MATHEMATICS AND COMPUTER SCIENCE

In a society becoming ever more mathematical and computerized, the department seeks to provide courses which introduce all students to the ideas of mathematics and computer science. The department also provides advanced courses for those wishing to specialize in one of these areas. We teach these technical concepts in a manner consistent with the liberal arts aim of the College and in a way that encourages the student to use these abilities to serve others.

Mathematics Curriculum

The purpose of the mathematics curriculum is to present the basic concepts and methods in modern mathematics, to develop the student's ability to think critically using the axiomatic method, and to apply these ideas to other disciplines. This major provides the mathematical background for students preparing for:

1. Licensure in secondary education
2. Graduate study in a mathematical discipline
3. A career in an area using mathematics, such as engineering, economics, statistics, or actuarial science

Students who complete a Mathematics major are granted a Bachelor of Science degree unless they request a Bachelor of Arts degree.

Concentrations

All mathematics majors choose one of the following four concentrations: Pure Mathematics, Statistics, Applied Mathematics, or Math with Secondary Education.

Mathematics and Secondary Education Double Majors:
Students may complete any of the four mathematics concentrations (along with Math 324 and Math 325) with the secondary education major.

Calculus Readiness Assessment:

Students who plan to enroll in MATH 231 Calculus I must have Wheaton College credit for MATH 131 Precalculus or must score 75 or above on Wheaton College's Calculus Readiness Assessment (CRA). Without credit for MATH 131 Precalculus, students may register for MATH 231 Calculus I but will not be allowed to remain if they do not meet the benchmark of 75 before the first class period. The Calculus Readiness Assessment is a dynamic, online assessment that evaluates students' strengths in arithmetic, algebra, and other pre-calculus skills. We will allow up to 3 hours for the test but it is typically completed in 60-90 minutes. There is a link to the Calculus Readiness Assessment on the Wheaton College student portal. There is a short video (https://vimeo.com/413631570/) to help find this link.

The assessment comes with effective learning modules specially designed to help students "brush up" on all pre-calculus skills. Students should sign into the CRA well in advance of the semester in which they intend to take MATH 231 Calculus I and try a first assessment. If more than one attempt is necessary to reach the benchmark of 75, the student should spend time in the learning modules before taking another assessment. The learning modules remain available until 6 weeks after the semester begins. Though the assessment is unproctored, we expect students to follow the assessment procedures honestly (which means that students should not use outside help and should only use the calculator app provided by the program) so that our department and the student have an accurate sense of the student's preparedness. Students who do not meet the 75 score and need MATH 231 Calculus I for their program are encouraged to enroll in MATH 131 Precalculus.

Computer Science Curriculum

The curriculum in computer science presents the fundamentals of computation—the science underlying the computing technologies that have become so pervasive in contemporary society. This foundation better prepares one to make choices about how those technologies can and should be applied, at the organizational and societal levels, as well as individually. The deeper study required of a computer science major provides experience in the discipline's methods of analysis and problem-solving. Furthermore, experimental work throughout the curriculum allows majors to develop skills in the design, analysis, and development of software systems, and so provides excellent preparation for a computing-related career, as well as for graduate study in computer science or engineering.

Students who complete a Computer Science major are granted a Bachelor of Science degree unless they request a Bachelor of Arts degree.

Faculty

Chair, Professor Mary Vanderschoot
Professors Paul Isihara, Stephen Lovett
Associate Professors Danilo Diedrichs, Hyunju Kim, Thomas VanDrunen
Assistant Professors Peter Jantsch, Devin Pohly
Visiting Assistant Lecturer Martha Van Zee

Programs

- Mathematics Major with Pure Math Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/mathematics-major-pure-math-concentration/)
- Mathematics Major with Applied Mathematics Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/mathematics-major-applied-math-concentration/)
- Mathematics Major with Statistics Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/mathematics-major-statistics-concentration/)
- Mathematics Major with Secondary Education Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/mathematics-major-sec-ed-concentration/)
- Mathematics Minor (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/mathematics-minor/)
- Computer Science Major (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/computer-science-major/)
- Computer Science Minor (https://catalog.wheaton.edu/undergraduate/arts-sciences/mathematics-computer-science/computer-science-minor/)

Courses
Mathematics Courses

MATH 106. Mathematics for the Benefit of Mission and Society. (4 Credits)
An overview of how mathematics benefits the mission of the Church and society worldwide, with special regard for those who are suffering and/or marginalized. Examples will be drawn both from history and our contemporary world.
Tags: AAQR

MATH 107. Finite Mathematics and Applications. (4 Credits)
Designed to provide the mathematical tools that a college graduate is likely to encounter in his or her work. Core topics include systems of linear equations, mathematics of finance, and basic probability and statistics. Additional topics may include game theory for decision making, linear programming, iterated processes, or networks. Extensive use of spreadsheet programs. The course illustrates the relevance of mathematics to life applications by taking real or realistic examples from business, economics, social sciences, and life sciences.
Tags: AAQR

MATH 121. Data Science I. (4 Credits)
This course combines inferential thinking, computational thinking, and real-world relevance. The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets from a variety of disciplines/industries. The course also covers current ethical issues pertinent to decision-making data. Prerequisite: Precalculus knowledge.
Tags: AAQR

MATH 125. Mathematics for Elementary and Middle Grade Education. (4 Credits)
Set theory, numeration systems, number theory, and properties of the natural numbers, integers, rational, and real number systems with an emphasis on problem solving and critical thinking. Selected topics from geometry, algebra, probability, and statistics. Satisfies AAQR for Elementary Education majors only. Prerequisite: Elementary Education major.
Tags: AAQR

MATH 131. Precalculus. (4 Credits)
A course in elementary functions intended to prepare students for MATH 221 or MATH 231. Topics include the properties of the real number system, inequalities and absolute values, functions and their graphs, solutions of equations, polynomial functions, trigonometric functions, exponential, and logarithm functions. Emphasis on using functions to model physical or social systems.
Tags: AAQR

MATH 215. Data Science for the Common Good. (2 Credits)
Can the power of data science be used to benefit the mission of the Church and society? How do these tools help (or hinder!) causes of justice and equity? This course is both a hands-on introduction to the basics of Python programming for data science—data wrangling, visualization, and statistical methods—as well as a look at how these tools may be used to better understand God's world. No previous programming experience is required. (Open to Wheaton College Summer Institute students only)

MATH 221. Applied Calculus. (4 Credits)
This course covers the ideas of calculus, emphasizing applications to business and the social sciences. It includes a wider range of topics than MATH 231 but with less depth of coverage. Topics include limits, definitions and applications of the derivative and integral, and functions of one or more variables. Prerequisite: MATH 131 or Precalculus competence. This course does not count towards the mathematics major. Only one of MATH 221 or MATH 231 may be taken for credit.
Tags: AAQR

MATH 231. Calculus I. (4 Credits)
This course covers differential and integral calculus of functions of a single real variable, including trigonometric, exponential, and logarithmic functions. Derivatives and integrals are studied symbolically, graphically, and numerically. Applications of calculus are emphasized throughout the course. Three lectures, two hours drill. Prerequisite: MATH 131 or a score of 75% on the Calculus Readiness Assessment.
Tags: AAQR

MATH 232. Calculus II. (4 Credits)
Infinite series, polar coordinates and parametric curves. Three-dimensional geometry and vector algebra, functions of two variables, partial differentiation, double integration. Applications of these topics are emphasized throughout the course. Three lectures, two hours drill. Prerequisite: MATH 231 or 233 with a minimum grade of C-, or AP Calculus AB score of 4 or 5, or BC score of 3.

MATH 233. Calculus I B. (2 Credits)
This is a 2-hour course that covers the B-Quad material of MATH 231. Applications of differentiation, including optimization and Newton's Method. Introduction to integration, Fundamental Theorem of Calculus, applications of integration, integration techniques. The course meets concurrently with MATH 231 in B-Quad. Three lectures, two hours drill. Prerequisite: AP Calculus AB score of 3 or BC score of 2.
Tags: AAQR

MATH 234. Calculus II B. (2 Credits)
This is 2-hour course that covers the B-Quad material of MATH 232, including analytic geometry in three dimensions, vector algebra, multivariable calculus with functions of two and three variables, partial differentiation, multivariable optimization, and double integrals. Prerequisite: AP Calculus BC score of 4 or 5.

MATH 241. Introduction to Proofs. (2 Credits)
Propositional logic, quantifiers, elementary proof techniques and strategies. An introduction to set theory, including operations on sets, definition of functions, relations. Basic number theory including divisibility, primes, greatest common divider, Euclidean Algorithm. Induction and well-ordering. Permutations and combinations. Axiomatic systems. Prerequisite: MATH 232 or MATH 234. Pre or Corequisite: MATH 245.

MATH 245. Linear Algebra. (4 Credits)
Starting with solving systems of linear equations, matrix algebra is used to explore vector spaces and linear transformations. Emphasis is given to bases, dimension, eigenvectors, and orthogonality. Prerequisite: MATH 231 or MATH 233.

MATH 263. Introduction to Statistics. (4 Credits)
An introduction to statistics, sampling theory, and statistical decision making from a solid mathematical basis for non-mathematics majors. Topics chosen from discrete and continuous distributions, moments, hypothesis testing, correlation and multiple correlation, regression (linear, multivariate, logistic), ANOVA, contingency tables with tests for independence, sampling theory, and rudimentary non-parametric statistics. Students will use selected software packages for data processing and analysis and will need access to a laptop and a graphing calculator with an inverse t-distribution function. Prerequisite: MATH 131 or Precalculus knowledge.
Tags: AAQR

MATH 301. Intro to Upper-Level Math. (2 Credits)
Introduction to learning and communication processes used in upper-level mathematics: primary literature sources, presenting mathematics in writing and orally using specialized software. The vocation of a mathematician: ongoing research developments, professional opportunities in academia and in the industry. For sophomore or junior math or applied math majors only. Prerequisite: MATH 232 or MATH 234. Pre or Corequisite: MATH 245.

MATH 302. Applied Project I. (2 Credits)
Submission of Applied Project proposal. Preliminary draft of research project including problem statement, scope of project, background, design and methodology in consultation with faculty project advisor(s). Prerequisite: MATH 301.

MATH 314. Problem Solving Seminar. (2 Credits)
Mathematical problem solving aimed at students who enjoy solving problems in a variety of areas of mathematics, and who would like to strengthen their creative mathematical thinking. Students are required to take the William Lowell Putnam Undergraduate Mathematics Competition. Prerequisites: MATH 232 (or MATH 234) and MATH 245.

MATH 324. Methods of Teaching Mathematics. (2 Credits)
Theories and methods for teaching mathematics at the secondary level. Topics include cooperative learning, classroom management, and creative teaching ideas. Consideration of current math technology and curriculum standards. Required of mathematics majors in WheTEP, prior to student teaching. Prerequisite: Acceptance to WheTEP.

MATH 325. Methods of Teaching Middle Grade Mathematics. (2 Credits)
Theories and methods for teaching mathematics at the middle grade level. Topics include effective teaching strategies, planning, and assessment of math content. Based on current state and national content and teaching standards. Prerequisite: EDUC 225, EDUC 225L and Admission into WheTEP.

MATH 331. Vector Calculus. (2 Credits)
Vector algebra, properties of transformations, curves and surfaces, line, surface, and volume integrals, Green's, Stokes', and the divergence theorems. Prerequisite: MATH 232 or 234.

MATH 333. Differential Equations. (4 Credits)
An introduction into the theory, methods of solution, and selected applications of ordinary differential equations. Topics include first order equations, second order linear equations with constant coefficients, numerical analysis of ordinary differential equations, Laplace Transforms, series solutions, and systems of differential equations. Prerequisite: MATH 232 or 234.

MATH 341. Modern Algebra. (4 Credits)
An introduction to the theory of groups, rings, and fields. Topics in group theory include Lagrange's theorem, quotient groups, applications to geometry, public key cryptography, and finitely generated abelian groups. Topics in ring theory include ideals, quotient rings, and polynomial rings. Topics in field theory include field extensions, Euclidean construction problems, cubic and quartic equations. Prerequisites: MATH 245 and (MATH 241 or CSCI 243), or consent of instructor.

MATH 351. Analysis I. (4 Credits)
Derivation of the properties of continuity, differentiability, integrability, and convergence by use of the limit concept and basic axioms of the real number field. Prerequisite: MATH 232 or MATH 234. Pre or Corequisite: MATH 241 or CSCI 243.

MATH 352. Complex Analysis. (4 Credits)
An introduction to functions of a complex variable. Topics include the algebra and geometry of complex numbers, mappings of the complex plane, elementary analytic functions, complex functions defined by power series, and differentiation and integration of complex functions. Prerequisite: MATH 331 (MATH 351 recommended). Offered spring of odd-numbered years.

MATH 362. Geometry. (4 Credits)
Selected topics from finite, affine, projective, Euclidean and non-Euclidean geometry from both the axiomatic and transformation approaches. Prerequisite: MATH 245. Offered spring of odd-numbered years.

MATH 363. Probability Theory. (4 Credits)
An introduction to probability theory, including discrete and continuous distributions. Topics covered include independence, conditional probability, expectation, variance and covariance, random vectors, and the central limit theorem. Students will need access to a non-CAS (Computer Algebra System) graphing calculator with an inverse t-distribution function. Prerequisites: MATH 232 (or MATH 234) and MATH 245.

MATH 364. Mathematical Modeling. (4 Credits)
This applied course teaches mathematical modeling techniques used in the natural and social sciences including discrete and continuous dynamical systems, optimization, stochastic and data-driven models based on statistical methods, regression and interpolation. Analytical and numerical methods are used alongside computer simulations to study models used in biology, ecology, economics, epidemiology, meteorology, pharmacology, sociology, and supply chain logistics. Prerequisites: MATH 232 (or MATH 234) and MATH 245.

MATH 385. Topics in Applied Mathematics. (4 Credits)
A topic selected for each semester in which the course is offered that focuses upon a particular applied mathematics discipline in a way that brings important mathematical theory and methods to practice. Possibilities include MATLAB modeling, Numerical Analysis, Dynamical Systems, Applied Linear Algebra, Operations Research, Cryptography, or Applied Discrete Math. Prerequisites: MATH 232 (or MATH 234) and MATH 245 or consent of instructor.

MATH 386. Topics in Statistics. (4 Credits)
A topic selected for each semester in which the course is offered that focuses upon a particular application in depth and goes beyond methods covered in MATH 363. Some possible topics include Bayesian Analysis, Machine Learning, Nonparametric Methods, Regression, or Structural Equation Modeling. Prerequisite: MATH 363.

MATH 433. Partial Differential Equations. (4 Credits)
Partial differential equations (PDE's) are differential equations involving functions of multiple independent variables and partial derivatives. PDEs are ubiquitous in the natural sciences, especially physics and engineering, appearing in mathematical models that vary in time and space such as diffusion, fluid flow, vibrating strings and membranes, waves (sound, electromagnetic), transport phenomena, and quantum mechanics. The course focuses on analytical methods for solving PDEs with extensions into Fourier theory, L2 theory, and Sturm-Liouville theory. Prerequisites: MATH 245 and 333.

MATH 441. Algebra II. (4 Credits)
Advanced group theory, including group actions and Sylow theorems. Module theory with selected applications. Galois theory of field extensions. Multivariable polynomial rings with applications of Groebner bases. Introduction to the concept of categories. Prerequisite: MATH 341. Offered fall of even-numbered years.

MATH 451. Analysis II. (2 or 4 Credits)
Study of topics from real analysis. Prerequisite: MATH 351. Alternate years.

MATH 463. Mathematical Statistics. (4 Credits)
Starting from a review of probability distributions and their underlying assumptions and features, this course focuses upon statistical inference and data analysis. Topics will be chosen from parametric hypothesis testing, ANOVA, contingency tables and tests for independence, regression techniques and some Bayesian/non-parametric methodology. Students will use selected software packages for data processing and analysis and will need access to a laptop (Windows/Mac/Linux OS) as well as to a non-CAS (Computer Algebra System) graphing calculator with an inverse t-distribution function. Prerequisite: MATH 363.

MATH 464. Bayesian Statistics. (4 Credits)
Students will study advanced statistical analysis methods from a Bayesian perspective. The course will cover all the fundamental concepts of Bayesian methods, including Bayes Rule, hierarchical models (a.k.a. multilevel models), Markov chain Monte Carlo (MCMC) methods, and the use of STAN as the modeling algorithm. Methods will be applied to various types of data. Inference and model fit measures will be discussed. Prerequisite: MATH 363.

MATH 465. Applied Machine Learning. (4 Credits)
An introduction to machine learning that emphasizes application to data. Both supervised and unsupervised methods are discussed, including classification, clustering, regression, and feature selection, along with neural networks/deep learning. Prerequisite: MATH 363.

MATH 485. Advanced Topics in Mathematics. (4 Credits)
A topic selected for each semester in which the course is offered that focuses upon a particular applied mathematics discipline in a way that brings important mathematical theory and methods to practice. Possibilities include Numerical Analysis, Dynamical Systems, Applied Linear Algebra, Operations Research, Cryptography, Combinatorics, or Applied Discrete Math. Prerequisites: MATH 232 (or MATH 234) and MATH 245, or consent of instructor.

MATH 493. Mentored Research Seminar. (2 or 4 Credits)
Faculty and student collaboration on a project of mutual interest. Limited enrollment - faculty approval required.

MATH 494. Senior Seminar. (2 Credits)
A survey of the history and philosophical foundations of mathematics, and also its current research trends and cultural impact. Students will discuss the diverse vocations of a Christian including their fulfilment of God's kingdom, equity, and social justice, as well as the stewardship of mathematical ability for the flourishing of society via research, teaching, and industry. Students will also engage in projects involving literature review, creative teaching and problem solving, mathematical models, or statistical analysis. Prerequisites:Senior standing in the mathematics major.
General Education: SHAR

MATH 495. Problems In Mathematics. (1 to 4 Credits)
Independent study for senior majors. A maximum of two hours can be applied to the major.

MATH 496. Internship. (1 to 4 Credits)
Graded pass/fail. Prerequisite: junior or senior standing with Mathematics or Applied Mathematics major.

Computer Science Courses

CSCI 212. Computer Programming Principles. (2 Credits)
A gentle introduction to computer programming using the principles of algorithmic thinking. Intended for students who intend to take CSCI 235 in a future semester but desire a slower-paced first experience with programming.

CSCI 233. Introduction to Scientific Computing. (4 Credits)
Introduction to programming and computer analysis of data for scientific applications. Scripting and treatment of numerical issues are integrated into the content stream.

CSCI 235. Programming I: Problem Solving. (4 Credits)
A first course in computer programming for beginners. Structured and object-oriented programming in Java or a similar programming language. Types, control structures, methods, and recursion; objects, classes, interfaces, encapsulation and polymorphism; exceptions, library classes, file I/O, linked lists, and graphical user interfaces.
Tags: AAQR

CSCI 236. Accelerated Introduction to Programming. (2 Credits)
A condensed, accelerated version of CSCI 235 for students with prior programming experience. This course focuses on preparing students to take CSCI 245. Offered occasionally.

CSCI 243. Discrete Mathematics and Functional Programming. (4 Credits)
Sets, logic, the nature of proof, induction, algorithms, algorithm correctness, relations, lattices, functions, and graphs. Functional programming and recursion using the ML programming language. May not be taken after MATH 341 or MATH 351.
Tags: AAQR

CSCI 245. Programming II: Object-Oriented Design. (4 Credits)
A gateway to the computer science major, introducing a range of themes in the field of computer science. Object-oriented programming in Java or a similar language: code reuse with composition and inheritance; generic types; design patterns. Software development: development tools, attributes of good design. Algorithmic analysis; searching and sorting algorithms. Abstract data types: stacks, queues, trees, hashing; linked vs array-based implementation. Systems programing in C; pointers and dynamic allocation; model of machine memory, organization, and execution. Prerequisite: CSCI 235 or departmental approval.

CSCI 335. Software Development. (4 Credits)
Principles and practices of software development including design patterns, validation and testing, coordination of team projects. Introduction to databases and user interface design. Professional issues in computing. Prerequisite: CSCI 245; Pre or Corequisite: CSCI 243.

CSCI 345. Data Structures & Algorithms. (4 Credits)
Formal and experimental approaches to verifying algorithms' correctness and analyzing their efficiency. Abstract data types and their implementations. Efficient implementations of maps using balanced binary search trees and hash tables. Graph algorithms. Dynamic programming. Prerequisites: CSCI 243 and CSCI 245.

CSCI 351. Introduction to Computer Systems. (4 Credits)
An introduction to low-level systems issues from the perspective of the programmer. Representation of both data and program as produced by a compiler; hardware support for memory, input/output, and parallelism; fundamental ideas in operating systems and networking. Prerequisite: CSCI 245.

CSCI 357. Networking. (4 Credits)
Examination of the fundamental problems in computer internetworking, from the link to application levels, with particular attention to the Internet protocols. Issues include naming/addressing, error-handling, routing, and decentralized control. Prerequisite: CSCI 351. Course offered alternate years.

CSCI 359. Information Security. (4 Credits)
An introductory course in the technical aspects of computer security, exploring both theory and practice. General security properties and ideas: confidentiality, integrity, availability, threats, trust, protection, access control. Policy: access matrix, discretionary and mandatory access control, Bell–LaPadula, Biba, Chinese Wall, availability policies. Cryptography and its applications: symmetric and asymmetric ciphers, cryptographic hashes and digital signatures, key management and exchange, random number generation, single sign-on, cryptanalysis. Topics in systems security: vulnerabilities, malware, rootkits, botnets, social engineering, covert channels, information flow. Topics in network security: denial-of-service attacks, intrusion detection, firewalls, network protocol flaws, Web vulnerabilities, anonymous communication. Prerequisite: CSCI 351. Course offered alternate years.

CSCI 361. Computer Graphics. (4 Credits)
Introduction to graphical programming environments, OpenGL libraries. Rendering three-dimensional images, transformations, windowing, clipping, shading, and image enhancements. Prerequisite: CSCI 345. Course is offered occasionally.

CSCI 365. Programming Language Concepts. (4 Credits)
A survey of the design and implementation of programming languages: grammars, parsing, and abstract syntax; compilers, interpreters, and other language systems; type-checking and other static analyses; formal semantic specifications; implementation of imperative, functional, and object-oriented language features; type-soundness proofs; tail form and continuation passing style. Prerequisites: CSCI 335 and CSCI 351. Course offered alternate years.

CSCI 371. Database Management Systems. (4 Credits)
History and motivation for database systems. Entity-relationship model, relational model, SQL overview, keys. Relational algebra and calculus, SQL nested, aggregate, cursor queries, null values. Storage of data on disk systems, file organization, hash and tree indexing. Schema refinement and normal forms. Web-based access of database systems. Transaction processing. Prerequisites: CSCI 335 and CSCI 345. Course offered alternate years.

CSCI 373. Platform-Specific Development. (4 Credits)
Introduction to developing software on a specific platform, such as iOS programming using Swift for applications on iPhones and iPads. Topics include developer tools, programming in a platform-specific language, MVC design pattern, user interfaces, persistent storage solutions, and frameworks for additional app functionality. Prerequisite: CSCI 335. Course offered alternate years.

CSCI 381. Machine Learning. (4 Credits)
Theory, algorithms, and applications of machine learning. Machine learning techniques including k-nearest neighbors, expectation-maximization, neural nets, support vector machines, and principal component analysis. Ethical considerations for how machine learning applications are used and how they affect society. Prerequisite: CSCI 345 and MATH 245. Course offered alternate years.

CSCI 384. Computational Linguistics. (4 Credits)
An exploration of big ideas in computational linguistics, natural language processing, and/or language technologies. Language models, n-grams, information theory and entropy, and semantics. Applications of computational linguistics such as part-of-speech tagging, authorship attribution, automatic translation, and sentiment analysis. Prerequisite: CSCI 345 (non-majors without the prerequisite may enroll with departmental approval). Course offered alternate years.

CSCI 394. Seminar. (2 or 4 Credits)
Selected topics in Computer Science at each offering, including such subjects as object-oriented design, e-commerce, human computer interface, networking services. May be taken again when a different topic is offered. Prerequisite: Departmental approval.

CSCI 445. Analysis of Algorithms. (4 Credits)
An introduction to algorithmic efficiency and to techniques for the design and analysis of efficient algorithms. General topics include review of asymptotics, algorithm design techniques (such as divide-and-conquer, dynamic programming, and greedy algorithms), graph algorithms, languages and automata, and NP-completeness. Prerequisite: CSCI 345. Course offered alternate years.

CSCI 455. Operating Systems. (4 Credits)
Dynamic process activation, system structure, abstract machines, kernels, performance evaluation, memory management, processor management, time management, recovery procedures, file systems, security, scheduling, device management, networks. Prerequisites: CSCI 335 and CSCI 351. Course offered alternate years.

CSCI 493. Mentoring Seminar. (2 or 4 Credits)
Faculty and student collaboration on a project of mutual interest. Limited enrollment - faculty approval required.

CSCI 494. Social and Ethical Issues in Computing. (2 Credits)
A study of the ways in which the computer and communications revolution is changing society to develop an awareness of and sensitivity to the ethical issues that arise in computer science and related professions. Prerequisite: Senior standing in the major.
General Education: SHAR

CSCI 495. Independent Study. (1 to 4 Credits)
An individually adapted study of any aspect of computing science or its relationship to other fields of study.

CSCI 496. Internship. (2 or 4 Credits)
Graded pass/fail. Prerequisite: junior or senior standing with Computer Science major. May repeat once for a total of 4 hours.