\] Software Engineering II](#)
- [\[B-MAT-200\] Mathematics](#)
- [\[G-PCP-200\] Personal and Group Development](#)
- [\[B-PMP-200\] Introduction to project management](#)

[B-PRO-200] Professional communication	.....
[B-PSU-200] Shell programming	.....
[G-SEC-200] Introduction to cyber security	.....
[G-SEC-201] Binary security	.....
[B-WEB-200] Introduction to web development	.....

Semester 4 Modules.....

[B-ASM-400] Assembler x86_64	.....
[B-CCP-400] Competitive programming	.....
[G-CNA-400] Computer Numerical Analysis	.....
[G-CUS-400] Computer literacy - Networks and communication	.....
[G-CUS-401] Computer literacy - Video games	.....
[B-DOP-400] DevOps	.....
[B-ENG-400] English	.....
[B-FUN-400] Functional Programming	.....
[B-NWP-400] Network programming	.....
[B-OOP-400] Object-oriented programming	.....
[G-PCP-400] Personal and Collective Development	.....
[B-PMP-400] Project management	.....
[B-PRO-400] Professional communication	.....
[B-PSU-400] ELF binary instrumentation	.....
[B-SEC-400] Cyber security	.....
[B-YEP-400] Year-end project	.....

Semester 5 Modules.....

[B-AIA-500] Artificial intelligence - Game theory	.....
[B-CNA-500] Computer Numerical Analysis	.....
[B-CPP-500] C++ Advanced	.....
[G-CUS-500] Computer literacy - Algorithms	.....
[G-CUS-501] Computer literacy - Video games	.....
[B-DEV-500] Application development	.....
[B-DOP-500] Advanced DevOps	.....
[B-ENG-500] English	.....
[B-FUN-500] Functional Programming	.....
[B-PRO-500] Professional setting	.....
[B-PRO-510] Professional communication	.....

Modules common to all 5 years

[G-INN-001] Conferences & Talks

1 ECTS	Conferences & Talks		
Duration in hours	Price: 25	TP/TD : N/A	Project : N/A
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> - Opening up to the world of words - Discover technical subjects - Developing curiosity 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Everything to do with IT and our industry can be covered in this module. - Topics depend on the interests of our students and partners. 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Student presentations - Organized presentations by partner companies 		
Evaluation methods	<ul style="list-style-type: none"> - Evaluation of participation 		
Name(s) of person(s) in charge	Fabrice MARCO		
Bibliography/webography	https://www.epitech.eu/innovation/		

[G-INN-010] Hackathon

1-2 ECTS	Hackathon		
Duration in hours	Course: N/A	TP/TD : N/A	Project: 25-60
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> - Technical skills: Programming, web development, application development and use of new tools and technologies. 		

	<ul style="list-style-type: none"> - Teamwork: Collaborate with team members, communicate effectively and distribute tasks. - Problem solving: Develop creative solutions to challenges, think independently and solve problems. - Project management: Plan, organize and manage time and resources to meet deadlines. - Networking: Connect with peers, mentors and industry professionals. - Presentation skills: Present ideas and finished projects to judges and audiences. - Innovation and creativity: Think outside the box and experiment with new ideas. 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Any type of tech-related hackathon can be covered in this module. 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Participation in external hackathons or hackathons organized with our partners 		
Evaluation methods	<ul style="list-style-type: none"> - Hackathon participation and awards 		
Name(s) of person(s) in charge	Fabrice MARCO		
Bibliography/webography	https://www.epitech.eu/innovation/ https://www.reseau-canope.fr/agence-des-usages/quelles-potentialites-pedagogiques-du-hackathon.html		

[G-INN-020] Exploration project

2-4 ECTS	Exploration project		
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"> - Technical skills: Programming, web development, application development and use of new tools and technologies. - Teamwork: Collaborate with team members, communicate effectively and distribute tasks. - Problem solving: Develop creative solutions to challenges, think independently and solve problems. - Project management: Plan, organize and manage time and resources to meet deadlines. - Innovation and creativity: Think outside the box and experiment with new ideas. 		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Students will need to demonstrate their ability to define a need and establish the technical and organizational steps required to produce a finished project. - Students will be encouraged to explore a technical field on their own, using an experimental approach to develop monitoring and self-learning mechanisms. 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Support from the teaching team and mentors, depending on the project. 		
Evaluation methods	<ul style="list-style-type: none"> - Evaluation through regular presentations throughout the project 		
Name(s) of person(s) in charge	Fabrice MARCO		
Bibliography/webography	https://www.epitech.eu/innovation/		

[G-INN-020] Technical interest groups

2-4 ECTS	Technical interest groups		
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"> - Enable students to come together around points of interest (cybersecurity, robotics, AI, video games, etc.). - Organize and participate in workshops and training sessions on these themes 		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Technical skills: Exposure to new technologies, tools and methodologies, often through workshops. - Problem solving: Participating in collaborative troubleshooting can improve your ability to solve technical problems and think critically. - Teamwork: Working with others can strengthen your ability to collaborate effectively. - Self-confidence: Reinforce confidence in your skills and knowledge by getting involved in a supportive community and receiving feedback from your peers. 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Support from the teaching team and mentors depending on the theme. 		
Evaluation methods	<ul style="list-style-type: none"> - Participation in activities 		
Name(s) of person(s) in charge	Fabrice MARCO		
Bibliography/webography	https://www.epitech.eu/innovation/		

Semester 1 Modules

[B-CPE-100] Introduction to C programming I

4 ECTS	Introduction to C programming I		
Duration in hours	Course: 10	TP/TD : 4	Project: 90

ECUE prerequisites	No
Objectives of the ECUE	<ul style="list-style-type: none"> - A 3-week introduction to the fundamentals of programming using the C language - Basic use of git and github
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Discovering the working environment (linux, git, github) - Discovering functions, parameters and returns - Conditions, loops and pointers - String manipulation - Compiling via Makefile and creating dynamic libraries
Teaching methods and/or resources	<ul style="list-style-type: none"> - 13 days, each with a series of exercises to introduce and deepen programming concepts and the C language. - Two one-week mini-projects to apply the concepts covered during the week - Two "rush" periods (short-term projects) in pairs to review the week's progress
Evaluation methods	<ul style="list-style-type: none"> - Continuous assessment, with each successful exercise contributing to the validation of one or more associated skills.
Name(s) of person(s) in charge	Jonathan Nau
Bibliography/webography	<p>https://www.indeed.com/career-advice/career-development/c-programming#:~:text=By%20learning%20C%2C%20you%20can,over all%20concepts%20that%20drive%20programming.</p> <p>"The C Language - ANSI Standard" (2^e edition, 2014) by Brian W. Kernighan and Dennis M. Ritchie</p>

[B-CPE-101] Introduction to C programming II

3 ECTS	Introduction to C programming II		
Duration in hours	Course: 2	TP/TD : 5	Project: 70

ECUE prerequisites	Basic knowledge of C programming (provided by UE B-CPE-100)
Objectives of the ECUE	<ul style="list-style-type: none"> - Understand the classic project life cycle at Epitech. - Apply the basic C skills learned in Part 1.
ECUE content (<i>Main points covered</i>)	<ul style="list-style-type: none"> - Creating a program from A to Z - Discovering variadic functions
Teaching methods and/or resources	<ul style="list-style-type: none"> - An introductory mini-project to lay the foundations for the final project - 1 2-week project to re-implement a current utility in C.
Evaluation methods	<ul style="list-style-type: none"> - Competency-based assessment of projects
Name(s) of person(s) in charge	Jonathan Nau
Bibliography/webography	"The C Language - ANSI Standard" (2 ^e edition, 2014) by Brian W. Kernighan and Dennis M. Ritchie

[B-CPE-110] Basics of algorithms

5 ECTS	Algorithm basics		
Duration in hours	Course: 2	TP/TD: 13	Project: 110
ECUE prerequisites	Basic knowledge of C programming (provided by UE B-CPE-100)		
Objectives of the ECUE	<ul style="list-style-type: none"> - Handling different data structures - Discovering sorting, compression and collision algorithms - Creating entire programs in C 		
ECUE content (<i>Main points covered</i>)	<ul style="list-style-type: none"> - Dynamic programming - Tables and tables of tables - Sorting 		

	<ul style="list-style-type: none"> - Compression / decompression - Linked lists
Teaching methods and/or resources	<ul style="list-style-type: none"> - Realization of 3 projects to do on your own; each oriented to the understanding of a type of algorithm and data structure.
Evaluation methods	<p>Each project is evaluated by automated tests assessing 5 different skills for each project:</p> <ul style="list-style-type: none"> - Algorithm application - Data structure - Optimization - Syntax analysis - Robustness
Name(s) of person(s) in charge	Kevin SPEGT
Bibliography/webography	<p>https://fr.wikipedia.org/wiki/Programmation_dynamique</p> <p>https://fr.wikipedia.org/wiki/Algorithme_de_tri</p> <p>The Art of Computer Programming by Donald Knuth</p>

[G-CUS-100] Computer literacy - Fundamentals of computing

1 ECTS	Computer literacy - Fundamentals of computing		
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 <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Computer basics: Understanding hardware (computers, servers, networks) and software (operating systems, applications). - Networks: Principles of computer networks, including the Internet, network protocols (TCP/IP) and network security. 		

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

[G-CUS-101] Computer literacy - Fundamentals of software development

1 ECTS	Computer literacy - Fundamentals of software development		
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"> - Algorithms and data structures: Study problem-solving algorithms and data structures for efficient data storage, retrieval and manipulation. - Computational theory: Exploration of computational theory, including automata theory, complexity theory and computational limits (P vs. NP). - Programming languages and paradigms: Understanding of various programming languages, their syntax, semantics and paradigms (object-oriented, functional, procedural). - Software engineering: Principles and practices of software design, development, testing and 		

	maintenance, including methodologies such as Agile and DevOps.
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	https://medium.com/geekculture/the-fundamentals-of-software-development-the-core-process-9ffaa6f8fabf https://onecoredevit.com/news-and-insights/software-development/software-development-fundamentals-what-you-need-to-know/

[B-ENG-100] English

2 ECTS	English		
Duration in hours	Course: 5	PT/DT: 25	Project: 30
ECUE prerequisites	Terminal fundamentals		
Objectives of the ECUE	Improve English language skills in general, with a particular focus on speaking.		
ECUE content (Main points)	<ul style="list-style-type: none"> - Reading comprehension - Writing production - Listening comprehension - Oral interaction - Oral production 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Choice of several projects - Weekly English-language exchange sessions 		

Evaluation methods	<ul style="list-style-type: none"> - Written project file - Oral presentation on the project - Participation in exchange sessions
Name(s) of person(s) in charge	Daniel COTTON
Bibliography/webography	https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDC-TMContent?documentId=090000168045bb57

[B-MAT-100] Mathematics I

2 ECTS	Mathematics I		
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 within the framework of scientific programming.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Linear algebra (vector analysis, matrix calculus) - Geometry (geometric transformations and coordinate systems) - Solving non-linear equations (polynomials of degrees 2 and 4) 		
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 GROSZY		

Bibliography/webography	https://fr.wikipedia.org/wiki/Produit_matriciel#Produit_matriciel_ordinaire
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[B-MUL-100] Graphic programming I

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

[B-NSA-100] Introduction to system and network administration

2 ECTS	Introduction to system and network administration		
Duration in hours	Course: 1	TP/TD : 6	Project: 45
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> - Discover how virtual machines work - Understand the difference between different operating systems - Basic administration of a Linux installation 		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Virtual machine creation - Dual-boot installation of different operating systems - System configuration - Installation of essential utilities - Account and group creation (rights management) - File sharing between operating systems 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 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"> - How to partition a disk - Setting up the environment - Set the language used - Manage groups and users - Manage folder and file permissions - Configuring an SSH server - Mount partitions belonging to other operating systems - Installing and configuring a web server 		

Name(s) of person(s) in charge	Aymeric FOUCHAULT & Jordan BANKOLE
Bibliography/webography	https://gbp.resinfo.org/?p=261

[B-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	<p>Get people thinking about how to work on a project on their own and in a group.</p> <ul style="list-style-type: none"> - Collaborate as part of a team, sharing values and pooling knowledge, resources, tools and skills with a view to production. - Work independently. - Take the initiative. 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Work methodology - Group conflict management - Task management tools 		
Teaching methods and/or resources	<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>		
Evaluation methods	<p>Reviews are evaluated on the following points:</p> <ul style="list-style-type: none"> - Breaking down the project into tasks - Distribution of work among group members - Implementation of work organization processes (time and task management tools, etc.) 		
Name(s) of person(s) in charge	Gildas VINSON		

Bibliography/webography	https://asana.com/fr/resources/it-project-management
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[B-PRO-100] Professional communication I

2 ECTS	Professional communication I		
Duration in hours	Course: 1	TP/TD: 9	Project: 40
ECUE prerequisites	Acquis de terminale		
Objectives of the ECUE	<p>Implement the basics of professional-quality written and oral communication.</p> <ul style="list-style-type: none"> - Argue by being able to take a position between different options and to explain, taking into account theoretical and pragmatic frameworks. - Express yourself fluently in writing, using French registers appropriate to the context. - Express yourself with ease orally, in front of an audience, using different registers of the French language. 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Writing a polished, professional e-mail - Creating an effective, impactful presentation - Defend your position in a courteous manner 		
Teaching methods and/or resources	<p>Blended learning :</p> <ul style="list-style-type: none"> - Asynchronous video and PDF courses (online) - Synchronous face-to-face workshops 		
Evaluation methods	<p>Written work is assessed by peers + checks carried out by the teaching team in 5 areas:</p> <ul style="list-style-type: none"> - Rigor and compliance with standards - Relevance and impact - Language skills - Appropriate tone, position and vocabulary - Page layout 		

Name(s) of person(s) in charge	Juliette GIBERT
Bibliography/webography	<ul style="list-style-type: none"> - DUBOST M. and TURQUE C., <i>Améliorer son expression écrite et orale: Toutes les clés</i> (2018), ellipses - Bescherelle, <i>Rédiger et communiquer efficacement pour optimiser ses écrits</i>, 2021, Hatier

[B-PSU-100] UNIX system programming

5 ECTS	Unix 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"> - File management and rights - Advanced terminal management (signals) - Discovering and using a library (Ncurses) 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 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	Joffrey RIELA & Johan Tay-Nam		
Bibliography/webography	https://man7.org/linux/man-pages/man1/ls.1.html https://man7.org/linux/man-pages/man7/signal.7.html		

Semester 2 modules

[G-AIA-200] Introduction to data analysis

2 ECTS	Introduction to data analysis		
Duration in hours	Course: 1	TP/TD : 3	Project: 45
ECUE prerequisites	<ul style="list-style-type: none"> - Fundamentals of C programming. - Basic understanding of algorithmic principles 		
Objectives of the ECUE	<ul style="list-style-type: none"> - Introduce the principles of "artificial intelligence" through data analysis - Create a library to facilitate data analysis 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Recreate a library for reading and analyzing data in CSV format - Pandas discovery 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 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	https://pandas.pydata.org/		

[G-AIA-201] Data analysis & A.I.

4 ECTS	Data analysis & A.I.		
Duration in hours	Course: 1	TP/TD : 6	Project: 90
ECUE prerequisites	<ul style="list-style-type: none"> - Fundamentals of C programming. - Basic understanding of algorithmic principles 		
Objectives of the ECUE	<ul style="list-style-type: none"> - Use data analysis tools to select, clean and analyze data - Discovering how to use Jupyter 		

	<ul style="list-style-type: none"> - Using data with an A.I. model
Teaching methods and/or resources	<ul style="list-style-type: none"> - 1 6-week project to be carried out in groups of 3.
Evaluation methods	<ul style="list-style-type: none"> - The project is evaluated by automated tests and a presentation.
Name(s) of person(s) in charge	Julien CALENGE & Léo SAROCHAR
Bibliography/webography	https://pandas.pydata.org/ https://jupyter.org/

[B-CPE-200] Elementary programming

8 ECTS	Elementary programming		
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"> - Shortest path search algorithm - Graph theory 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 3 projects, each focused on understanding a different type of algorithm and data structure. - The final project is an "assessment" project, applying the concepts learned during the course of the year. 		
Evaluation methods	<p>Each project is evaluated by automated tests assessing 5 different skills for each project:</p> <ul style="list-style-type: none"> - Algorithm application 		

	<ul style="list-style-type: none"> - Data structure - Optimization - Syntax analysis - Robustness
Name(s) of person(s) in charge	Kevin SPEGT
Bibliography/webography	http://sdz.tdct.org/sdz/le-pathfinding-avec-dijkstra.html https://fre.myservername.com/graph-implementation-c-using-adjacency-list https://www.techiedelight.com/fr/implement-graph-data-structure-c/

[G-CUS-200] Computer literacy - A.I. fundamentals

1 ECTS	Computer literacy - A.I. 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)	<ul style="list-style-type: none"> - Machine Learning: supervised, unsupervised and reinforcement learning - Neural networks - Automatic natural language processing - Ethics and Bias 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Self-paced learning in MOOC format 		
Evaluation methods	<ul style="list-style-type: none"> - Evaluation via multiple-choice questionnaire 		
Name(s) of person(s) in charge	Jonathan NAU		

Bibliography/webography	https://learn.microsoft.com/fr-fr/credentials/certifications/azure-ai-fundamentals/
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[G-CUS-201] Computer literacy - Fundamentals of cybersecurity

1 ECTS	Computer literacy - Cybersecurity fundamentals		
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"> - Triad CIA: Confidentiality, Integrity and Availability - Cryptography - Risk management - Network security 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Self-paced learning in MOOC format 		
Assessment methods	<ul style="list-style-type: none"> - Evaluation via multiple-choice questionnaire 		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	https://learn.microsoft.com/en-us/credentials/certifications/security-compliance-and-identity-fundamentals https://learn.microsoft.com/en-us/training/paths/describe-basic-concepts-of-cybersecurity/		

[B-DOP-200] Introduction to DevOps

2 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"> - Containerization with Docker - Basic orchestration with Docker Compose - Task automation with GitHub Actions
Teaching methods and/or resources	<ul style="list-style-type: none"> - 1 project to deploy an existing application using containers. - 1 second project focusing on the principles of process automation via Github Actions
Evaluation methods	<ul style="list-style-type: none"> - The first project is evaluated via automated tests, and the second via a presentation. - The module concludes with a review in which students demonstrate their understanding of specific principles.
Name(s) of person(s) in charge	Hugo PEREZ
Bibliography/webography	https://www.docker.com/ https://docs.docker.com/compose/ https://github.com/features/actions

[B-ENG-200] English

2 ECTS	English		
Duration in hours	Course: 5	TP/TD: 25	Project: 30
ECUE prerequisites	Terminal fundamentals		
Objectives of the ECUE	Improve English language skills in general, with a particular focus on speaking.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Reading comprehension - Writing production 		

	<ul style="list-style-type: none"> - Listening comprehension - Oral interaction - Oral production
Teaching methods and/or resources	<ul style="list-style-type: none"> - Choice of several projects - Weekly English-language exchange sessions
Evaluation methods	<ul style="list-style-type: none"> - Written project file - Oral presentation on the project - Participation in exchange sessions
Name(s) of person(s) in charge	Daniel COTTON
Bibliography/webography	https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDC TMContent?documentId=090000168045bb57

[G-ING-200] Software engineering

2 ECTS	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	Learn to use an external library, and understand its documentation. Learn how to design and create a user interface Learn the basics of game and level design		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Use and understanding of an external C graphics library (CSFML) 		

	<ul style="list-style-type: none"> - Graphical visualization of raw data
Teaching methods and/or resources	<ul style="list-style-type: none"> - Group synthesis project - Practical work sessions on each project - Project follow-up sessions for progress
Evaluation methods	<ul style="list-style-type: none"> - An automatic game - Part manual correction, code review - A keynote
Name(s) of person(s) in charge	Tom KLEIN
Bibliography/webography	CSFML (SFML / Download / Bindings) (SFML-dev.org) Level design - Wikipedia (wikipedia.org) Game design - Wikipedia (wikipedia.org)

[G-ING-201] Software Engineering II

4 ECTS	Software Engineering II		
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	Learn to use an external library, and understand its documentation. Learn how to design and create a user interface Learn the basics of game and level design		
ECUE content (Main points)	<ul style="list-style-type: none"> - Use and understanding of an external C graphics library (CSFML) - Design and create a video game by thinking about game design and level design 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Group synthesis project - Practical work sessions on each project 		

	<ul style="list-style-type: none"> - Project follow-up sessions for progress
Evaluation methods	<ul style="list-style-type: none"> - An automatic game - Part manual correction, code review - A keynote
Name(s) of person(s) in charge	Tom KLEIN
Bibliography/webography	CSFML (SFML / Download / Bindings) (sfml-dev.org) Level design - Wikipedia (wikipedia.org) Game design - Wikipedia (wikipedia.org)

[B-MAT-200] Mathematics

2 ECTS	Mathematics		
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"> - Numerical sequences - Calculation and analysis of functions (derivatives, integrals) 		
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 GROSZ		
Bibliography/webography	https://fr.wikipedia.org/wiki/D%C3%A9rivation_num%C3%A9rique		

[G-PCP-200] Personal and Group Development

2 ECTS	Collective Personal Development		
Duration in hours	Course: 20	TP/TD: 30	Project: 0
ECUE prerequisites	No		
Objectives of the ECUE	Help students identify the skills they need to set life goals that can improve their employability prospects, boost their confidence and lead to a more fulfilling, higher-quality life.		
ECUE content <i>(Main points)</i>	<ul style="list-style-type: none"> - Time management - Improve your self-confidence - Public speaking - Understanding the job search 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Lectures and workshops on the different themes of the module by specialist supervisors in each field. 		
Evaluation methods	<p>Assessment of achievements during workshops: written production, oral production, project.</p> <p>Through these productions, the teacher will ensure the acquisition of the expected skills.</p>		
Name(s) of person(s) in charge	Laurence ABIASSI and Julie PERRIER		
Bibliography/webography			

[B-PMP-200] Introduction to project management

2 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"> - Developing test policies - Collaborate within a team, sharing values and pooling knowledge, resources, tools and skills with a view to production. 		

	<ul style="list-style-type: none"> - Work independently. - Take the initiative. - Manage a project (design, steering, team coordination, implementation and management, evaluation, dissemination) that can mobilize multidisciplinary skills within a collaborative framework.
<p>ECUE content</p> <p><i>(Main points covered)</i></p>	<ul style="list-style-type: none"> - Work methodology - Group conflict management - Task management tools - Unit testing - Integration tests
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	<p>Reviews are evaluated on the following points:</p> <ul style="list-style-type: none"> - Breaking down the project into tasks - Distribution of work among group members - Implementation of work organization processes (time and task management tools, etc.) - Setting up a test policy - Unit test coverage rate
Name(s) of person(s) in charge	Gildas VINSON
Bibliography/webography	https://asana.com/fr/resources/it-project-management https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022

2 ECTS	Professional communication		
Duration in hours	Course: 1	TP/TD: 9	Project: 40
ECUE prerequisites	Acquis de terminale		
Objectives of the ECUE	<p>Implement the basics of professional-quality written and oral communication.</p> <ul style="list-style-type: none"> - Argue by being able to take a position between different options and to explain, taking into account theoretical and pragmatic frameworks. - Express yourself fluently in writing, using French registers appropriate to the context. - Express yourself with ease orally, in front of an audience, using different registers of the French language. 		
ECUE content <i>(Main points covered)</i>	<p>Know how to put yourself at the right level for the person you're talking to, explain exhaustively, use layout methods to clarify your message, memo writing codes, adopt an effective approach to job application research and follow-up, motivational message codes.</p>		
Teaching methods and/or resources	<p>Blended learning :</p> <ul style="list-style-type: none"> - Asynchronous video and PDF courses (online) - Synchronous face-to-face workshops 		
Assessment methods	<p>Written work is assessed by peers + checks carried out by the teaching team in 5 areas:</p> <ul style="list-style-type: none"> - Rigor and compliance with standards - Relevance and impact - Language skills - Appropriate tone, position and vocabulary - Page layout 		
Name(s) of person(s) in charge	Juliette GIBERT		

Bibliography/webography	<ul style="list-style-type: none"> - DUBOST M. and TURQUE C., <i>Améliorer son expression écrite et orale: Toutes les clés</i> (2018), ellipses - Bescherelle, <i>Rédiger et communiquer efficacement pour optimiser ses écrits</i>, 2021, Hatier
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[B-PSU-200] Shell programming

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

	https://fr.wikipedia.org/wiki/Analyse_LL
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[G-SEC-200] Introduction to cyber security

2 ECTS	Introduction to 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 (Main points covered)	<ul style="list-style-type: none"> - Command injection - SQL injection - SSTI (Server Side Template Injection) operation - SUID vulnerability exploitation - Exploiting vulnerabilities Capabilities - Exploitation of CVEs (Common Vulnerabilities Exposures) 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability. - Capture The Flag project to be carried out in pairs 		
Evaluation methods	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.		
Name(s) of person(s) in charge	Théo CAMPOS		
Bibliography/webography	https://tryhackme.com/ https://www.root-me.org/fr/Capture-The-Flag/		

[G-SEC-201] Binary security

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

[B-WEB-200] Introduction to web development

2 ECTS	Introduction to web development		
Duration in hours	Course: 1	TP/TD : 5	Project: 40
ECUE prerequisites	<ul style="list-style-type: none"> - Programming fundamentals 		
Objectives of the ECUE	<ul style="list-style-type: none"> - Understand the basic principles of web development - Discovering the back-end/front-end difference - Discover how to use a database - Introduction to NodeJS and REST APIs 		
ECUE content	<ul style="list-style-type: none"> - Creating a to-do list application 		

<i>(Main points covered)</i>	<ul style="list-style-type: none"> - Communication between back-end and front-end via an API - SQL database - http protocol (verbs, response code, authentication, etc.) 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 1 project for a group of 2 or 3 people to create an API for managing a to-do list. 		
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"> - Project architecture - Authentication implementation - Persistence through a database - How the API works - Respecting REST conventions 		
Name(s) of person(s) in charge	Enes KOC & Jonathan NAU		
Bibliography/webography	https://blog.logrocket.com/build-rest-api-node-express-mysql/ https://developer.mozilla.org/fr/docs/Learn/Server-side/Express_Nodejs/Introduction		

Semester 4 Modules

[B-ASM-400] Assembler x86_64

2 ECTS	x86_64 assembler		
Duration in hours	Course: 1	TP/TD : 5	Project: 40
ECUE prerequisites	Basic knowledge of the C language		

Objectives of the ECUE	Discover x86-64 assembler programming so you can write small applications in assembler and understand disassembled code.
ECUE content (Main points covered)	Creation of a dynamic library containing a number of glibc functions recoded in x86-64 assembler.
Teaching methods and/or resources	1 individual project
Evaluation methods	Automated project testing
Name(s) of person(s) in charge	Ilias GROS Y
Bibliography/webography	https://en.wikipedia.org/wiki/X86-64 https://www.intel.com/content/www/us/en/developer/articles/technical/intel-sdm.html

[B-CCP-400] Competitive programming

4 ECTS	Competitive 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	<ul style="list-style-type: none"> - Discover parallelism and concurrent programming 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Discover threads, mutexes and conditional variables - Implementation of a parallel producer/consumer diagram. - Managing competition between multiple processes and threads 		
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	https://blog.engineering.publicissapient.fr/2008/08/13/programmation-concurrentielle-notions-fondamentales/

[G-CNA-400] Computer Numerical Analysis

3 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"> - Probability (random variables, random experiments, events, binomial law, Poisson's law) - Combinatorial calculation - Statistics (descriptive statistics, correlations, sampling) - Expectation, variance, standard deviation 		
Teaching methods and/or resources	9 2-week projects to be carried out in pairs		
Evaluation methods	<p>Each project is evaluated using automated tests to determine the ability to implement mathematical concepts within an IT project.</p> <p>There are also 2 reviews to assess understanding of the mathematical concepts themselves.</p>		
Name(s) of person(s) in charge	Ilias GROSZ		
Bibliography/webography			

[G-CUS-400] Computer literacy - Networks and communication

1 ECTS	Computer literacy - Networks and communication		
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"> - OSI model - Network devices (router, switch, gateway) - History of telecommunications - Internet 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Autonomous learning on a corpus of resources provided 		
Evaluation methods	<ul style="list-style-type: none"> - 3 Q.C.M. 		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	https://fr.wikipedia.org/wiki/Mod%C3%A8le_OSI https://www.oreilly.com/library/view/routing-and-switching/9780133476200/		

[G-CUS-401] Computer literacy - Video games

1 ECTS	Computer literacy - 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)	<ul style="list-style-type: none"> - The professions behind video games - Working conditions in the video game industry - How a "game loop" works - The societal challenges of video games 		

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	http://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdf https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women

[B-DOP-400] DevOps

3 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"> - Task automation with Jenkins - Configuration management with Ansible 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - 1 project to discover the concept of "configuration-as-code" and deploy an instance of Jenkins - 1 project discovering task automation via Ansible 		
Evaluation methods	<ul style="list-style-type: none"> - The first project is evaluated via automated tests, and the second via a presentation. - The module concludes with a review, enabling students to demonstrate their understanding of specific principles. 		
Name(s) of person(s) in charge	Hugo PEREZ		
Bibliography/webography	https://www.jenkins.io/ https://www.ansible.com/		

[B-ENG-400] English

2 ECTS	English		
Duration in hours	Course: 5	TP/TD: 25	Project: 30
ECUE prerequisites	Terminal fundamentals		
Objectives of the ECUE	Improve English language skills in general, with a particular focus on speaking.		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Reading comprehension - Writing production - Listening comprehension - Oral interaction - Oral production 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Choice of several projects - Weekly English-language exchange sessions 		
Evaluation methods	<ul style="list-style-type: none"> - Written project file - Oral presentation on the project - Participation in exchange sessions 		
Name(s) of person(s) in charge	Daniel COTTON		
Bibliography/webography	https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDC TMContent?documentId=090000168045bb57		

[B-FUN-400] Functional Programming

5 ECTS	Functional Programming		
Duration in hours	Course: 3	TP/TD: 10	Project: 115
ECUE prerequisites	Basic functional programming (B-PDG-300)		
Objectives of the ECUE	Deepen your understanding of the functional paradigm and the Haskell language.		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Application design based on the functional paradigm - Recursive functions and higher-order functions - Handling lists, tuples and data structures - I/O management with the IO monad - Error handling with the Maybe monad 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Implementation of Wolfram's elementary cellular automata in Haskell (two-week project to be carried out alone) - Implementation of an image compression tool using the K-Means algorithm - Conversion between different text formats (markdown, html, json) 		
Evaluation methods	Automated project testing		
Name(s) of person(s) in charge	Marc PLANARD		
Bibliography/webography	https://mathworld.wolfram.com/ElementaryCellularAutomaton.html https://towardsdatascience.com/three-versions-of-k-means-cf939b65f4ea		

[B-NWP-400] Network programming

5 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"> - Discover network programming using TCP/IP sockets
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Creating a client/server architecture - Manage several customers in parallel - Using TCP packets - Implementing an existing protocol - Create and document an "in-house" protocol
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	http://manpagesfr.free.fr/man/man2/socket.2.html https://www.cnetfrance.fr/news/le-monde-est-plus-connecte-que-jamais-495-milliards-de-personnes-utilisent-internet-en-2022-39946508.htm

[B-OOP-400] Object-oriented programming

6 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"> - Application of object-oriented programming concepts discovered in the previous module. <p>Group work methodology.</p>		
ECUE content (Main points)	<p>Through 3 projects, acquire or reinforce the following concepts:</p> <ul style="list-style-type: none"> - Interfaces, abstract classes, polymorphism. 		

	<ul style="list-style-type: none"> - Encapsulation. <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"> - 1 introductory session to the project - 1 design follow-up <p>1 implementation follow-up</p> <ul style="list-style-type: none"> - 1 defense
Evaluation methods	Identification of student skills based on project presentations.
Name(s) of person(s) in charge	Guillaume DEVOILLE & Mattéo VOLPI
Bibliography/webography	https://isocpp.org/

[G-PCP-400] Personal and Collective Development

2 ECTS	Collective Personal Development		
Duration in hours	Course: 20	TP/TD: 30	Project: 0
ECUE prerequisites	No		
Objectives of the ECUE	Help students identify the skills they need to set life goals that can improve their employability prospects, boost their confidence and lead to a more fulfilling, higher-quality life.		
ECUE content (Main points)	<ul style="list-style-type: none"> - Time management - Improve your self-confidence - Public speaking - Understanding the job search 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Lectures and workshops on the different themes of the module by specialist supervisors in each field. 		
Evaluation methods	Assessment of achievements during workshops: written production, oral production, project.		

	Through these productions, the teacher will ensure the acquisition of the expected skills.
Name(s) of person(s) in charge	Laurence ABIASSI and Julie PERRIER
Bibliography/webography	

[B-PMP-400] Project management

2 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	<p>Deepen your knowledge of project and group management.</p> <ul style="list-style-type: none"> - Developing test policies - Collaborate within a team, sharing values and pooling knowledge, resources, tools and skills with a view to production. - Work independently. - Take the initiative. - Manage a project (design, steering, team coordination, implementation and management, evaluation, dissemination) that can mobilize multidisciplinary skills within a collaborative framework. - Deploy IT applications, manage test phases and upgrades. 		
ECUE content <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Work methodology - Group conflict management - Task management tools - Unit testing 		

	- Integration tests
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	Evaluation of organizational quality reviews.
Name(s) of person(s) in charge	Gildas VINSON
Bibliography/webography	https://asana.com/fr/resources/it-project-management https://learn.microsoft.com/fr-fr/visualstudio/test/unit-test-basics?view=vs-2022

[B-PRO-400] Professional communication

2 ECTS	Professional communication		
Duration in hours	Course: 1	TP/TD: 9	Project: 40
ECUE prerequisites	Acquis de terminale		
Objectives of the ECUE	Professionalize your writing for corporate communication: present your work, take a step back from your career, assume a position of authority. <ul style="list-style-type: none"> - Write a slide show to obtain funding for a project - Drawing up an experience report - Writing a reframing e-mail 		
ECUE content (Main points covered)	Adapting your speech to a specific audience: funders. Writing codes for slideshows and e-mails. Master your professional tone in a tense situation. Reframing without aggression.		
Teaching methods and/or resources	Blended learning : <ul style="list-style-type: none"> - Asynchronous video and PDF courses (online) - Synchronous face-to-face workshops 		
Evaluation methods	Written work is assessed by peers + checks carried out by the teaching team in 5 areas:		

	<ul style="list-style-type: none"> - Rigor and compliance with standards - Relevance and impact - Language skills - Appropriate tone, position and vocabulary - Page layout
Name(s) of person(s) in charge	Juliette GIBERT
Bibliography/webography	<ul style="list-style-type: none"> - DUBOST M. and TURQUE C., <i>Améliorer son expression écrite et orale: Toutes les clés</i> (2018), ellipses - Bescherelle, <i>Rédiger et communiquer efficacement pour optimiser ses écrits</i>, 2021, Hatier

[B-PSU-400] ELF binary instrumentation

5 ECTS	ELF binary instrumentation		
Duration in hours	Course: 2	TP/TD: 13	Project: 110
ECUE prerequisites	Knowledge of C programming		
Objectives of the ECUE	Discover how an ELF file works and the operating principles of a debugger		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Find out what information can be retrieved from an ELF file - Discerning kernel space from user space - Find out what information can be retrieved from a process - Exploring the concept of system calls in greater depth - Learn how to trace program execution - Learn to decode x86-64 binary instructions 		
Teaching methods and/or resources	3 projects, each designed to introduce new concepts: <ul style="list-style-type: none"> - Retrieving symbols and information from an ELF file 		

	<ul style="list-style-type: none"> - Creation of a system call tracer for ELF files - Creation of a function call tracer for ELF files
Evaluation methods	Automated project testing
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	https://www.intel.com/content/www/us/en/developer/articles/technical/intel-sdm.html

[B-SEC-400] Cyber security

2 ECTS	Cyber security		
Duration in hours	Course: 1	TP/TD : 4	Project: 45
ECUE prerequisites	Basic knowledge of cyber security (B-SEC-200)		
Objectives of the ECUE	Discover advanced hacking, enumeration and privilege elevation techniques.		
ECUE content (Main points)	<ul style="list-style-type: none"> - Command injection - SQL injection - SSTI (Server Side Template Injection) operation - SUID vulnerability exploitation - Exploiting vulnerabilities Capabilities - Exploitation of CVEs (Common Vulnerabilities Exposures) 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability. <p>Capture The Flag project to be carried out in pairs</p>		
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	Théo CAMPOS
Bibliography/webography	https://tryhackme.com/ https://www.root-me.org/fr/Capture-The-Flag/

[B-YEP-400] Year-end project

5 ECTS	Year-end project		
Duration in hours	Course: 1	TP/TD : 8	Project: 120
ECUE prerequisites	<ul style="list-style-type: none"> - C++ object-oriented programming - Knowledge of C programming - C/C++ network implementation skills - Basic skills in using a graphics library (SFML) 		
Objectives of the ECUE	<ul style="list-style-type: none"> - Apply the year's key concepts to a substantial project 		
ECUE content (Main points)	<ul style="list-style-type: none"> - Programming a graphical interface in C++ using SFML - C server capable of managing multiple clients - Implementing game logic - Development of small artificial intelligences capable of coordinating to win the game - Teamwork 		
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	https://fr.wikipedia.org/wiki/Zaphod_Beeblebrox		

Semester 5 Modules

[B-AIA-500] Artificial intelligence - Game theory

3 ECTS	Artificial intelligence - Game theory		
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"> - Discover game theory - Deepen your knowledge of A.I. 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Game theory - Min/max and alpha-beta pruning - Technical constraints (memory, speed) 		
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	https://www.jeu-de-go.com/gomoku-ninuki.html https://www.economie.gouv.fr/facileco/john-nash https://www.universalis.fr/encyclopedie/theorie-des-jeux/		

[B-CNA-500] Computer Numerical Analysis

3 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"> - Cryptography - Neural network 		

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 GROSZ
Bibliography/webography	

[B-CPP-500] C++ Advanced

7 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"> - Network programming - Software architecture - Software engineering (dependency management, cross-platform, source code management, etc.) - Technical documentation 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Discovery of ECS architecture through a TD - In "project mode" for the course of the module - Intermediary points to validate project progress 		
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	Game Engine Architecture - Jason Gregory - ISBN-13: 9781138035454 https://fabiansanglard.net/quake3/index.php		

[G-CUS-500] Computer literacy - Algorithms

1 ECTS	Computer literacy - 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"> - Theoretical discovery of data structures - The big names in algorithms - Different paradigms - Asymptotic comparison - Algorithmic complexity 		
Teaching methods and/or resources	<ul style="list-style-type: none"> - Independent learning on a corpus of provided resources 		
Evaluation methods	<ul style="list-style-type: none"> - 3 Q.C.M. 		
Name(s) of person(s) in charge	Jonathan NAU		
Bibliography/webography	https://en.wikipedia.org/wiki/Donald_Knuth https://www.101computing.net/heuristic-approaches-to-problem-solving/ https://www.pnas.org/doi/pdf/10.1073/pnas.1418680112		

[G-CUS-501] Computer literacy - Video games

1 ECTS	Computer literacy - 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	<ul style="list-style-type: none"> - The professions behind video games 		

<i>(Main points covered)</i>	<ul style="list-style-type: none"> - Working conditions in the video game industry - How a "game loop" works - The societal challenges of video games
Teaching methods and/or resources	<ul style="list-style-type: none"> - Independent learning on a corpus of provided resources
Evaluation methods	<ul style="list-style-type: none"> - 3 Q.C.M.
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	http://snjv.org/wp-content/uploads/2021/09/Barometre-SNJV-2021-1.pdf https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women

[B-DEV-500] Application development

7 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 <i>(Main points covered)</i>	<ul style="list-style-type: none"> - Exploring languages and technologies - Project planning - Using REST APIs - Oauth2 - Software engineering (dependency management, cross-platform, source code management, etc.) - Technical documentation 		
Teaching methods and/or resources	A 5-student group project divided into 3 phases:		

	<ul style="list-style-type: none"> - Planning - Minimum Viable Product - Final product
Evaluation methods	<p>3 presentations, each concluding a phase of the project.</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>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.</p>
Name(s) of person(s) in charge	Jonathan NAU
Bibliography/webography	https://ifttt.com/ https://fr.smartsheet.com/content/it-project-plan

[B-DOP-500] Advanced DevOps

3 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"> - Orchestration with Kubernetes - Use Docker, Jenkins, Ansible, and Kubernetes in a single project
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"> - The first project is evaluated via automated tests, and the second via a presentation. - The module concludes with a review in which students demonstrate their understanding of specific principles.
Name(s) of person(s) in charge	Hugo PEREZ
Bibliography/webography	https://kubernetes.io/

[B-ENG-500] English

2 ECTS	English		
Duration in hours	Course: 5	TP/TD: 25	Project: 30
ECUE prerequisites	Terminal fundamentals		
Objectives of the ECUE	Improve English language skills in general, with a particular focus on speaking.		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Reading comprehension - Writing production - Listening comprehension - Oral interaction - Oral production 		

Teaching methods and/or resources	<ul style="list-style-type: none"> - Choice of several projects - Weekly English-language exchange sessions
Evaluation methods	<ul style="list-style-type: none"> - Written project file - Oral presentation on the project - Participation in exchange sessions
Name(s) of person(s) in charge	Daniel COTTON
Bibliography/webography	https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDC TMContent?documentId=090000168045bb57

[B-FUN-500] Functional Programming

7 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"> - Syntax analysis using top-down recursion and combinators. - Techniques for implementing this parser in Haskell. - Syntax analysis of symbolic expressions (LISP) - Abstract syntax tree - Interpretation by syntax tree traversal - Stack-machine virtual machine - Compilation 		

Teaching methods and/or resources	<ul style="list-style-type: none"> - Implementation of a LISP interpreter using environment passing and syntax tree traversal, in Haskell. - Implementation of a combinatorial parsing library in Haskell. - Implementing a compiler - Virtual machine implementation (optional)
Evaluation methods	Intermediate and final defense
Name(s) of person(s) in charge	Marc PLANARD and Gabriel TOUBLANC
Bibliography/webography	http://languagelog.ldc.upenn.edu/myl/llog/jmc.pdf https://www.aosabook.org/en/500L/a-python-interpreter-written-in-python.html

[B-PRO-500] Professional setting

8 ECTS	Professional situations		
Duration in hours	Course: N/A	TP/TD : N/A	Project: 175
ECUE prerequisites	No		
Objectives of the ECUE	<ul style="list-style-type: none"> - Perfect your learning through the world of business - Gain additional professional experience 		
ECUE content (Main points covered)	<ul style="list-style-type: none"> - Discovering the world of business - Applying the school's "learning to learn" pedagogy - Adapt to a new environment and new technologies 		
Teaching methods and/or resources	Part-time internship (up to 2 days a week) OR in-house work experience projects		
Evaluation methods	<ul style="list-style-type: none"> - A written internship report - An oral presentation - Evaluation by the company 		

Name(s) of person(s) in charge	Gildas VINSON
Bibliography/webography	https://journals.openedition.org/edso/714?lang=fr https://www.enseignementsup-recherche.gouv.fr/fr/guide-des-stages-etudiants-informations-pratiques-46518

[B-PRO-510] Professional communication

2 ECTS	Professional communication		
Duration in hours	Course: 1	TP/TD: 9	Project: 40
ECUE prerequisites	Acquis de terminale		
Objectives of the ECUE	<p>Gain autonomy in your speech. Know how to communicate with the general public, follow a conversation, organize the work of your team, produce a complex argumentative speech.</p> <ul style="list-style-type: none"> - Writing argumentative texts for a specific purpose and audience - Writing informative texts - Produce identified and well-presented documents - Write clearly and precisely - Check the quality of your writing before handing it in. 		
ECUE content (Main points)	Journalistic writing: the different types of articles and their specific writing codes, the inverted pyramid plan. Different types of argument, the argument chain.		
Teaching methods and/or resources	<p>Blended learning :</p> <ul style="list-style-type: none"> - Asynchronous video and PDF courses (online) - Synchronous face-to-face workshops 		
Evaluation methods	<p>Written work is assessed by peers + checks carried out by the teaching team in 5 areas:</p> <ul style="list-style-type: none"> - Rigor and compliance with standards 		

	<ul style="list-style-type: none"> - Relevance and impact - Language skills - Appropriate tone, position and vocabulary - Page layout
Name(s) of person(s) in charge	Juliette GIBERT
Bibliography/webography	<ul style="list-style-type: none"> - DUBOST M. and TURQUE C., <i>Améliorer son expression écrite et orale: Toutes les clés</i> (2018), ellipses - Bescherelle, <i>Rédiger et communiquer efficacement pour optimiser ses écrits</i>, 2021, Hatier

[B-SEC-500] Cyber security

3 ECTS	Cyber 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 (Main points covered)	<ul style="list-style-type: none"> - Command injection - SQL injection - SSTI (Server Side Template Injection) operation - SUID vulnerability exploitation - Exploiting vulnerabilities Capabilities - Exploitation of CVEs (Common Vulnerabilities Exposures) - Exploiting vulnerabilities with SSH Tunneling - Exploiting vulnerabilities using reverse port forwarding 		

Teaching methods and/or resources	Attack on vulnerable virtual machines made available to students by the school, each focusing on different types of vulnerability.
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 & Julien CHASSARD
Bibliography/webography	https://book.hacktricks.xyz/generic-methodologies-and-resources/tunneling-and-port-forwarding

[B-SVR-500] Managing customer relations

4 ECTS	Prototyping		
Duration in hours	Course: 2	TP/TD : 3	Project: 95
ECUE prerequisites	Solid programming skills.		
Objectives of the ECUE	<ul style="list-style-type: none"> - Talking with customers to meet their needs - Adapting to any situation 		
ECUE content (Main points)	<ul style="list-style-type: none"> - Know how to communicate professionally - Developing a project within constraints - Anticipating the unpredictable - Saying "no 		
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/webography	https://www.myconnecting.fr/articles/adaptabilite-professionnelle-soft-		

	<u>skill/#:~:text=La%20meilleure%20fa%C3%A7on%20de%20s,s adapt%20%C3%A0%20the%20situation.</u>
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