

Computer Science

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Vertically-related courses in this subject field are: CS 120-121.

CS 101 Introduction to Computer Science (3 cr). *May be used as core credit in J-3-c.* Survey of computer science and topics of importance to computer scientists; includes topics such as the nature of problems, unsolvability, hardware, human factors, security, social, ethical, and legal issues; exposure to practical aspects of computer networks. Three lectures and one recitation per week. Recommended Preparation: two yrs of high school algebra.

CS 112 Introduction to Problem Solving and Programming (3 cr). *May be used as core credit in J-3-c.* Carries 2 credits after CS 120. Intro to fundamental problem solving techniques using the computer; use of a programming language, structured programming concepts; use of fundamental data types, including arrays and structures; basic concepts of computer organization, editing, and program execution; programming lab in which the student solves problems using C++. Prereq: Math 108 or sufficiently high ACT, SAT, or Math Placement Test score to qualify for Math 143.

CS 120 Computer Science I (4 cr). Carries 2 credits after CS 112. Fundamental programming constructs, Algorithms and problem-solving, Fundamental data structures, Overview of programming languages, Virtual machines, Introduction to language translation, Declarations and types, Abstraction mechanisms, Object-oriented programming. Three lec and one 2-hr lab a wk. Prereq: Math 108 or sufficiently high ACT, SAT, or Math Placement Test score to qualify for Math 143.

CS 121 Computer Science II (4 cr). Abstract data types and data structures: linked lists, stacks, queues, trees, and graphs. Methods to implement and algorithms to manipulate these structures. Dynamic memory methods, sequential file processing, additional searching and sorting algorithms, recursion, and object-oriented programming. Three lec and one 2-hr lab a wk. Prereq: CS 120, and Math 176.

CS 127 (s) Programming Language (1-3 cr, max arr). Introduction to computer programming in a selected language. Prereq: perm.

CS 150 Computer Organization and Architecture (3 cr). Digital logic and digital systems, Machine level representation of data, Assembly level machine organization, Memory system organization and architecture, Interfacing and communication, Functional organization, Multiprocessing and alternative architectures. Prereq: CS 120.

CS 204 (s) Special Topics (cr arr). Prereq: perm.

CS 210 Programming Languages (3 cr). Major features of good programming languages, with primary emphasis on language features and their role in writing good software; programming language design alternatives; various types of languages, including procedure, data-flow, functional, and object-oriented languages. Prereq: CS 121.

CS 240 Computer Operating Systems (3 cr). Overview of operating systems, Operating system principles, Concurrency, Scheduling and dispatch, Memory management, Introduction to net-centric computing, Communication and networking, OS security. Prereq: CS 121 and 150.

CS 270 System Software (3 cr). Programming productivity tools such as make. Debugging tools. Linking and loading. Shell programming and scripting languages. Process management and interprocess communication. Concurrent programming using threads. Exception handling. Prereq: CS 121.

CS 299 (s) Directed Study (cr arr). Prereq: perm.

CS ID&WS324 Computer Graphics (3 cr). WSU Cpt S 442. Use of the computer to define, store, manipulate, and display 2-D and 3-D objects; 2-D curvefitting and 3-D surface development. Prereq: CS 213 or CS 121, and Math 330.

CS 336 Introduction to Information Assurance (3 cr). Introduces the confidentiality, availability and integrity goals of information systems; resistance, recognition and response categories of assurance. Focus on computer security and survivability, including cryptography, network security, general purpose operating system security and dependability and special purpose systems for high assurance security and dependability. Prereq: CS 240.

CS 360 Database Systems (3 cr). Study of database design and implementation; comparison of basic models (entity-relationship, hierarchical, network, relational); study of query languages; discussion of issues of integrity, security, dependencies, and normal forms.

CS 383 Software Engineering I (3 cr). Current topics in development of software systems; software life cycle model, requirements definition, design, verification and validation, and project management techniques. Prereq: CS 270 or perm.

CS 384 Software Engineering II (3 cr). Continuation of CS 383, Individual projects are developed. Prereq: CS 383.

CS 385 **Theory of Computation** (3 cr). See Math 385.

CS 395 **Analysis of Algorithms** (3 cr). See Math 395.

CS 398 (s) **Computer Science Cooperative Internship** (1-3 cr, max 3). Supervised internship in professional computer science settings, integrating academic study with work experience; requires formal plan of activities before co-op assignment and final written report evaluated by on-campus faculty members. Graded P/F. Prereq: perm.

CS 401 **Contemporary Issues in Computer Science** (1 cr). Ethical, legal, and intellectual property issues; current research topics; and other issues of importance to the professional computer scientist. Graded P/F. Prereq: Sr standing in CS.

CS 404 (s) **Special Topics** (cr arr). Prereq: perm.

CS J413/J513 **Concurrent Systems** (3 cr). Issues of parallel computer architecture considering a hardware/software approach; topics include convergence of parallel architectures, fundamental design issues, parallel programs, programming for performance, workload-driven evaluation, shared memory multiprocessors, snoopy-based multiprocessor design, scalable multiprocessors, cache coherence, hardware software tradeoffs, interconnection network design, latency tolerance, and future directions of concurrent systems.

CS 414 **Object-Oriented Design** (3 cr). Concepts and techniques used in object-oriented design (OOD) and object-oriented programming (OOP); current topics in OO discussed; concepts illustrated with the design and implementation of both individual and group projects.

CS J415/J515 **Computational Biology: Sequence Analysis** (3 cr). Design and analyze algorithms that address the computational problems posed by biological sequence data, such as DNA or protein sequences. Topics may include: comparing sequences (from genes to genomes), database searching, multiple sequence alignment, phylogenetic inferencing, gene discovery and annotation, and genome assembly. Additional class presentation and/or paper required for graduate credit. Prereq: Knowledge of high level programming language, basic probability theory, basic molecular biology, or perm.

CS J420/J520 **Data Communication Systems** (3 cr). Concept and terminology of data communications, equipment, protocols (including ISO/OSI and TCP/IP), architectures; transmission alternatives, regulatory issues and network management. Additional projects/assignments reqd for grad cr.

CS J424/J524 **Advanced Computer Graphics** (3 cr). Graphical user interfaces; rendering for realism including shading, shadows and textures; fractals; raster displays, pixmaps, and antialiasing; 3D curves and surfaces; color theory; hidden surfaces; ray tracing; games. Additional work required for graduate credit. Prereq: CS 324, Math 175. (Spring only)

CS J436/J536 **Advanced Information Assurance Concepts** (3 cr). Cryptographic systems, coding and decoding of messages; network, database, and operating system security issues, capability and access-control mechanisms; current trends and research in mandatory and discretionary security policies. Additional projects/assignments reqd for grad cr. Prereq: CS 336.

CS ID-J438/ID-J538 **Network Security** (3 cr). WSU Cpt S 425. Practical topics in network security; policy and mechanism, malicious code; intrusion detection, prevention, response; cryptographic techniques for privacy and integrity; emphasis on tradeoffs between risk of misuse, cost of prevention, and societal issues; concepts implemented in programming assignments. Additional projects/assignments reqd for grad cr. Recommended Preparation: Knowledge of C or C++. Prereq: CS 336.

CS J439/J539 **Applied Security Concepts** (3 cr). Hands-on approach to computer security with emphasis on developing practical knowledge of how cyber attacks work and how to defend against them. Detailed exploration of attacks such as buffer overruns, string attacks, worms, trojan horses, and denial-of-service attacks, and development of defenses against them. Additional work reqd for grad cr. Recommended preparation: Good knowledge of C, operating system concepts and Unix. Prereq: CS 336 or perm.

CS J441/J541 **Advanced Operating Systems** (3 cr). Principles of contemporary operating systems for network and distributed computer systems; sequential processes, scheduling, process synchronization, device management, file systems, memory management, and protection and security. Additional work required for graduate credit. Prereq: CS 240.

CS ID&WS445 **Compiler and Translator Design** (4 cr). WSU Cpt S 452. Algorithms used by the following system software: assemblers, macro-processors, interpreters, and compilers; compiler design options and code optimization; all concepts implemented in major programming assignments.

CS J447/J547 **Computer and Network Forensics** (3 cr). Competence in using established forensic methods in the handling of electronic evidence; rigorous audit/logging and data archival practices; prevention, detection, apprehension, and prosecution of security violators and cyber criminals; identifying and correcting computer vulnerabilities in a way that is smart, prudent, and responsible. Additional work required for graduate credit. Prereq: CS 336 and perm.

CS J448/J548 **Survivable Systems and Networks** (3 cr). Computers and networks under malicious threat or attack. Attributes of survivability, trustworthiness, dependability and assurance. Threats to survivability, security, reliability and performance. Models and analytical methods to assess survivability, vulnerability, interdependence and risk. Systemic inadequacies and approaches for overcoming deficiencies. Literature review and case studies. Additional projects/assignments required for graduate credit. Recommended Preparation: CS J449/J549 or CS 438.

CS J449/J549 Fault-Tolerant Systems (3 cr). Same as ECE J449/J549. Design, modeling, analysis and integration of hardware and software to achieve dependable computing systems employing on-line fault tolerance; theory and fundamental concepts of designing reliable systems; analytical evaluation techniques, faults and advances in ultra-reliable distributed systems, fault-tolerant software systems; case studies include the space Shuttle, Airbus, and Boeing fly-by-wire primary flight computers as well as systems in reliable data bases and financial markets. Additional projects and assignments reqd for grad cr. Prereq: ECE 441 or perm.

CS J451/J551 Advanced Computer Architecture (3 cr). CS 551 same as ECE 541. Principles and alternatives in instruction set design; processor implementation techniques, pipelining, parallel processors, memory hierarchy, and input/output; measurement of performance and cost/performance trade-off. Additional work required for graduate credit. Prereq: CS 150, Stat 301 or perm.

CS J461/J561 Advanced Database Systems (3 cr). Theory, analysis, and implementation of database architecture, security, performance, query optimization, recovery and concurrency control, reliability, integrity, commit protocols, distributed processing, deadlock detection and management. Additional projects/assignments reqd for grad cr. Prereq: CS 360.

CS J470/J570 Artificial Intelligence (3 cr). Concepts and techniques involved in artificial intelligence, Lisp, goal-directed searching, history trees, inductive and deductive reasoning, natural language processing, and learning. Extra term paper reqd for cr in 570.

CS J472/J572 Evolutionary Computation (3 cr). Solving computation problems by "growing" solutions; simulates natural evolution using analogues of mutation, crossover, and other generic transformations on representations of potential solutions; standard EC techniques such as genetic algorithms and evolutionary programming, mathematical explanations of why they work, and a survey of some applications; the focus is on solving real-world problems using projects. Graduate-level research and possible paper or presentation required for grad cr.

CS 480 Design--Individual Project (4 cr). Formal development techniques applied to definition, design, coding, testing, and documentation of a computer programming project; each student completes an individual project. Two lec a wk; significant lab work reqd. Prereq: Engl 317 and Sr standing in CS.

CS 481 Senior Capstone Design (4 cr). Application of formal design techniques to development of a large computer science project performed by students working in teams. Significant lab work reqd. Prereq: CS 384 and Engl 317, or CS 480.

CS J482/J582 Software Project Management (3 cr). Techniques for planning, organizing, scheduling, and controlling complex software system development and support projects. Additional projects/assignments reqd for grad cr. Prereq: CS 383 or 480 or perm.

CS J484/J584 Software Quality Assurance (3 cr). Actions necessary to provide confidence that a software product conforms to established technical requirements; strategies for implementation and management of SQA, product reviews, test plans and procedures, audits, configuration management, and reliability assessment; concepts of software quality. Additional projects/assignments reqd for grad cr. Prereq: CS 383.

CS J486/ID&WS-J586 Software Specification (3 cr). WSU Cpt S 524. Formal specification and analysis of software using a formal specification language, and case studies of designs expressed in a formal specification language. Additional projects/assignments reqd for grad cr. Prereq: perm.

CS 499 (s) Directed Study (cr arr). Prereq: perm.

CS 500 Master's Research and Thesis (cr arr). Prereq: perm.

CS 501 (s) Seminar (cr arr). Prereq: perm.

CS 502 (s) Directed Study (cr arr). Prereq: perm.

CS 504 (s) Special Topics (cr arr). Prereq: perm.

CS 507 Fundamentals of Research (3 cr). See For 510.

CS ID&WS510 Theory of Programming Languages (3 cr). WSU Cpt S 518. Advanced topics in programming language theory including formal syntax, formal semantics, denotational semantics, and type theory; principles of programming language design are stressed; not a comparative language class. Coreq: CS 385 or equiv.

CS 513 Concurrent Systems (3 cr). See CS J413/J513.

CS 515 Computational Biology: Sequence Analysis (3 cr). See CS J415/J515.

CS 520 Data Communication Systems (3 cr). See CS J420/J520.

CS 524 Advanced Computer Graphics (3 cr). See CS J424/J524.

CS 536 Advanced Information Assurance Concepts (3 cr). See CS J436/J536.

CS 538 Network Security (3 cr). See CS J438/J538.

CS 539 Applied Security Concepts (3 cr). See CS J439/J539.

CS 541 Advanced Operating Systems (3 cr). See CS J441/J541.

CS 547 Computer and Network Forensics (3 cr). See CS J447/J547.

CS 548 Survivable Systems and Networks (3 cr). See CS J448/J548.

CS 549 Fault/Tolerant Systems (3 cr). See CS J449/J549.

CS 551 Advanced Computer Architecture (3 cr). See CS J451/J551.

CS 561 Data Base Management Systems (3 cr). See CS J461/J561.

CS 570 Artificial Intelligence (3 cr). See CS J470/J570.

CS 572 Evolutionary Computation (3 cr). See CS J472/J572.

CS 580 Graduate Project (1-6 cr, max 6). Application of formal design and documentation techniques to the development of computer programming project; project selected in consultation with student's major professor. Prereq: CS 383, 480 or perm.

CS ID581 Software Engineering Analysis (3 cr). WSU Cpt S 521. Intro to research in software engineering; strong emphasis on application of quantitative techniques in the software life cycle; students will develop a command of current software engineering literature; exploration of techniques of mathematical modeling and solutions to software engineering problems.

CS 582 Software Project Management (3 cr). See CS J482/J582.

CS ID583 Software Engineering Measurement (3 cr). WSU Cpt S 523. Measurement methodology is the foundation of the emerging discipline of software engineering; software products are constructed by people engaged in a software development process in a development environment; focus on learning to measure the attributes of these four measurement domains; examples of software measurement and the applications of these measurements; using these techniques as the basis for the design of software engineering experiments; application of the scientific method in evaluation of programming methods and models; extension of the measurement concepts into the area of statistical modeling. Prereq: CS 581.

CS 584 Software Quality Assurance (3 cr). See CS J484/J584.

CS 585 Software Process Management (3 cr). Systematic software development from management perspective that centers on constituent tasks and their interrelationships; evaluation of software development process maturity and means to improve process maturity. Additional projects/assignments reqd for grad cr. Prereq: CS 383.

CS ID&WS586 Software Specification (3 cr). See CS J486/J586.

CS 590 Computability and Complexity (3 cr). Various models of computation, such as Turing machines, recursive functions, and register machines; relative strengths and weaknesses of these models, with particular attention to uncomputability results; computational complexity as a natural outcome of restrictions to these models. Prereq: CS 385.

CS 599 (s) Non-thesis Master's Research (cr arr). Research not directly related to a thesis or dissertation. (There is a limit on the number of credits in 599 that can be included on a study plan.) Prereq: perm.

CS 600 Doctoral Research and Dissertation (cr arr).