Computer Science (B.S.)

The program of study for the B.S. in Computer Science is designed to offer students opportunities to prepare for an industrial, business, or governmental career in a rapidly changing profession and to prepare for graduate study in a field in which further education is strongly recommended. The school offers a "fast track" B.S./M.S. option; see Fast Track Baccalaureate/Master's Degree Program.

In addition to foundation courses in the natural sciences, the major includes a strong mathematical component. The computer science program includes operating systems, computer architecture, programming languages, data structures, software engineering, and automata theory. Electives include theoretical and practical courses in both computer science and electrical engineering.

Bachelor of Science in Computer Science Degree Requirements (120 hours)

I. Core Curriculum Requirements¹: 42 hours

A. Communication (6 hours)
   3 hours Communication (RHET 1302)
   3 hours Communication Elective (CS 3390) ²

B. Social and Behavioral Sciences (15 hours)
   6 hours Government (GOVT 2305 and 2306)
   6 hours History (HST 1301 and 2301)
   3 hours Social and Behavioral Science elective

C. Humanities and Fine Arts (6 hours)
   3 hours Fine Arts (AP 1301)
   3 hours Humanities (A&H 1301)

D. Mathematics and Quantitative Reasoning (6 hours)
   6 hours Calculus (MATH 2417 and 2419)³

E. Science (9 hours)
   6 hours Lecture courses (PHYS 2325 and 2326)
   2 hours Laboratory courses (PHYS 2125 and 2126)
   3 hours Science Elective ⁴

¹Curriculum Requirements can be fulfilled by other approved courses from accredited institutions of higher education. The courses listed in parentheses are recommended as the most efficient way to satisfy both Core Curriculum and Major Requirements at U.T. Dallas.

II. Major Requirements: 57 hours

Major Preparatory Courses (20 hours)
   MATH 2417 Calculus I³
   MATH 2419 Calculus II³
   MATH 2418 Linear Algebra
   CS 1315 Computer Science I
   CS 2305 Discrete Mathematics I
   CS 2315 Computer Science II
   CS 2325 Computer Organization
   3 hours Science Elective ⁴

Major Core Courses (28 hours)
   CS 3305 Discrete Mathematics for Computing II
   CS 3341 Probability and Statistics in Computer Science
   CS 3345 Algorithms Analysis and Data Structures
CS 3354 Software Engineering
CS 3390 Technical Writing
CS 4337 Organization of Programming Languages
CS 4340 Computer Architecture
CS 4140 Computer Architecture Laboratory
CS 4348 Operating Systems
CS 4349 Advanced Data Structures
CS 4384 Automata Theory

**Major Guided Electives (9 hours)**

CS guided electives are 4000 level CS courses approved by the student's CS advisor. The following courses may be used as guided electives without the explicit approval of an advisor:

- CS 4334 Numerical Analysis
- CS 4347 Database Systems
- CS 4361 Computer Graphics
- CS 4365 Artificial Intelligence
- CS 4375 Principles of UNIX
- CS 4376 Object Oriented Programming Systems
- CS 4380 Senior Design
- CS 4386 Compiler Design
- CS 4390 Computer Networks
- CS 4399 Senior Honors in Computer Science
- EE 4325 Introduction to VLSI Design
- EE 4420 Microprocessor Design

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2 Hours fulfill the communication elective of the Core Curriculum.

3 Six hours of Calculus are counted under Mathematics Core, and two hours of Calculus are counted as Major Preparatory Courses.

4 One hour of Science is counted under Science Core. Two hours are counted as Major Preparatory Courses.

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**III. Elective Requirements: 21 hours**

**Advanced Electives (6 hours)**

All students are required to take at least six hours of advanced electives outside their major field of study. These must be either upper-division classes or lower-division classes that have prerequisites.

**Free Electives (15 hours)**

All students must accumulate at least 120 hours of university credit to graduate. Both lower- and upper-division courses may count as free electives but students must complete at least 51 hours of upper-division credit to qualify for graduation.

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**Fast Track Baccalaureate/Master’s Degrees**

In response to the need for post-baccalaureate education in the exciting field of computer science, a Fast Track program is available to exceptionally well-qualified students who choose their courses carefully. At the end of five years of successful study, it is possible to earn both the B.S. and the M.S. degrees in Computer Science. Being within 30 hours of graduation, a student admitted to the graduate program and accepted into the Fast Track program may, during the senior year, take 15 graduate hours which may be used to complete the bachelor’s degree and also to satisfy requirements for the master’s degree.

Interested students should see the College Master for specific admission requirements to the Fast Track program.

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**Specified Course Descriptions**
A&H 1301 (HUMA 1301) Exploration of the Humanities (3 semester hours) An introduction to the concept of cultural tradition through the study of selected works of literature, philosophy, music, and visual art. Emphasis on the relations among various forms of cultural expression and developing students' ability to interpret complex artistic works in their historical, cultural, and intellectual contexts. General education core course. (3-0) S

AP 1301 (ARTS 1301) Exploration of the Arts (3 semester hours) This course introduces students to the physical and intellectual demands required of the author, the performer, and the visual artist. This introduction includes, but is not limited to, the student's production of a creative project as well as written assessments of art and performance. (3-0) Y

CS 1315 (COSC 1315) Computer Science I (3 semester hours) Computer programming in a high-level, block structured language. Algorithmic thinking and the history and utility of machines which automate it. Basic data types and variables, memory usage, control structures (sequential, selection, repetition), functions and parameter passing, recursion, console and file input/output. Prerequisite: Basic computer literacy/programming skills (see CS 1115 description) or concurrent enrollment in CS 1115. (3-0) S

CS 2305 (MATH 2305) Discrete Mathematics for Computing I (3 semester hours) Principles of counting. Boolean operations. Propositional calculus. Sets, relations, functions, strings, languages, partial orders, and lattices. Prerequisite: MATH 1326 or MATH 2419 or consent of the instructor. (3-0) S

CS 2315 (COSC 2315) Computer Science II (3 semester hours) Advanced programming techniques, including an introduction to object-oriented programming. Classes, inheritance, dynamic function binding, strings, stacks, queues, lists, and trees. Dynamic memory allocation/management. Prerequisite: CS 1315. (3-0) S

CS 2325 (COSC 2325) Computer Organization (3 semester hours) The composition of central processing units and its impact on low-level programming. The study of computers as symbolic processors; the nature and manipulation of the symbols. Assembly language programming. Prerequisite: CS 2315. (3-0) S

CS 3305 Discrete Mathematics for Computing II (3 semester hours) Topics in enumeration; principle of inclusion and exclusion. Algorithmic complexity; recurrence relations. Graph theory. Prerequisite: CS 2305. (3-0) S

CS 3341 Probability and Statistics in Computer Science (3 semester hours) Axiomatic probability theory. Calculation of probabilities of compound events, with illustrations from Computer Science examples. Random variables. Synthesis of important random variables from Computer Science-related random experiments-binomial, geometric, multinomial, Poisson, exponential, and related distributions. Expectation. Important functions of random variables and evaluation of distributions of functions. Generation of random numbers of various distributions, starting from the standard uniform random number generators. Sums of independent random variables. Convolution and the use of transforms in simple cases involving exponential and Poisson random variables. Illustrative examples and simulation exercises from queuing, reliability, and program analysis disciplines. Elements of parameter (point) estimation. Prerequisites: MATH 1326 or MATH 2419, and CS 2305 (3-0) S

CS 3345 Algorithm Analysis and Data Structures (3 semester hours) Metrics for performance evaluation of algorithms. Formal treatment of basic data structures such as arrays, stacks, queues, lists, trees. Various sorting and searching techniques. Fundamental graph algorithms. Prerequisites: CS 2315 and CS 3305. (3-0) S

CS 3354 Software Engineering (3 semester hours) Introduction to software life cycle models. Software requirements engineering, formal specification and validation. Techniques for software design and testing. Cost estimation models. Issues in software quality assurance and software maintenance. Prerequisites: CS 2315 or CS 3333, and CS 2305 (3-0) S

CS 3390 Technical Writing (3 semester hours) This course trains students to develop technical communications skills required by computer professionals and computer science researchers. The course satisfies the Advanced Writing component of core curriculum requirements. (3-0) S

CS 4140 Computer Architecture Laboratory (1 semester hour) Laboratory for CS 4340. Must be taken concurrently with CS 4340. Must be taken Credit/No Credit. (0-1) S

CS 4334 Numerical Analysis (3 semester hours) Solution of linear equations, roots of polynomial equations, interpolation and approximation, numerical differentiation and integration, solution of ordinary differential equations, computer arithmetic, and error analysis. Prerequisites: CS 1315, MATH 2418, MATH 2419. (Same as MATH 4334.) (3-0) Y

CS 4337 Organization of Programming Languages (3 semester hours) Language definition structure, data types and structures, control structures and data flow, run-time considerations. Interpretive languages; functional programming. Prerequisites: CS 2315 or CS 3333, and CS 2305. (3-0) S

CS 4340 Computer Architecture (3 semester hours) Boolean algebra and logic circuits; register transfer operations; design of a small computer; input, output, and interrupt organization; powerful addressing modes, instruction formats, and
their hardware structures; microprogram control. Must be taken concurrently with CS 4140. Prerequisites: CS 2305 and CS 2325. (3-0) S

**CS 4347 Database Systems** (3 semester hours) This course emphasizes the concepts and structures necessary for the design and implementation of database management systems. Topics include data models, data normalization, data description languages, query facilities, file organization, index organization, file security, data integrity, and reliability. Prerequisite: CS 3345. (3-0) Y

**CS 4348 Operating Systems Concepts** (3 semester hours) An introduction to fundamental concepts in operating systems: their design, implementation, and usage. Topics include process management, main memory management, virtual memory, I/O and device drivers, file systems, secondary storage management, and an introduction to critical sections and deadlocks. Prerequisites: CS 3345 (may be taken concurrently), CS 4340, and a working knowledge of C and UNIX. (3-0) S

**CS 4349 Advanced Data Structures and Algorithms** (3 semester hours) Height balanced trees, B-trees, and other techniques for efficient storage and retrieval of information. Algorithm design techniques such as greedy method, dynamic programming, and divide-and-conquer. Issues from computational complexity. Prerequisite: CS 3345. (3-0) Y

**CS 4361 Computer Graphics** (3 semester hours) Review of graphic display architecture and graphic input devices. Two- and three-dimensional transformations, matrix formulations, and concatenation. Clipping and windowing. Data structures for graphics systems, segmented display files, rings, etc. Hidden line and surface elimination. Shading. Graphics packages and applications. Prerequisites: linear algebra, CS 2315, and CS 3345. (3-0) Y

**CS 4365 Artificial Intelligence** (3 semester hours) Basic concepts and techniques that enable computers to perform intelligent tasks. Examples are taken from areas such as natural language understanding, computer vision, machine learning, search strategies and control, logic, and theorem proving. Prerequisites: CS 2315 and CS 3345. (3-0) Y

**CS 4375 Principles of UNIX** (3 semester hours) Design and history of the UNIX operating system. Detailed study of process and file system data structures. Shell programming in UNIX. Use of process-forking functionality of UNIX to simplify complex problems. Interprocess communication and coordination. Device drivers and streams as interfaces to hardware features. TCP/IP and other UNIX inter-machine communication facilities. Prerequisite: CS 2315 (C/C++) or CS 3333 or CS 3335 or equivalent programming experience, including knowledge of C. (3-0) S

**CS 4376 Object-Oriented Programming Systems** (3 semester hours) In-depth study of the features/advantages of object-oriented approach to problem solving. Special emphasis on issues of object-oriented analysis, design, implementation, and testing. Review of basic concepts of object-oriented technology (abstraction, inheritance, and polymorphism). Object-oriented programming languages, databases, and productivity tools. Prerequisite: CS 2315 (C/C++) or CS 3333 or CS 3335 or equivalent programming experience, including knowledge of C++. (3-0) S

**CS 4380 Senior Design Project** (3 semester hours) Detailed design, implementation, and testing of a system or component under the guidance of a faculty member. Specific technical requirements will be specified by the individual faculty member teaching/supervising the course. All students must submit a written report and make an oral presentation at the culmination of the project. May be repeated for credit (6 hours maximum) to complete a two-semester project. Prerequisite: senior standing. (3-0) Y

**CS 4384 Automata Theory** (3 semester hours) A review of the abstract notions encountered in machine computation. Topics include finite automata, regular expressions, PDAs, and context-free languages. Prerequisite: CS 3305. (3-0) S

**CS 4386 Compiler Design** (3 semester hours) Basic phases of a compiler and their design principles. Topics include lexical analysis, basic parsing techniques such as LR(K) and LL(K) grammars. Prerequisites: CS 3345 and CS 4384. (3-0) T

**CS 4390 Computer Networks** (3 semester hours) The design and analysis of computer networks. Topics include: the ISO reference model, transmission media, medium-access protocols, LANs, data link protocols, routing, congestion control, internetworking, and connection management. Prerequisite: CS 4348. (Same as TE 4390) (3-0) S

**CS 4399 Senior Honors in Computer Science** (3 semester hours) For students conducting independent research for honors theses or projects. (3-0) R

**EE 4325 Introduction to VLSI Design** (3 semester hours) Introduction to CMOS digital IC design using semi-custom and full-custom design techniques with an emphasis on techniques for rapid prototyping and use of various VLSI design tools. FPGA's, standard cell and full-custom design styles. Introduction to a wide variety of CAD tools. Prerequisite: EE 4320 (or, for CS majors, CS 4340). (3-0) T

**EE 4420 Microprocessor Systems Design** (4 semester hours) Design of microcomputer hardware and software using the MC68x0 family; hardware-oriented topics include microprocessor buses and interfacing to open bus standards, memory, and I/O devices; software topics include assembly language programming, exception and interrupt handling, and multitasking. Includes project-oriented laboratory. Prerequisite: EE 4320 (or, for CS majors, CS 4340). (2-3) T
GOVT 2305 (GOVT 2305) Constitutional Foundations and Political Behavior in the U.S. and Texas (3 semester hours) This course examines the evolution and current state of political behavior and public policy making in the U.S. and Texas. Topics will include the constitutions, federalism, intergovernmental relations, voting, elections, political parties, public opinion, and interest groups. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

GOVT 2306 (GOVT 2306) Political Institutions in the U.S. and Texas (3 semester hours) This course explores the primary institutions of U.S. and Texas government. It examines the bureaucracy as well as the executive, legislative, and judicial branches of government at the state and federal level. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

HST 1301 Themes and Ideas in American History (3 semester hours) An introduction to the methods of historical inquiry through the study of selected main themes in American history. A course designed to offer students an understanding of the historical and cultural context of America in the contemporary world. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) S

HST 2301 Issues in American History (3 semester hours) Readings, commentary, and discussion aimed at varying aspects of history and culture. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) Y

MATH 2417 (MATH 2417) Calculus I (4 semester hours) Functions, limits, continuity, differentiation; integration of function of one variable; logarithmic, exponential, and inverse trigonometric functions; techniques of integration, and applications. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2312 or equivalent. (4-0) S

MATH 2418 Linear Algebra (4 semester hours) Systems of linear equations, determinants, vectors and vector spaces, linear transformations, eigenvalues and eigenvectors, quadratic forms. Three lecture hours and two discussion hours per week. Credit given for only one of MATH 2333 or 2418. Prerequisite: MATH 2419 or consent of instructor. (4-0) S

MATH 2419 Calculus II (MATH 2419) (4 semester hours) Continuation of MATH 2417. Improper integrals, sequences, infinite series, power series, parametric equations and polar coordinates, vectors, vector-valued functions, functions of several variables, partial derivatives and applications, multiple integration. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2417. (4-0) S

PHYS 2125 (PHYS 2125) Physics Laboratory I (1 semester hour) Laboratory course to accompany PHYS 2325. Personal computer-based data presentation and curve fitting. Basic measurement concepts such as experimental uncertainty, mean, standard deviation, standard error, and error propagation will be covered. Corequisite: PHYS 2325. (0-3) Y

PHYS 2126 (PHYS 2126) Physics Laboratory II (1 semester hour) Laboratory course to accompany PHYS 2326. Builds on concepts of Physics Lab I. Will emphasize the use of an oscilloscope and measurements using simple circuits constructed in class. Corequisite: PHYS 2326. (0-3) Y

PHYS 2325 (PHYS 2325) Mechanics and Heat (3 semester hours) Calculus based. Basic physics including a study of space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, harmonic oscillation, temperature and heat. Two lectures and one recitation session per week. Prerequisite: MATH 2417. Corequisite: PHYS 2125. (3-0) Y

PHYS 2326 (PHYS 2326) Electromagnetism and Waves (3 semester hours) Continuation of PHYS 2325. Topics include electrostatics and electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday, Maxwell's theory of propagation and optics. Two lectures and one recitation session per week. Prerequisites: PHYS 2325 and MATH 2419. Corequisite: PHYS 2126. (3-0) Y

RHET 1302 (ENGL 1302) Rhetoric (3 semester hours) The course presents an integrated approach to writing, reading, and critical thinking by developing the grammatical, logical, and rhetorical skills necessary for university writing. All classes work in a computerized learning environment. Students are taught basic computer literacy and submit all work electronically and on paper. (3-0) S