

Computer Science

Tony R. Martinez, Chair
3361 TMCB, (801) 422-3027

College of Physical and Mathematical Sciences Advisement
Center
N-179 ESC, (801) 422-6270

Admission to Degree Program

The degree programs in the Department of Computer Science are open enrollment.

The Discipline

Computer science touches virtually every area of human endeavor. Software is responsible for everything from the control of kitchen appliances to sophisticated climate models used in predicting future environmental change. Students in computer science learn to approach complex problems in business, science, and entertainment using their strong background in mathematics, algorithms, and data structures.

The degree programs in the Computer Science Department prepare students to be confident software developers and technical problem solvers. The curriculum also trains students for research into new avenues where computers will have a significant impact.

The BS curriculum is accredited by the Computing Accreditation Commission of ABET.

Career Opportunities

Graduates pursue exciting opportunities in graphics, artificial intelligence, software engineering, database design, scientific programming, systems administration, and research at universities and national laboratories.

The bioinformatics emphasis is designed for students who are interested in building software to assist in analyzing biological systems. Students will graduate with a significant background in biology coupled with the software development and analysis skills necessary to implement large bioinformatics applications.

Graduation Requirements

To receive a BYU bachelor's degree a student must complete, in addition to all requirements for a specific major, the following university requirements:

- The university core, consisting of requirements in general and religious education (See the University Core section of this catalog for details. For a complete listing of courses that meet university core requirements, see the current class schedule.)
- A minimum of 30 credit hours in residence
- A minimum of 120 credit hours
- A cumulative GPA of at least 2.0

Undergraduate Programs and Degrees

BS	Computer Science Emphasis (optional) Bioinformatics
Minors	Computer Science Computer Science Teaching

Students should see their college advisement center for help or information concerning the undergraduate programs.

Graduate Programs and Degrees

MS	Computer Science
PhD	Computer Science

For more information see the BYU 2007–2008 Graduate Catalog.

General Information

Personnel in the College of Physical and Mathematical Sciences Advisement Center will advise regarding core courses and suggested general education. Questions regarding curriculum and career decisions should be directed to the undergraduate advisor in the Computer Science Department.

Note: All hours of credit applied toward a major in computer science must be of C– or better and must be taken within eight years of declaring the computer science fundamentals major. Any exceptions must be approved by the department. Students may choose to graduate under later requirements by updating their date of entry into the major at the college advisement center.

BS Computer Science (79–81 hours*)

Major Requirements

1. No D credit is allowed in major courses.
2. Complete the following:
C S 124, 142, 235, 236, 240, 252, 312, 330, 340, 345, 360, 404.
3. Complete the following supporting courses:
Engl 316.
Math 112, 113, 343.
Phscs 121, 220.
Stat 321.
4. Complete at least 6 hours from the following:
Biol 100, 120, 220.
Chem 105, 106.
Geol 111, 330.
~~InBio 341.~~
Phscs 123, 222.
5. Complete four courses from the following:
400-level computer science courses.
EC En 324, 425.
6. Complete one additional course from the following:
400- or 500-level computer science courses.
EC En 324, 425.

Note: C S 598R requires senior or graduate status in computer science and departmental approval before registering.

*Hours include courses that may fulfill university core requirements.

BS Computer Science: Bioinformatics Emphasis

(83–84 hours*)

Major Requirements

1. No D credit is allowed in major courses.
2. Complete the following:
C S 124, 142, 235, 236, 240, 252, 312, 340, 345, 404.
3. Complete one course from the following:
Chem 152, 351.
4. Complete the following supporting courses:
Biol 120, 240, 340.
Chem 105.
Engl 316.
InBio 265, 365, 465.
Math 112, 113, 214.
Phscs 121.
Stat 441, 442.
5. Complete three elective courses from 400-level computer science courses. C S 360 will also count.

*Hours include courses that may fulfill university core requirements.

Minor Computer Science (15 hours*)

Minor Requirements

1. No D credit is allowed in minor courses.
2. Complete the following:
C S 142, 235, 236.
3. Complete two additional computer science courses from the following:
C S 100, 124, 240, 252.

Recommendations

1. Although not required, C S 100 is strongly recommended.
2. Students wishing to emphasize programming skills should include C S 240.
3. Students wishing to emphasize computer architecture should include C S 124.
4. Students wishing to emphasize mathematical rigor, should include C S 252.
5. Students wishing to take particular upper-division courses may be allowed to substitute 300- or 400-level computer science courses (except C S 404 and C S 405) for one or both of the two additional computer science courses. This option requires proper preparation and prior approval of course instructors and the undergraduate coordinator.

Minor Computer Science Teaching (17–18 hours)

Minor Requirements

1. Complete the following:
C S 124, 142, 235, 236, 240.
2. Complete one additional computer science course with the approval of the Computer Science Department undergraduate coordinator.

Computer Science (C S)

Undergraduate Courses

100. Fundamentals of Computing and Information. (3:3:0) For nonmajors. F, W, Sp

Computing, information structures, programming principles, Internet, World Wide Web, text, spreadsheets, data representations for images, sound and video.

124. (C S-EC En) Introduction to Computer Systems. (3:3:2) F, W, Su Prerequisite: C S 142 or concurrent enrollment.

How a computer works, from hardware to high-level programming. Logic circuits, computer instructions, assembly language, binary arithmetic, C programming, program translation, data structures, and algorithm analysis.

142. Introduction to Computer Programming. (3:3:0) F, W, Sp, Su Prerequisite: knowledge of algebra.

Introduction to object-oriented program design and development. Principles of algorithm formulation and implementation.

199R. Academic Internship. (1–3:0:0 ea.) F, W, Sp, Su

Internships or cooperative education experiences with organizations outside BYU.

235. Data Structures and Algorithms. (3:3:0) F, W, Sp, Su Prerequisite: C S 142.

Fundamental data structures and algorithms of computer science; basic algorithm analysis; recursion; sorting and searching; lists, stacks, queues, trees, hashing; object-oriented data abstraction.

236. Discrete Structures. (3:3:0) F, W, Sp, Su Prerequisite: C S 235.

Introduction to grammars and parsing; predicate and propositional logic; proof techniques; sets, functions, relations, relational data model; graphs and graph algorithms.

240. Advanced Programming Concepts. (3:3:0) F, W, Alt. Sp, Su term Prerequisite: C S 236.

Advanced software development with an object-oriented focus. Development and testing of several 1500 to 2000 line modules from formal specifications. UNIX and C++ environment.

252. Introduction to Computational Theory. (3:3:0) F, W, Alt. Sp, Su term Prerequisite: C S 236.

Finite state automata, regular languages, lexical analysis; push-down automata, context-free languages, parsing; Turing machines and unrestricted grammars; computability, complexity, NP-completeness.

301R. Topics in Computer Science. (3:3:0 ea.) F, W Prerequisite: instructor's consent.

Undergraduate-level topics as announced.

312. Algorithm Analysis. (3:3:0) F, W, Alt. Sp, Su term Prerequisite: C S 240, 252.

Analysis of algorithms including searching, sorting, graphs, and trees.

330. Concepts of Programming Languages. (3:3:0) F, W, Sp Prerequisite: C S 236, 240.

Principles and concepts characterizing high-level computer programming languages, process and data abstraction, encapsulation, inheritance, functional programming, logic programming, scanners, and parsers.

340. Software Design and Testing. (3:3:0) F, W, Sp, Su Prerequisite: C S 236, 240.

Principles of software design, design patterns, design representation, refactoring. Principles of software quality assurance and testing. Development of testing tools.

345. Operating Systems Design. (3:3:0) F, W, Su Prerequisite: C S 240.

Principles and concepts of operating systems design and the implementation of an operating system.

360. Internet Programming. (3:3:0) F, W Prerequisite: C S 236, 345.

Internet application programming, including sockets, threads, CGI, database, e-commerce, Web services.

401R. Topics in Computer Science. (1–3:Arr:0 ea.) Prerequisite: instructor's consent.

Undergraduate level subjects as announced before each semester.

404. Ethics and Computers in Society. (2:2:0) F, W Prerequisite: C S 240; junior–senior status.

Societal impact of computer technology, the computer scientist's place in society, ethical issues. Reading, discussion, and writing seminar.

405. Creating and Managing a Software Business. (3:3:0) F, W Prerequisite: C S 240, Engl 316.

Entrepreneurship, idea/opportunity generation, strategic planning, legal organization, product development, marketing/sales, customer support, fund raising, and effective management.

412. Modeling and Optimization. (3:3:0) W Prerequisite: C S 312, Math 343, Stat 321.

Modeling, learning, and decision/control identified and placed in perspective. Linear optimization, game theory, operations research, network flows, and Markov processes.

428. Software Engineering. (3:3:0) F, W Prerequisite: C S 340.

Analysis, design, implementation, and testing of significant software systems.

431. Algorithmic Languages and Compilers. (3:3:0) Alt. sem., Alt. Sp, Su term Prerequisite: C S 330, 340.

Formal description of algorithmic languages and techniques used in their compilation: semantics, ambiguities, procedures, replication, iteration, recursion.

450. Introduction to Digital Signal and Image Processing. (3:3:0) F, W Prerequisite: C S 312, Math 343, Stat 321.

One- and two-dimensional signal-processing fundamentals, including sampling, noise, transforms, filtering, enhancement, and compression. Hands-on experimentation with speech, music, still images, and full-motion video.

452. Database Modeling Concepts. (3:3:0) F, W Prerequisite: C S 340, 360.

Database models: relational, deductive, object-oriented. Integrity constraints, query languages, database design.

455. Computer Graphics. (3:3:0) F, W, Alt. Sp, Su term Prerequisite: C S 340; Math 343.

Interactive computer graphics systems programming and architecture.

456. Introduction to User Interface Software. (3:3:0) W Prerequisite: C S 340.

Introduction to software architectures and techniques for graphical user interfaces. Input devices, windowing systems, event-driven programming, interactive geometry.

460. Computer Communications and Networking. (3:3:0) F, W Prerequisite: C S 340, 360.

Introduction to data communications and computer networking. Communications fundamentals, computer networks, software, architecture, telecommunications, regulation, standards.

462. Large-Scale Distributed System Design. (3:3:0) F Prerequisite: C S 340, 360.

Designing and implementing client-server enterprise applications. Web servers, application servers, database connectivity, remote procedure calls, transactions, messaging, directory, naming services, threads, security, data formats.

465. Computer Security. (3:3:0) F Prerequisite: C S 360. Recommended: C S 404.

Introduction to computer security fundamentals: confidentiality, integrity, authentication, and access control. Secret key and public key cryptography, network security protocols, viruses, and fire walls.

470. Introduction to Artificial Intelligence. (3:3:0) F Prerequisite: C S 312, Math 343, Stat 321.

Introduction to core areas of artificial intelligence; intelligent agents, problem solving and search, knowledge-based systems and inference, planning, uncertainty, learning, and perception.

478. Introduction to Neural Networks and Machine Learning. (3:3:0) F, W Prerequisite: C S 312, Math 343, Stat 321.

Neural network and machine learning models include Perceptrons, back-propagation, decision trees, genetic algorithms, and other mechanisms allowing computers to learn without being programmed.

486. Verification and Validation. (3:3:0) F Prerequisite: C S 312, Math 343, Stat 321.

Implementing formal verification algorithms and using them in protocol and circuit design; proving both incorrectness and correctness.

500-Level Graduate Courses (available to advanced undergraduates)

501R. Advanced Topics in Computer Science. (1–3:Arr.:0 ea.) Prerequisite: instructor's consent.

Advanced undergraduate- and graduate-level subjects as announced before each semester.

557. Computer-Aided Geometric Design. (3:3:0) W Prerequisite: C S 240, Math 343; or equivalents.

Free-form curves and surfaces; mathematical theory and algorithms. Bezier and B-spline curves and surfaces, subdivision surfaces, T-splines, free-form deformation, and intersection algorithms. Several programming projects.

579. Natural Language Processing. (3:3:0) W Prerequisite: instructor's consent.

Machine translation, human-computer dialog, question answering, parsing, and generating from an artificial intelligence and machine-learning perspective.

598R. Special Projects. (1–3:0:0 ea.) Prerequisite: instructor's consent.

Graduate Courses

For 600- and 700-level courses, see the BYU 2007–2008 Graduate Catalog.

Computer Science Faculty

Professors

Barrett, William A. (1987) BA, PhD, U. of Utah, 1974, 1978.
Burton, Robert Preece (1974) PhD, U. of Utah, 1973.
Egbert, Parris (1992) BS, Utah State U., 1986; MS, PhD, U. of Illinois, 1990, 1992.
Embley, David W. (1982) BA, MS, U. of Utah, 1970, 1972; PhD, U. of Illinois, 1976.
Flanagan, Kelly J. (1993) BS, MS, PhD, Brigham Young U., 1988, 1989, 1993.
Martinez, Tony R. (1987) BS, Brigham Young U., 1982, MS, PhD, U. of California, Los Angeles, 1983, 1986.
Olsen, Dan R. (1985) BS, MS, Brigham Young U., 1976, 1978; PhD, U. of Pennsylvania, 1981.
Sederberg, Thomas W. (1978) BS, MS, Brigham Young U., 1975, 1977; PhD, Purdue U., 1983.
Woodfield, Scott N. (1985) BS, MS, Brigham Young U., 1975, 1978; PhD, Purdue U., 1980.

Associate Professors

Barker, Joseph Cory (2001) BS, PhD, Brigham Young U., 1982, 1994.
Clement, Mark J. (1994) BS, MS, Brigham Young U., 1985, 1989; PhD, Oregon State U., 1994.
Giraud-Carrier, Christophe G. (2004) BS, MS, PhD, Brigham Young U., 1991, 1993, 1994.
Goodrich, Michael A. (1999) BS, MS, PhD, Brigham Young U., 1992, 1995, 1996.
Knutson, Charles D. (2000) BS, MS, Brigham Young U., 1988, 1994; PhD, Oregon State U., 1998.
Morse, Bryan S. (1994) BS, MS, Brigham Young U., 1986, 1990; PhD, U. of North Carolina, 1994.
Ng, Yiu Kai (Dennis) (1991) BS, Brigham Young U., 1982; MS, Brigham Young U., 1984; PhD, Kansas State U., 1991.
Seamons, Kent (2000) BS, Brigham Young U., 1986; PhD, U. of Illinois, 1996.
Snell, Quinn (1997) BS, MS, Utah State U., 1992, 1993; PhD, Iowa State U., 1997.
Windley, Phillip J. (2004) BS, U. of Idaho, 1982; MS, PhD, U. of California, Davis, 1988, 1990.
Zappala, Daniel M. A. (2004) BS, Stanford U., 1990; PhD, U. of Southern California, 1997.

Assistant Professors

Jones, Michael D. (2001) BS, MS, Brigham Young U., 1995, 1997; PhD, U. of Utah, 2001.
Mercer, Eric G. (2002) BS, MS, PhD, U. of Utah, 1996, 1999, 2002.
Ringger, Eric (2005) BS, Brigham Young U., 1992; MS, PhD, U. of Rochester, 1994, 2000.
Rodham, Kenneth J. (2001) BS, MS, PhD, Brigham Young U., 1990, 1992, 1995.
Roper, Paul R. (2004) BS, MS, Brigham Young U., 1976, 1979.
Seppe, Kevin (2002) BS, Brigham Young U., 1983; MS, U. of Santa Clara, 1986; PhD, U. of Texas, 1990.
Ventura, Dan A. (2001) BS, MS, PhD, Brigham Young U., 1992, 1995, 1998.
Warnick, Sean C. (2003) BSE, Arizona State U., 1993; MS, PhD, Massachusetts Inst. of Technology, 1996, 2003.

Emeriti

- Ashton, Alan C. (1972) BA, PhD, U. of Utah, 1966, 1970.
 Beus, H. Lynn (1971) BA, Brigham Young U., 1961; MS, Case Inst. of Technology, 1964; PhD, Case Western Reserve U., 1967.
 Burton, Robert C. (1964) BS, Brigham Young U., 1956; PhD, U. of North Carolina, 1963.
 Christensen, Larry C. (1983) BA, Brigham Young U., 1963; MA, Central Michigan U., 1968; EdD, Brigham Young U., 1981.
 Cornell, Aurel (1980) MS, PhD, Polytechnic Inst. of Timisoara, Rumania, 1960, 1971.
 Dean, C. Edwin (1949) BS, MS, Brigham Young U., 1948, 1952; MS, U. of Michigan, 1955.
 Hays, Bill (1970) BS, East Texas State U., 1963; MS, U. of Iowa, 1967; PhD, Northwestern U., 1970.
 Ivie, Evan Leon (1979) BS, BES, Brigham Young U., 1956, 1956; MS, Stanford U., 1957; PhD, Massachusetts Inst. of Technology, 1966.
 McClurg, Lynn E. (1972) BGE, U. of Nebraska, 1966; MS, U. of Southern California, 1972; EdD, Brigham Young U., 1978.
 Norman, Theodore A. (1970) BS, U. of Utah, 1962; MS, PhD, Washington State U., 1968, 1970.
 Robison, Parley P. (1967) BS, U. of Utah, 1958.
 Stokes, Gordon E. (1969) BS, Brigham Young U., 1961; MS, U. of Idaho, 1969; EdD, Brigham Young U., 1981.
 Wright, Norman Edward (1963) BS, Brigham Young U., 1951.

Computers and the Humanities

See Linguistics and English Language section of this catalog.

Construction Management

See School of Technology.

Counseling Psychology and Special Education

Mary Anne Prater, Chair
 340 MCKB, (801) 422-3857

David O. McKay School of Education Advisement and Certification Office
 120 MCKB, (801) 422-3426

Admission to Degree Program

Students must apply to the Counseling Psychology and Special Education Department for admission to the special education undergraduate degree and post-baccalaureate licensing programs. Applications may be obtained from the department office in 340 MCKB or on the department Web site at <http://education.byu.edu/cpse>. See additional information below.

Graduation Requirements

To receive a BYU bachelor's degree a student must complete, in addition to all requirements for a specific major, the following university requirements:

- The university core, consisting of requirements in general and religious education (See the University Core section of this catalog for details. For a complete listing of courses that meet university core requirements, see the current class schedule.)
- A minimum of 30 credit hours in residence
- A minimum of 120 credit hours
- A cumulative GPA of at least 2.0

Undergraduate Programs and Degrees

BS Special Education
 Emphases
 Mild/Moderate Disabilities
 Severe Disabilities

Students should see their college advisement center for help or information concerning the undergraduate programs.

Graduate Programs and Degrees

MS Special Education
 EdS School Psychology
 PhD Counseling Psychology

For more information see the BYU 2007–2008 Graduate Catalog.

General Information

Post-Baccalaureate Special Education Licensing

Individuals who have already completed a bachelor's degree who apply and are admitted to the special education licensing program may be licensed in special education upon completion of the required licensing course work. No degree designation is given for this option.

Admission to BS Programs

Among other factors, the application review process involves consideration of the following:

1. Significant experience working with individuals who have disabilities (see Special Education Exploratory Experience Log and Summary Report in application packet on Web site).
2. A university cumulative GPA of 2.85 or higher.
3. A fingerprinting and FBI background check. See Education Advisement and Certification Office (120 MCKB) for instructions.
4. Successful completion of technology skills assessment.