BACHELOR IN COMPUTER SCIENCE

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CST

OBJECTIVES

The Bachelor in Computer Science aims to train computer scientists who are:

- Operational, capable of integrating into the competitive job market as soon as they graduate.
- Ready to pursue further studies in the various disciplines of computer science.
- Able to evolve in their careers in different sectors at the local, regional, and international levels.
- Capable of becoming decision-makers, innovators, and leaders in their profession.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

- Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Communicate effectively in a variety of professional contexts.
- Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

PROGRAM REQUIREMENTS

180 credits: Required courses (144 credits), Institution's elective courses (30 credits), Open elective courses (6 credits).
USJ General Education Program (32 credits - may be part of the above categories).

USJ General Education Program (32 Cr.)
English (4 Cr.)
English Level A (4 Cr.)
Arabic (4 Cr.)
Arabic Culture and Language (2 Cr.)
Arabic Language and the Media (2 Cr.) or
Arabic Language and the Arts (2 Cr.) or
Arabic Language: The Contemporary Novel, Cinema, and Theater (2 Cr.)
Courses taught in Arabic (2 Cr.)
Labor Law (2 Cr.)
Humanities (8 Cr.)
Ethics (2 Cr.)
Ethical Issues in Computer and Communication Engineering (2 Cr.)
Religious Sciences (2 Cr.)
Faith and Science (2 Cr.) or
Freemasonry and Religions (2 Cr.)
Civic and Citizen Engagement (2 Cr.)
Non-violent Communication (2 Cr.)
Other (2 Cr.)
USJ Values (2 Cr.)

Social Sciences (6 Cr.)
Entrepreneurship (4 Cr.)
Work Ready Now (4 Cr.)
Other (4 Cr.)
Fintech (2 Cr.) or
Marketing (2 Cr.)
Communication Techniques (4 Cr.)
Effective Communication and Time Management (4 Cr.).
Quantitative Techniques (8 Cr.)
Probability and Statistics (6 Cr.)

Fundamental Courses
Required Courses (144 credits including 16 from the USJ General Education Program)
Arithmetic (4 Cr.). Artificial Intelligence (4 Cr.). Calculus I (4 cr.). Calculus II (4 Cr.). Computer Organization (4 Cr.). Data Structures and Algorithms (6 Cr.). Design Patterns (4 Cr.). Digital Circuits (6 Cr.). Effective Communication and Time Management (4 Cr.). English level A (4 Cr.). Ethical Issues in Computer and Communication Engineering (2 Cr.). Foundations of Mathematics (4 cr.). Introduction to Computer Science (2 Cr.). Introduction to Networks (6 Cr.). Labor Law (4 Cr.). Linear Algebra (4 Cr.). Object-Oriented Programming and C++ (6 Cr.). Windows and UNIX Operating Systems (6 Cr.). Operating System Architecture (4 Cr.). Parallel Programming (4 Cr.). Probability and Statistics (6 Cr.). Programming I (6 Cr.). Programming II (6 Cr.). Relational Databases (4 Cr.). Software Development Project (6 Cr.). Software Engineering (6 Cr.). Web Technologies (4 Cr.). Web Programming (4 Cr.).

Institution's Elective Courses (16 Cr.)
Arabic Language: The Contemporary Novel, Cinema, and Theater (2 Cr.). Arabic Language and the Arts (2 Cr.). Arabic Language and the Media (2 Cr.). Cloud and Virtualization (4 Cr.). Compilers (4 Cr.). Data Analysis and Engineering (4 Cr.). Faith and Science (2 Cr.). Fintech (2 Cr.). Firmware Design (4 Cr.). Freemasonry and Religions (2 Cr.). Game Development (4 Cr.). Introduction to Cybersecurity (4 Cr.). Introduction to Routing and Switching (4 Cr.). Local Networks and Interconnections (4 Cr.). Machine Learning (4 Cr.). Non-Violent Communication (2 Cr.). Secure Coding (4 Cr.). Social Media (4 Cr.). Social Media Analysis (4 Cr.). USJ Values (2 Cr.).

Open Elective Courses (6 Cr.)

SUGGESTED STUDY PLAN

Semester 1

Code	Course Name	Credits
048BANML1	Calculus I	4
026CILOL1	Digital Circuits	6
048FOMML1	Foundations of Mathematics	4
026IN1CL1	Programming I	6
026INIFL1	Introduction to Computer Science	2
018ETCIL5	Ethical Issues in Computer and Communication Engineering	2
026COTML1	Effective Communication and Time Management	4
	Open Elective Courses (to choose from the list proposed by USJ)	2
	Total	**30**

Semester 2

Code	Course Name	Credits
048ALLML2	Linear Algebra	4
026ARORL2	Computer Organization	4

048ARIML2	Arithmetic	4
048FONML2	Calculus II	4
026IN2CL2	Programming II	6
026INREL4	Introduction to Networks	6
435LALML2 435LALAL2 435LRCTL2	Arabic Language and the Media Arabic Language and the Arts Arabic Language: The Contemporary Novel, Cinema, and Theater	2
	Total	**30**

Semester 3

Code	Course Name	Credits
026SYEXL3	Windows and UNIX Operating Systems	6
026BAD1L3	Relational Databases	4
026PTSTL1	Probability and Statistics	6
026STDAL3	Data Structures and Algorithms	6
026TWEBL2	Web Technologies	4
048FONML2	USJ Values	2
064CRSCI2 064FRMAL1	Faith and Science Freemasonry and Religions	2
	Open Elective Courses (to choose from the list proposed by USJ)	2
	Total	**32**

Semester 4

Code	Course Name	Credits
026DEPAL4	Design Patterns	4
026INARL4	Artificial Intelligence	4
026PROOL3	Object-Oriented Programming and C++	6
026BDNRL5	Non-Relational Databases	4
026ARSEL4	Operating System Architecture	4
026WEBDL5	Web Programming	4
026INRCL3 026GDEVL4	Introduction to Routing and Switching / Game Development	4
017FCNVI3	Non-Violent Communication	2
	Total	**32**

Semester 5

Code	Course Name	Credits
026ANNAL5	English level A	4
026POPAL4	Parallel Programming	4
026GELOL3	Software Engineering	6
026PRINL5	Software Development Project	4
026COTRL5	Labor Law	2

026DEANL6	Android Programming	4
026RLICL4 026INCYL4 026ANRSL6 026COMPL5	Local Networks and Interconnections Introduction to Cybersecurity Social Media Analysis Compilers	4
026MARKL5 026FINTL5	Marketing Fintech	2
	Total	**30**

Semester 6

Code	Course Name	Credits
026STENL6	Internship	12
026FIDEL5 026CLVLL6	Firmware Design Cloud and Virtualization	4
026SECOL3 026MALEL5 026DAANL4	Secure Coding Machine Learning Data Analysis and Engineering	4
026WNOWL1	Work Ready Now	4
	Open Elective Courses (to choose from the list proposed by USJ)	2
	Total	**26**

COURSE DESCRIPTION

026DEANL6 Android Programming 4 Cr.

This course offers an introduction to programming applications under Android, focusing on the particularity of development imposed by the particular structure of Android applications based on components (Activity, Service, Intents, Broadcast receiver, Data providers, etc.).
Prerequisite: Programming II (026IN2CL2)

435LALML2 / 435LALAL2 / 435LRCTL2: Arabic Language: The Contemporary Novel, Cinema and Theater / Arabic Language and the Arts/Arabic Language and the Media (2 Cr.)

These courses aim to provide students with an introduction to the Arabic language as well as to the culture and specific areas of their choice: media, arts or novel, theater and cinema. Students will develop their Arabic language skills while exploring the cultural aspects related to their chosen option. The courses focus on the acquisition of practical communication skills and the understanding of Arab culture, both contemporary and traditional.

026PROOL3 Object-Oriented Programming and C++ 6 Cr.

Prerequisite: Programming I (026IN1CL1)

048ARIML2 Arithmetic 4 Cr.

Students who have completed this course will be able to manipulate the usual algebraic structures and solve classic arithmetic problems in the ring of integers and that of polynomials with coefficients in a field. After becoming familiar with arithmetic in each of these sets, students are encouraged, at the end of the course, to question the existence of an underlying structure unifying the common arithmetic properties in each of these rings (Gauss lemma, Bézout's Identity, Euclid's theorem, fundamental theorem of arithmetic, etc.). This course covers algebraic structures (internal composition laws, groups, group morphisms, rings, fields), arithmetic in Z (Euclidean division and its consequences, GCD, LCM, Gauss lemma, Diophantine equations, prime numbers, factorization

of an integer into prime factors, congruence, rings Z/nZ), arithmetic in IK[X] (ring of polynomials, polynomial arithmetic, polynomial root, Taylor formula, irreducibility over IR vs irreducibility over C, relationship between coefficients and roots of a polynomial, field of rational fractions and decomposition into simple elements.

048BANML1 Calculus I 4 Cr.

In this course, students will be able to identify the elementary properties of real and complex numbers, sequences, and functions. This course covers real numbers, complex numbers, numerical sequences, functions of a real variable, differentiation, and common functions.

048FONML2 Calculus II 4 Cr.

In this course, students will be able to locally compare functions using the technique of limited development and study and carry out the calculation of the integral of functions over any interval. This course also allows students to solve differential equations of different types and to be introduced to a set of basic notions on functions of several variables. This course covers the local comparison of functions, primitives, the Riemann integral, integration over any interval, differential equations (DEs), and notions on functions of several variables.
Prerequisite: Calculus I (048BANML1)

026DEPAL4 Design Patterns 4 Cr.

This course will allow students who have already learned the notions of object-oriented programming in C++ or C#, to recognize and identify the design models and apply the design principles in their development. Students will be able to carry out an architectural analysis to produce the structural units, design the interfaces to ensure the integration of the different components of the solution, carry out the detailed design of the solution and develop the code. The course covers all the usual models: Abstract Factory - Builder - Factory Method - Object Pool - Prototype - Singleton - Adapter - Bridge - Composite - Decorator - Facade - Flyweight – Private Class Data - Proxy - Chain of responsibility - Command - Interpreter - Iterator - Mediator - Memento - Null Object - Observer - State - Strategy - Template method - Visitor.
Prerequisite: Programming II (026IN2CL2)

026CILOL1 Digital Circuits 6 Cr.

This course introduces the basic notions of digital electronics and presents the functional aspects of combinatorial and sequential digital circuits. It covers, in a first phase, coding, digitization systems, combinatorial circuits through the expression of a logic function, logic gates, Boolean algebra and the different reduction techniques. In a second phase, we approach state machines and sequential circuits with the different types of flip-flops and the implementations of sequential circuits such as counters and shift registers. For each system, we move from analysis to synthesis of circuits using different methods. Part of the lab work takes place around the Quartus II tool which allows students to implement digital circuits in a schematic or descriptive form and to simulate and analyze the circuits with signals and practical considerations. The other part of the lab work is reserved for the practical creation of digital circuits using integrated circuits on a breadboard to allow students to discover electronic components and their wiring.

026CLVLL6 Cloud and Virtualization 4 Cr.

This course introduces the concepts of Cloud, Data Centers, and virtualization with the different associated technologies. It covers the following topics: Introduction to Data Centers and the Cloud - Strategic Data Center - Principles and types of Data Centers - Data Center Design - Cloud Computing - Cloud Security - Software-Defined Approach for Networks (SDN), Data Center (SDDC) and Storage (SDS) - Virtualization - Workstation and Server Virtualization - Data Virtualization - Operating System Virtualization - Network Function Virtualization.
Prerequisite: Introduction to Networks (026INREL4).

026COMPL5 Compilers 4 Cr.

This course introduces the theoretical foundations and techniques used to design and implement a compiler. The concepts and techniques developed in this field are so general and fundamental that a computer scientist (and

even a non-computer scientist) will use them very often throughout their career: data processing, search engines, text analysis, etc. This course also allows students to deepen their knowledge of algorithms, optimization, and programming languages. It covers the following topics: - Languages and Compilers: different forms of translators, compiler environment, compiler structure, compilation phases, and grouping - Formal Languages: alphabet, languages, grammars, derivations, sentences, syntax tree, ambiguous grammars - Lexical Analysis: role of a lexical analyzer, lexical units and lexemes, design of a lexical analyzer, regular languages, regular expressions, Kleene's theorem, finite automata, Thompson construction, transformation of a non-deterministic finite automaton into a deterministic finite automaton, optimization of a deterministic finite automaton, implementation of a lexical analyzer, generator of a lexical analyzer (LEX). - Top-Down Syntactic Analysis: methods of syntactic analysis, hierarchy of context-free grammars, pushdown automaton, top-down syntactic analysis, LL(K) grammars, predictive context-free grammar, generator of a non-recursive LL(1) parser, recursive LL(1) parsing - Bottom-Up Syntactic Analysis: LR stack automaton, deterministic LR parsers, characteristic finite automaton, LR(0) parser, LR(1) parsers: SLR parser and LALR parser, use of ambiguous grammars, error handling - Semantic Analysis: syntax-directed translation, attributed grammars, synthesized and inherited attributes, S-attributed grammars, L-attributed grammars, top-down translation, bottom-up translation - Intermediate Code Generation: three-address code, assignments, Boolean expressions, arithmetic evaluation, control flow instructions, translation of declarations, machine-independent optimizations.
Prerequisite: Programming II (026IN2CL2)

026ARORL2 Computer Organization 4 Cr.

This course presents the components and foundations of computer organization and architecture. It introduces the basic concepts of computer architecture, the principles of architecture and organization of a computer, the evolution of computer architecture, the different performance evaluation criteria for computers, the different components of a computer and their interactions, interruption mechanisms, bus interconnections, and other interconnection interfaces, the different input/output (I/O) mechanisms and peripherals, the memory hierarchy of a computer system (including registers, cache, internal memory, external storage), the different instruction sets of microprocessors, as well as the instruction formats and addressing modes, the pipelining and optimization concepts implemented in scalar and superscalar microprocessors, the different parallel architectures and their implementations available on the market.
Prerequisite: Logic Circuits (026CILOL1)

026DAANL4 Data Analysis and Engineerin 4 Cr.

This course introduces Python programming, Pandas in Python, data cleaning, Matplotlib, Seaborn, descriptive statistics, Microsoft PowerBI, PostgreSQL, ETL solutions, Prehook, Hook, and Posthook, predictive analysis, inferential statistics, and data visualization.
Prerequisite: Relational Databases (026BAD1L3).

026STDAL3 Data Structures and Algorithms 6 Cr.

This course covers the following themes: complexity analysis, elementary data structures (linked lists, arrays, queues and stacks), search problems (sequential, dichotomy), sorting problems (elementary sorting, quicksort, merge sort), trees (characteristics, structure, traversal), string search algorithms, priority queues, maximize, graphs (characteristics, structures), graph algorithms (shortest path, connectivity, spanning tree, etc.), scheduling problems, flow problems (maximum flow, minimum cost flow, etc.), coupling problems, dynamic programming, linear programming (simplex).
Prerequisites: Programming I (026IN1CL1).

026COTML1 Effective Communication and Time Management 4 Cr.

Throughout this course students will develop their communication prowess, understanding the mechanics and methods of effective communication, while also honing their abilities to recognize diverse thinking patterns and preferred learning approaches in others. The course will empower students to become more adept at interpersonal interactions, leading to improved personal and business relationships.

In addition to communication skills, the course delves into the realm of time management, where students will learn invaluable techniques to optimize their productivity. They will master the art of organizing their workflow efficiently, utilizing planners and calendars effectively to prioritize tasks and meet deadlines. By developing strategies for effective planning and setting SMART goals, students will gain greater control over their time and increase their overall efficiency. Moreover, the course addresses common challenges such as procrastination and stress management, offering students tools and methods to overcome these obstacles.

026ANNAL5 English Level A 4 Cr.

This course aims to help students master technical English in order to facilitate their future integration into the professional world. It is carried out in parallel with the software development project to support students in writing their project report.
Prerequisite: English Level B

018ETCIL5 Ethical Issues in Computer and Communication Engineering 4 Cr.

Modern Communication Engineering allows for a constructive path to evaluate and assess professional behavior (individual and collective), both generally and specifically. It covers: the structure of ethical life, the interdependence of science, ethics, and law in the professional and institutional framework identifying values in social communication tools and goals (e.g., dignity, freedom, privacy, truth, safety, growth, development, production), applicable principles and guidelines for distinguishing between "Good and Evil."

064CRSCI2 Faith and Science 2 Cr.

This course aims to study scientific approaches to belief. Neuroscientists, psychoanalysts, and anthropologists have reflected on this concept and have conducted experimental, quantitative, and qualitative studies to arrive at results that we will address and interpret in a rational approach. By the end of this course, participants will be able to explain the main studies on religious belief in neuroscience, psychology, and anthropology and to engage in critical reflection on scientific approaches to belief in light of contemporary texts.

026FIDEL5 Firmware Design 4 Cr.

This course focuses on mastering C programming for microcontroller-based embedded system environments. It covers the internal structure and operation of microcontrollers, firmware architecture methodologies including low-level drivers, interfacing, and task-based programming. Topics include: computer architecture in limited resource platforms, C programming with pointers and data structures, code optimization for limited resources (RAM, program memory, and speed), firmware architecture including flat and task-based programming approaches (schedulers, RTOS, etc.), system debugging, simulation, emulation, and source control using GIT repositories (commit, checkout, push, pull, branch, merge, etc.).
Prerequisite: Object-Oriented Programming and C++ (026PROOL3).

026FINTL5 Fintech 2 Cr.

This course is designed for students interested in exploring how new technologies are disrupting the financial services industry, leading to radical changes in business models, products, applications, and the customer user interface. Participants will explore artificial intelligence, deep learning, blockchain technology, and application programming interfaces (APIs), as well as the specific opportunities for their application in the following areas: payments, credit, trading, and risk management. We will review the competitive advantages of leading Fintech companies and startups, global finance and technology leaders.

048FOMML1 Foundations of Mathematics 4 Cr.

This course is an introduction to the different types of reasoning, notations, and mathematical objects. Students who have completed this course are able to manipulate numbers, sets, functions, binary relations, and quotient sets. This course introduces the mathematical language, notions on set theory, binary relations and quotient sets, applications, and natural integers.

064FRMAL1 Freemasonry and Religions 2 Cr.

This course examines Freemasonry under the watchful eye of academic analysis: delving into its history, nature, missions, symbols, and exploring its complex relationships with Christianity and Islam.

026GDEVL4 Game Development 4 Cr.

This course is designed for students with a basic programming background. Its goal is to introduce them to game development using Unreal Engine. By the end of the course, students should be capable of creating a basic game. Topics covered include game development fundamentals, Unity Engine, interface navigation, scene building, Blueprints scripting, and creating both 2D platformers and 3D first-person shooter games.
Prerequisite: Programming I (026IN1CL1).

026STENL6 Internship 12 Cr.

The internship in a company allows students to carry out a project within a company and to familiarize themselves with the professional world and put their knowledge into practice, validate and refine their professional project or even make contacts to build a professional network.
Prerequisites: Programming II (026IN2CL2), Relational Databases (026BAD1L3).
Prerequisites: 120 required credits.

026INIFL1 Introduction to Computer Science 2 Cr.

The objective of this course is to provide students with a general introduction to many computer science concepts, to develop their curiosity and motivation for their field of study. It introduces theoretical computer science (complexity, theory of computation, cryptography, data structures and algorithms, Turing machines, automata, formal methods) and computer and software engineering (programming paradigms, programming languages, operating systems, software engineering best practices, version control, computer architecture and hardware, web/mobile development, high-performance software). It also covers machine learning, optimization, artificial intelligence, image processing, game development, virtual and augmented reality, computer science research, and competitive programming.

026INCYL4 Introduction to Cybersecurity 4 Cr.

This course introduces the basic concepts related to information and network security. It helps develop the skills necessary to troubleshoot and protect data networks from threats and attacks. It covers the following topics: Network Basics - Network Protocols and TCP/IP - Introduction to Cybersecurity - Computer Security and Malware - Physical Security - Information Security (confidentiality, integrity, and availability) - Types of Attacks and Protection Methods - Network Security, Level 2 and 3 Attacks.
Prerequisite: Introduction to Networks (026INREL4).

026INREL4 Introduction to Networks 6 Cr.

The objective of this course is to provide the fundamental concepts of networks and communication technologies, enabling students to develop basic practical and conceptual skills. This course, covering the first course of the Cisco CCNA Routing & Switching training, focuses on the OSI and TCP/IP models, the role of protocols and their interactions. The covered concepts are: definition of a network (LAN, MAN, WAN), the different types of media, equipment, and network topologies, Ethernet network and MAC address, basic configuration of a Cisco Switch, ARP protocol (meaning and manipulation of the ARP table), IPv4 and IPv6 protocols, routing a host and its IP configuration, the router and its basic configuration, IP addressing and network segmentation, TCP and UDP protocols, and application protocols (DHCP, DNS, FTP, http, SMTP/IMAP/POP).

026INRCL3 Introduction to Routing and Switching 4 Cr.

This course aims to familiarize students with the essential routing and switching techniques in small IPv4 and IPv6 networks. It covers the following topics: Introduction to LAN Architecture - Basic Switching Concepts and Configuration - Virtual LANs and Inter-VLAN Routing - Introduction and Basic Routing Configuration - Packet Transfer Principle and Routing Table - Static Routing - Dynamic Routing: RIPv1, RIPv2, and OSPF Single Area -

Access Control Lists - DHCPv4 and DHCPv6 Operation - Configuring a Router as a DHCP Server and DHCP Client for DHCPv4 and DHCPv6 - NAT Features and Configuration of Static NAT, Dynamic NAT, and PAT - Troubleshooting.
Prerequisite: Introduction to Networks (026INREL4).

026COTRL5 Labor Law 2 Cr.

This course aims to introduce students to the social protection that must be ensured by the legal rules applicable to the relations between the employer and the employee in Lebanon. After presenting the history of labor law and the trade union movement in Lebanon, the course first addresses the sources and institutions of labor law before delving deeper into access to employment as well as the conclusion of the employment contract and its execution. The issues raised by the labor law crisis in Lebanon and the collapse of social protection highlighted by the economic crisis are explored in depth.

048ALLML2 Linear Algebra 4 Cr.

Students who have completed this course will be familiar with the various properties of vector spaces, will be able to manipulate linear applications and matrices, will also be able to calculate their determinant and use it to calculate the rank and inverse of a matrix when it is invertible. Finally, they will be able to solve linear systems and diagonalize matrices. This course covers vector spaces, linear applications, matrices, determinants, reduction of endomorphisms and matrices.
Prerequisite: Foundations of Mathematics (048FOMML1)

026RLICL4 Local Networks and Interconnections 4 Cr.

This course focuses on the architecture, components, and operation of routers and switches in a larger and more complex data network. It introduces configuration of these devices for advanced functionalities. The course also emphasizes WAN technologies and network services required by converged applications in a complex network, allowing students to understand the criteria for selecting network devices and WAN technologies that meet network requirements.
Prerequisite: Introduction to Networks (026INREL4)

026MALEL5 Machine Learning 4 Cr.

Machine learning (ML) is a subfield of artificial intelligence. It is the science of making machines learn by example. The ultimate goal of ML is to create a computer capable of learning autonomously from examples. The main research topics in ML include: natural language understanding, computer vision, and self-driving cars. In this course, we will study the implementation of different algorithms using python with tensorflow and keras. We will present several algorithms such as decision trees, random forest, support vector machines, neural networks as well as other algorithms.
Prerequisites: Programming I (026IN1CL1).

026MARKL5 Marketing 2 Cr.

The objective of this course is to present basic marketing concepts in organizations. It is mainly aimed at beginners in the subject. It covers the following topics: introduction to basic marketing concepts - analysis of macro and micro environments - elements of strategic marketing: marketing tools, targeting, differentiation, segmentation, etc. - marketing strategies - marketing mix, offensive and defensive strategies, other strategies - e-commerce - internet marketing and examples - case studies of industrial companies - case study - evaluation.

026BDNRL5 Non-Relational Databases 4 Cr.

This course presents the different types of NoSQL databases. It covers the comparison between relational and non-relational databases, document-based databases (mongoDB, CouchDB), key-value stores (Rizk), column-based databases (HBase, Cassandra) and graph databases (Neo4j).
Prerequisite: Relational Databases (026BAD1L3)

017FCNVI3 Non-Violent Communication 2 Cr.

Non-Violent Communication (NVC) is a communication approach developed by Marshall Rosenberg in the 1970s. It allows us to understand how our way of thinking, expressing ourselves, and communicating with others is a fundamental factor that can generate violence, as well as facilitate communication and contribute to defusing conflicts. This approach calls on us to reconsider our way of expressing ourselves and listening, basing our understanding on four essential elements: observation or description, feelings, discovering and expressing needs, and formulating requests in an achievable way.

026PROOL3 Object-Oriented Programming and C++ 6 Cr.

This course introduces object-oriented programming in C++. It covers the structure of a C++ program, types and variables, expressions and instructions, control instructions (conditionals, loops), composite types, functions and parameters, objects (encapsulation and abstraction, inheritance, polymorphism), inputs/outputs, streams, error and exception handling, template programming, move semantics, C++ STL, lambdas and functional programming, C++ API design, build engines, and solving interview problems.
Prerequisite: Programming I (026IN1CL1).

026ARSEL4 Operating Systems Architecture 4 Cr.

This course studies the set of hardware and software techniques used to build an operating system: process, memory, and file management issues, examples of algorithms, evolution of concepts in this field, and example of the Linux system. It covers the following: Historical evolution of OS - Typology of OS - Structure of OS - Processes - Execution threads - Process scheduling - Concurrent access and synchronization - Deadlocks - Memory management - Virtual memory management - File system - Input/output systems - Protection mechanisms.
Prerequisites: Logic Circuits (026CILOL1)

026POPAL4 Parallel Programming 4 Cr.

This course introduces parallel programming for parallel and multi-core machines. It covers the following themes: parallel architecture, writing multi-core programs (multithreading, multiprocessing, and IPC), synchronization, critical sections, and race conditions, GPUs and CUDA, OpenCL, data extraction using vectors and SIMD, task parallelism, efficient synchronization, profiling, and performance tuning.
Prerequisite: Programming II (026IN2CL2).

026PTSTL1 Probability and Statistics 6 Cr.

This course presents the foundations of probability and statistics, enabling students to understand the role of these concepts in studying and modeling non-deterministic situations. It covers the axioms of probability calculus, conditional probabilities, independence, Bayes theorem, probability laws, expectation, variance, pair of random variables, marginal law, Bernoulli's law, Poisson's law, normal distribution, uniform law, exponential law, law of large numbers, central limit, approximation of the binomial law by the Poisson law, samples, estimators and punctual estimation, Student's T probability law, chi-squared law, confidence intervals for a mean, a proportion, and a variance, hypothesis testing (type I and II error), hypothesis tests on the mean and proportion of a sample, chi-squared tests, and ANOVA test.
Prerequisite: Foundations of Mathematics (048FOMML1).

026IN1CL1 Programming I 6 Cr.

The objective of this course is to introduce students to programming and in particular to *C#*. Students are quickly led to build graphical interfaces and manipulate objects using the interface or by program. It covers the following themes: The Visual Studio environment (Windows Forms) - My first application .Net – Design View, Code View, etc. - Add an action Listener that displays a message - Types of bases, variables and literals - Complex types (objects) - Conditional instructions - Loops: while, for, do, while break, continue - Tables: static table - Collections: List, Set, Maps, etc. - Operating modes and syntax – Functions, local and global variables - Use debugging tools: Trace, step-by-step execution, Watch. The course includes with multiple lab sessions.

026IN2CL2 Programming II 6 Cr.

The objective of this course is to develop computer skills by creating more complex applications in terms of design, application logic, user experience, and algorithms. It covers the following themes: Class/Object concepts: encapsulation, enrichment, specialization, and polymorphism - Encapsulation for data protection - Inheritance to enrich and specialize - Polymorphism - Specialize an existing visual component - Create a new non-existent visual component - Complex user interfaces: multi-window and navigation - TableView, ListView, ComboBoxes – Files.
Prerequisite: Programming I (026IN1CL1)

026BAD1L3 Relational Databases 4 Cr.

This course presents the fundamentals of relational databases in order to be able to develop information systems that include data management. It covers the following: Introduction - Databases vs files - Concepts of relational algebra - Functional dependencies - Normal forms and normalization - SQL language - Data Definition Language (DDL) – Database design - Data Manipulation Language (DML)
Prerequisite: Programming I (026IN1CL1)

026SECOL3 Secure Coding 4 Cr.

This course introduces students to the primary best practices of secure coding, including lab tools, vulnerable web applications (OWASP Top 10), SANS Top 25 vulnerabilities, active defenses, and threat modeling. It emphasizes the importance of secure coding in reducing risk and vulnerabilities. Topics covered include Cross-Site Scripting (XSS), Direct Object Reference, Data Exposure, Buffer Overflows, Resource Management, Active Defenses, and Threat Modeling. Understanding these vulnerabilities equips developers to engineer products that effectively prevent them. The course covers Application Security Issues, OWASP Top 10 Attacks, SANS/CWE Top 25 Vulnerabilities, Buffer Overflow Vulnerability, CERT Secure Coding Standards, Active Defenses, Threat Modeling, and utilizes Lab Tools such as SamuraiWTF Virtual Machine, Burp Suite Proxy Tool, and WebGoat.
Prerequisite: Programming II (026IN2CL2)

026ANRSL6 Social Network Analysis 4 Cr.

This course presents the methods and techniques used to extract useful information from traffic on social networks. It covers the following topics: Networks today - Network science - Different types of networks - Analysis with local measurement - Analysis with global measurement - Network structure: regular networks, random networks, small world networks, scale-free networks - Propagation in networks: percolation and diffusion.

026GELOL Software Engineering 6 Cr.

This course allows students to assess the technical and economic feasibility of the solution to be designed, draw up specifications following the identification of the client's needs, carry out the analysis of the system to identify the use cases, design the structural units of the solution using the appropriate design patterns, carry out a qualitative and quantitative quality control study in order to carry out a refactoring, test the code at the levels: unit, integration, functional and non-functional (performance, load, etc.), and manage versions, configurations, and bugs, using the appropriate tools. This course covers software engineering and its ethics, the software development process, the Agile methodology, extreme programming (XP), version control systems, UML diagrams, software testing, and software deployment using Docker.
Prerequisites: Programming II (026IN2CL2), Relational Databases (026BAD1L3)

026PRINL5 Software Development Project 4 Cr.

This project aims to provide students with experience in software development under the supervision and guidance of a professional. This experience covers both the technical and management aspects of a software project. Students work in groups and must deliver a final prototype.
Prerequisite: Programming II (026IN2CL2), Relational Databases (026BAD1L3), Web Programming (026WEBDL5).

026WEBDL5 Web Programming 4 Cr.

This course introduces the development of front-end and back-end web applications and covers the following themes: introduction to the HTTP protocol and the client-server architecture, ASP.NET, SQL refresher and website layout, controls, events, PostBack, and tracing, validation, user controls, GridView, data controls, ADO.NET, (DML), file handling, sessions and authentication, REST API.
Prerequisite: Web Technologies (026TWEBL2).

026TWEBL2 Web Technologies 4 Cr.

The main objective of this course is to enable students to understand the fundamental concepts of how the Web works and the technologies involved. It covers the following topics: Web basics and components (server, client), Internet and ecosystem, HTML (HTML document skeleton, HTML elements), CSS (rule declaration, elements and properties, element positioning), JavaScript (general syntax, prototypes, event programming, interaction with HTML: DOM, jQuery), interactive business models (Search, Advertising, E-commerce, Social media, Big data, etc.).

026SYEXL3 Windows and UNIX Operating Systems 6 Cr.

This course introduces the essential concepts for administering UNIX and Windows operating systems. For the Windows part, the course covers the following topics: Microsoft Windows products, basic concepts of TCP/IP network architecture, client-server concept, operating systems and system and network security, workgroup vs. domain, Windows 2008 R2 operating system, its features and different versions, Windows operating system architecture, Windows Server 2008 R2 installation, Management Console and Server administration tools, user account creation and management, resource access management using groups, data management and security using the NTFS file system, the concept of roles and features of a Windows server (Roles & Features), introduction to Microsoft Active Directory directory services, DNS (Domain Name System) name resolution, DHCP (Dynamic Host Configuration Protocol) service, group policy structure and management (Group Policies), use of group policy objects (GPOs).
For the UNIX part, the course covers the following topics: UNIX operating system architecture, system access and security, command interpreter, input-output redirection and pipes, basic commands, file and process manipulation, network utilities, shell programming.
Prerequisite: Logic Circuits (026CILOL1).

026WNOWL1 Work Ready Now 4 Cr.

This course aims to equip students with essential soft skills and practical work experience to excel in professional environments. Through active engagement and hands-on learning, students will develop and refine crucial skills, fostering the self-confidence needed to pursue, secure, and excel in roles aligned with their career aspirations. Work-based learning activities will prepare them for internships and entry-level positions, while digital assignments will reinforce these skills in practical contexts. Additionally, students will build a comprehensive career portfolio throughout the course, serving as a valuable tool in their transition from student to employee.