

Department of Computer Science

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The Department of Computer Science offers a program leading to the degree of Bachelor of Science (BS) in Computer Science. It also offers a program leading to the degree of Master of Science (MS) in Computer Science. For more information about the department visit its webpage at <http://www.cs.aub.edu.lb/>.

Undergraduate Program

BS Degree in Computer Science

In addition to the general requirements of the Faculty of Arts and Sciences, the department requires the following:

In computer science: CMPS 200, CMPS 212, CMPS 253, CMPS 255, CMPS 256, CMPS 257, CMPS 258, CMPS 272, CMPS 277, CMPS 282, and nine additional credits in computer science courses numbered 220 and above.

In mathematics and statistics: MATH 201, MATH 211 (or CMPS 211), and three additional credits to be chosen from MATH 218 (or MATH 219), STAT 230 (or STAT 233), MATH 251 (or CMPS 251), and MATH 261. Note: Since MATH 251 is equivalent to CMPS 251, it cannot count as both a computer science elective and mathematics elective.

In sciences: Physics 228, 228L, and six additional credits in natural sciences (i.e., biology, chemistry, geology, or physics).

All prospective computer science majors are expected to complete CMPS 200, MATH 201, MATH 211, and CMPS 212 in the sophomore year. Computer science majors are expected to complete CMPS 253, CMPS 255, CMPS 256, and CMPS 258 in the junior year, and maintain an average grade of at least 70 in computer science courses. Finally, students are encouraged to take ACCT 210 and PHIL 211 among their general elective courses.

A minor in computer science requires 18 credits: CMPS 200, CMPS 212, CMPS 255, and nine additional credits in computer science courses (CMPS) numbered 211 or above. [Note: If ECE 230 (ECE 330) is completed, students can get credit for only one of CMPS 200 (CMPS 212) or ECE 230 (ECE330)]. A minimum of 9 credits must be taken in the department.

Undergraduate Courses

CMPS 200 Introduction to Programming 3.3; 4 cr.

An introduction to a disciplined approach to computer programming and problem solving, utilizing a block-structured high level language, with an emphasis on procedural abstraction and good programming style. This course covers the basic repetition and selection constructs, procedures and functions, parameter passing, and scope of variables. Note: If ECE 230 is completed, students can get credit for only one of CMPS 200 or ECE 230. *Each semester.*

CMPS 206 Computers and Programming for the Arts 2.3; 3 cr.

An introduction to computers and an illustration of their use. Common applications are considered in word processing, spreadsheets, and database systems. This course also includes an introduction to the Internet and the World Wide Web. This course is meant to be a computer literacy course open to Arts students only. No credit is given for computer science majors. *Students can get credit for only one of CMPS 206, CMPS 209, or Education 219. Annually.*

CMPS 209 Computers and Programming for the Sciences 2.3; 3 cr.

A computer literacy course, covering all the topics in CMPS 206. Additionally, this course provides an introduction to programming using Visual Basic or a similar language. No credit is given for computer science majors. *Students can get credit for only one of CMPS 206, CMPS 209, or Education 219. Each semester.*

CMPS 211 Discrete Structures 3.0; 3 cr.

Equivalent to MATH 211. *Each semester.*

CMPS 212 Intermediate Programming with Data Structures 3.3; 4 cr.

A continuation of CMPS 200, this course consolidates algorithm design and programming techniques, emphasizing large programs. This course also provides a detailed study of data structures and data abstraction, and an introduction to complexity considerations and program verification. Note: If ECE 330 is completed, students can get credit for only one of CMPS 212 or ECE 330. *Prerequisite: CMPS 200. Each semester.*

CMPS 251 Numerical Computing 3.0; 3 cr.

Equivalent to MATH 251. *Each semester.*

CMPS 253 Professional Practice 3.0; 3 cr.

A course that combines the study of basic software engineering techniques with an analysis of the social and professional issues that arise in the practice of computing. The importance of users and their interactions with the software system is studied and considered from a software engineering perspective. This course emphasizes the role people play in the design and implementation of software systems. *Prerequisites: CMPS 211 and CMPS 212. Each semester.*

CMPS 255 Computer Architecture 3.0; 3 cr.

A structured overview of the fundamentals of designing digital computer systems. Topics covered include digital logic and systems, machine level representation of data, assembly level machine organization, memory system organization and architecture, CPU implementation and virtual machines, and exposure to one or more micro/mini architectures. *Prerequisite: CMPS 212. Each semester.*

CMPS 256 Advanced Algorithms and Data Structures 3.0; 3 cr.

A systematic study of algorithms and their complexity. Topics include techniques for designing efficient computer algorithms, proving their correctness, and analyzing their complexity; as well as advanced searching, sorting, selection, graph and matrix algorithms. *Prerequisite: CMPS 212. Each semester.*

CMPS 257 Theory of Computation 3.0; 3 cr.

A course that covers basic theoretical principles embodied in automata and grammars. Topics include regular expressions, finite automata, context-free grammars and parsing, pushdown automata, closure properties, Turing machines, Church's thesis, reductions and decidability. This course also provides a quick introduction to complexity theory. *Prerequisites: MATH 211 and CMPS 212. Each semester.*

CMPS 258 Programming Languages 3.0; 3 cr.

A course on the principles and programming styles that govern the design and implementation of contemporary programming languages, a history and overview of programming languages, fundamental issues in language design, and an introduction to language translation. This course focuses on design issues in imperative, object-oriented, functional, and rule-based paradigms. This last paradigm will be used to introduce intelligent systems issues. Languages such as C, C++, Haskell, and Prolog are used to illustrate key concepts. *Prerequisite: CMPS 212. Each semester.*

CMPS 272 Operating Systems 3.0; 3 cr.

An overview of operating systems and net-centric computing. Topics include operating system principles, scheduling and resource management, virtual memory, file systems, concurrent processing and synchronization, security and protections, the Internet, network structures, distributed operating systems, and Web technologies and operating systems (URL, HTML, HTTP, applets). A case study of a contemporary operating system like UNIX accompanies the course. *Prerequisites: CMPS 255 and CMPS 256. Each semester.*

CMPS 274 Compiler Construction 3.0; 3 cr.

A course that covers syntax specifications of programming languages, parsing theory, top-down and bottom-up parsing, parser generators, syntax-directed code generation, symbol table organization and management, dynamic storage allocation, code optimization, dataflow analysis, and register allocation. *Prerequisites: CMPS 255 and CMPS 257. Biennially.*

CMPS 277 Database Systems 3.0; 3 cr.

An overview of the nature and purposes of database systems and an introduction to data modeling: entity relationship model, relational model with relational algebra, relational calculus and SQL; integrity constraints; file organization and index files; normalization. *Prerequisite: CMPS 256. Each semester.*

CMPS 281 Numerical Linear Algebra 3.0; 3 cr.

A course on direct and interactive methods for solving general and special systems of linear equations, covering LU decomposition, Choleski decomposition, nested dissection, marching algorithms; Jacobi, Gauss-Seidel, successive over-relaxation, alternating directions, and conjugate gradient iterative methods. *This course is equivalent to MATH 281. Prerequisites: MATH 218 or 219, and MATH 251. Annually.*

CMPS 282 Software Engineering 3.0; 3 cr.

A course on software engineering dealing with large systems, including use of APIs, management of software teams, and software testing and validation; data flow concepts and decision tables; conditions and decision variables; design of output and input forms; files and database development; on-line and distributed environments; system documentation; and system implementation. Students are expected to complete a project in which they integrate their knowledge of the undergraduate computer science curriculum by implementing a significant software system in team work. *Prerequisite: CMPS 253. Each semester.*

CMPS 283 The Logic of Programming 3.0; 3 cr.

A course on computer programming as a rigorous mathematical discipline. Topics include sentential logic, predicate logic, expressions and commands, pre/post-conditions, assignment, repetition, invariant predicates, function predicates, modules, data structures, and concurrency. *Prerequisites: CMPS 212 and consent of instructor. Biennially.*

CMPS 284 Computer Networks 3.0; 3 cr.

An introduction to basic data communication, network architecture, protocols, local area networks, and wide area networks. Special emphasis is placed on the TCP/IP protocol suite. The BSD socket library is presented. *Prerequisite: CMPS 255. Each semester.*

CMPS 285 Computer Graphics 3.0; 3 cr.

A course that covers the practice of, and underlying mathematical foundation for, interactive graphics programming. Topics include basic graphics systems, graphics primitives and attributes, windows and viewports, clipping, geometric transformations, color systems, 2D texture mapping, and introduction to 3D graphics. . Programming in OpenGL will be used *Prerequisite: CMPS 212. Annually.*

CMPS 286 Computer-Aided Geometric Design 3.0; 3 cr.

A course that discusses the representation of free-form curves and surfaces in modeling objects by computers, including curve approximation and interpolation, spline curves (Bezier and B-splines), visual smoothness of curves, geometric continuity, parameterization of curves, introduction to surface interpolation and approximation, and spline surfaces (Bezier and B-splines). *Prerequisite: CMPS 285. Biennially.*

CMPS 287 Artificial Intelligence 3.0; 3 cr.

An introduction to the principles and techniques that enable computers to behave intelligently. This course covers basic problem solving methods, knowledge representation, reasoning methods, learning from samples and from experience, expert systems and knowledge acquisition, machine learning, and neural networks. Several projects are given, some of which are in Prolog. *Prerequisites: CMPS 256 and 258. Annually.*

CMPS 288 Internals of Database Management Systems 3.0; 3 cr.

A course on the internals of database management systems, especially relational DBMS. Topics include query processing and optimization, transaction processing, concurrency control, recovery, distributed transactions, database security, client-server, multi-tier architectures, and web deployed database systems. *Prerequisite: CMPS 277. Annually.*

CMPS 297 Special Topics in Computer Science 1–3 cr.

A course on selected topics which change according to the interests of the instructors and/or students. Topics are chosen from state-of-the-art innovations in software and computer information systems. *Prerequisite: Senior standing. Each semester.*

41 Credits in Computer Science

Modes of Analysis	English and Arabic (9)	Humanities (12)	Economics and Social Sciences (3)	Sciences, Math, and Technology (36+9+10)
Lecture Courses (9+12+3+39+9+10)	<ol style="list-style-type: none"> Required Arabic course (3): ARAB 201A or B, or any upper level course, as determined by placement Required English courses (usually 6): ENGL 203(3), 204(3), as determined by placement 	Required credits in the humanities: 12, including 6 credits from CVSP (see pp. 163–65)	Required courses (3): ACCT 210 is recommended	<ol style="list-style-type: none"> Required CMPS courses (30): CMPS 200(3+1)¹, 212(3+1)¹, 253(3), 255(3), 256(3), 257(3), 258(3), 272(3) 277(3), 282(3) Required CMPS electives (9): to be chosen from CMPS courses above 210 Required mathematics courses (6): MATH 201(3), 211(3) (or CMPS 211) Required electives (3): to be chosen from MATH 218(3), STAT 230(3), CMPS 251(3), and MATH 261(3) Required science courses (4): PHYS 228(3), 228L(1) Required natural science electives (6)
Seminar (0)				
Laboratory (2)				CMPS 200 ¹ , 212 ¹ (4 hrs/week)
Research Project (0)				CMPS 282 ²

1. CMPS 200 and CMPS 212 are 4-credit courses with 3 lecture hours (3 credits) and 3–4 lab hours (1 credit) per week.

2. CMPS 282 includes a major project.

Graduate Program

MS in Computer Science

In addition to the university requirements for graduate study in the Faculty of Arts and Sciences, students must complete 24 credits and a thesis (thesis option), or 30 credits and a project (project option), as detailed below. For both options the student must take 12 credits as follows: CMPS 356 or CMPS 357; CMPS 371, CMPS 372, CMPS 373, or CMPS 374; CMPS 363 or CMPS 366; CMPS 377, CMPS 385, or CMPS 393. The remaining credits (12 for the thesis option and 18 for the project option) are to be taken in coordination with the adviser. For more information about the program, visit <http://www.cs.aub.edu.lb/>.

Graduate Courses

Computer Science

CMPS 350 Discrete Models for Differential Equations 3.1; 3 cr.

A detailed study of methods and tools used in deriving discrete algebraic systems of equations for ordinary and partial differential equations: Finite Difference and Finite Element discretization procedures; generation and decomposition of sparse matrices, Finite-precision arithmetic, ill-conditioning and pre-conditioning, Scalar, vector and parallelized versions of the algorithms. The course includes tutorial "immersion" sessions in which students become acquainted with state of the art scientific software tools on standard computational platforms. *Prerequisite: linear algebra and the equivalent of MATH/CMPS 251 (which can be taken concurrently) or consent of the instructor. Same as MATH 350. Annually.*

CMPS 351 Optimization and Non-Linear Problems 3.1; 3 cr.

A study of practical methods for formulating and solving numerical optimization problems that arise in science, engineering, and business applications. Newton's method for nonlinear equations and unconstrained optimization. Simplex and interior-point methods for linear programming. Equality and inequality-constrained optimization. Sequential Quadratic Programming. Emphasis is on algorithmic description and analysis. The course includes an implementation component where students develop software and use state-of-the-art numerical libraries. *Prerequisite: MATH/CMPS 350 or consent of the instructor. Same as MATH 351. Annually.*

CMPS 354 The Finite Element Method 3.0; 3 cr.

A course that presents the theoretical foundations of the finite element method and some of its applications to partial differential equations. Topics include Sobolev spaces, existence and uniqueness of weak solutions and the Lax-Milgram lemma, regularity of weak solutions and a priori estimates, the Galerkin method, piecewise polynomial approximations, approximating solutions of boundary value problems for elliptic equations, and initial value problems for parabolic and hyperbolic equations. *Prerequisites: CMPS 251 and MATH 218 or MATH 219. Biennially.*

CMPS 356 Design and Analysis of Algorithms 3.0; 3 cr.

A course that studies advanced data structures and algorithms, with an emphasis on the design of algorithms. Topics include advanced graph and search algorithms, dynamic programming, amortized analysis, parallelism, greedy and approximate algorithms, string and pattern matching, computational geometry, and an introduction to the class of NP-complete problems. *Prerequisite: CMPS 256. Annually.*

CMPS 357 Complexity Theory 3.0; 3 cr.

A course that discusses complexity classes of algorithms, especially those arising from time and space analysis of bounded computations. Topics include sequential, deterministic, parallel, and non-deterministic models of computation, the Turing machine model, the class NP, questions of completeness and reducibility, and the hierarchy of complexity classes. *Prerequisite: CMPS 257. Annually.*

CMPS 358 Introduction to Symbolic Computing 3.0; 3 cr.

Introductory topics in computer algebra and algorithmic number theory that include Fast multiplication of polynomials and integers, Fast Fourier transforms, primality testing, and integers factorization. Applications to cryptography and pseudo-random number generation. Linear algebra and polynomial factorization over finite fields. Applications to error-correcting codes. Introduction to Grobner bases. *Prerequisite: Good background in programming, linear algebra, discrete mathematics or consent of instructor. Same as MATH 351. Annually.*

CMPS 360 Special Topics in Computational Science 3.0; 3 cr.

A course on selected topics in computational science, which change according to the interests of visiting faculty, instructors, and students. Selected topics cover state-of-the-art tools and applications in computational science. *Prerequisite: Consent of instructor. Same as MATH 360. Annually.*

CMPS 363 Software Engineering 3.0; 3 cr.

A course that studies techniques that facilitate the definition and development of reliable software systems. Topics include developing system requirements, requirement analysis, formulation of system architecture, establishing a detailed design, system integration, testing, and delivery. *Prerequisite: CMPS 282. Annually.*

CMPS 366 Object-Oriented Software Development Methods 3.0; 3 cr.

An introduction to object-oriented methods for the systematic development of software systems and reusable components. Topics include object-oriented life cycles, analysis and design techniques such as object modeling and event traces and their application using case tools, approaches for evolving designs into implementations, and management issues in applying object-oriented technologies and in controlling projects effectively. *Prerequisite: CMPS 282. Annually.*

CMPS 367 Object-Oriented Technology 3.0; 3 cr.

A course on advanced topics in object-oriented technology with in-depth treatment of design patterns, frameworks, concurrent, and distributed computing. *Prerequisite: CMPS 366. Annually.*

CMPS 368 Programming Language Design 3.0; 3 cr.

A course that studies unconventional and modern concepts of programming languages. Topics include concepts of exception handling, higher order functions and recursion, concurrent programming, mutual exclusion and synchronization, message passing, monitors, and support for concurrency control. *Prerequisite: CMPS 258. Annually.*

CMPS 371 Advanced Computer Architecture 3.0; 3 cr.

A course that discusses the structure of computer systems using processors, memories, input/output devices, and interfaces as building blocks. Topics include computer system instruction set design and implementation, memory hierarchies and pipelining, issues and tradeoffs involved in the design of computer system architectures with respect to the design of instruction sets, and parallelism and its exploitation in specific machines such as hypercubes and transputers. *Prerequisite: CMPS 255. Annually.*

CMPS 372 Advanced Operating Systems 3.0; 3 cr.

A course that discusses advanced topics in OS with an exposure to distributed systems. Topics include virtual memory management, synchronization and communication, protection and security, operating system extension techniques, distributed and parallel systems, and modification of an existing operating system. *Prerequisite: CMPS 272. Annually.*

CMPS 373 Parallel Computing 3.0; 3 cr.

A course that discusses the design, analysis, and implementation of algorithms for parallel computers. Topics include selection, merging, sorting, searching, matrix computations, numerical problems, and fast Fourier transforms. Students develop skills in designing parallel algorithms and analyzing their asymptotic running time and memory requirements, and develop medium-sized parallel codes using modern languages and libraries. *Prerequisites: CMPS 255, CMPS 256. Annually.*

CMPS 374 Compiler Construction 3.0; 3 cr.

Same as CMPS 274. Graduate students taking the course are expected to do extra reading and a term paper and/or an additional project. *Prerequisites: CMPS 255, CMPS 257. Annually.*

CMPS 377 Internals of Database Management Systems 3.0; 3 cr.

Same as CMPS 288. Graduate students taking the course are assigned extra work in the form of outside reading and a term paper and/or an additional project. *Prerequisite: CMPS 277. Annually.*

CMPS 378 Advanced Database Applications 3.0; 3 cr.

A course on advanced topics in database systems and their applications. Topics are chosen from object databases, data mining, schema evolution, distributed databases, web enabled databases, and databases for e-commerce applications. *Prerequisite: CMPS 277. Annually.*

CMPS 384 Advanced Computer Networks 3.0; 3 cr.

This course examines advanced topics in computer networks such as routing on the Internet, IP multicasting, quality of service, Internet telephony, IPv6, MultiProtocol Label switching (MPLS), network performance, network security, overlay networks, etc. The course covers also the architectures and main components of wireless local area networks (IEEE 802.11), Mobile IP Networks, Mobile Ad hoc Networks (MANETS), and WiMax networks (as defined in IEEE 802.16 standard). Some other topics may be covered through students' research projects, presentations, and assigned reading. The course starts by presenting a quick overview of the major protocols of TCP/IP stack. *Prerequisite: CMPS 284 or consent of instructor. Annually.*

CMPS 385 Advanced Computer Graphics 3.0; 3 cr.

A course that presents the basic concepts of 3D computer graphics. Topics include 3D object representations and manipulations, 3D transformation and viewing, hidden-surface and hidden-line removal, shading models, rendering, texture mapping, ray-tracing, and animation techniques. *Prerequisite: CMPS 285. Annually.*

CMPS 386 Computer-Aided Geometric Design 3.0; 3 cr.
Same as CMPS 286. Graduate students taking the course are assigned extra work in the form of outside reading and a term paper and/or an additional project. *Prerequisite: CMPS 285. Annually.*

CMPS 387 Data Visualization 3.0; 3 cr.
A course on techniques in visualizing scientific and other types of data. Topics include a review of computer graphics fundamentals, 2D and 3D data types, differential operators and metric spaces, visualization for 2D and 3D data sets, physical models, methods of computational science, visualization schemes for scalar, vector, and other types of data, ISO-surface and volume visualization, visual monitoring, and interactive steering. *Prerequisite: CMPS 385. Annually.*

CMPS 392 Knowledge Representation and Reasoning under Uncertainty 3.0; 3 cr.
Deductive logic as a tool for formal reasoning in AI and its limitations; probability theory as another tool for this purpose; emphasis on Bayesian belief networks, a technology for expert system applications such as medical diagnosis; syntax semantics and inference algorithms for Bayesian belief networks, in addition to extensions concerning reasoning over time and planning under uncertainty. *Prerequisite: CMPS 287. Annually.*

CMPS 393 Building AI Systems 3.0; 3 cr.
Key algorithms for building AI systems; algorithms for searching, backward and forward chaining, production-rule systems, truth maintenance, reasoning with uncertainty, and constraint satisfaction; application areas including diagnosis, temporal reasoning, and planning. *Prerequisite: CMPS 287. Annually.*

CMPS 394 Computer Arabization 3.0; 3 cr.
A course that discusses issues and techniques that arise in computer Arabization. Topics include Arabic text editing, morphology, information retrieval, language comprehension, spelling and grammar checking, WWW browsers, and computer-aided education. *Prerequisite: Consent of instructor. Biennially.*

CMPS 395 Subdivision for Modeling and Animation 3.0; 3 cr.
A course on subdivision surfaces and their use in geometric modeling and animation. Topics include polar form of Bezier and B-splines curves and surfaces; subdivision curves; subdivision surfaces; analysis of limit curves and surfaces; Subdivision for Modeling: shape control, interpolation, digitizing and designing objects; Basic Animation and Subdivision: key framing, free-form deformation, morphing, warping, particle systems. *Prerequisite: CMPS 285 or consent of instructor. Annually.*

CMPS 396 Special Topics in Computer Science 1–3 cr.
A course in which topics may vary each semester and are expected to be in areas of active research, such as computer-aided geometric design, databases, object orientation, and artificial intelligence. Students may register for this course twice (or more) on condition that course content differs. *Prerequisite: Consent of instructor. Annually.*

CMPS 397 Computer Science Tutorial 1–3 cr.

CMPS 398 MS Project

CMPS 399 MS Thesis 6 cr.