MATHEMATICS

Mathematics is the study of patterns and the logical connections between them. The patterns can be numerical, algebraic, or geometric. The logical connections are typically computations and proofs. When the patterns come from the real world, we get applied mathematics. The logical connections might then take the form of a differential equation that predicts how a disease outbreak will unfold, a statistical model that allows an actuary to assess risks, or a geometric algorithm that displays a three-dimensional object on a flat computer screen. When the patterns come from building up theory from axiomatic truths, we get the myriad sub-disciplines of pure mathematics: real analysis, abstract algebra, topology, non-Euclidean geometry, probability, and many others.

The mathematics major can tailor upper-level courses to his interests (including pure mathematics, applied mathematics and statistics) and career goals (including actuarial science, computer science and secondary education).

Advanced Placement

- A student who gets a 4 or 5 on the AB calculus exam receives immediate credit for MAT-111 Calculus I and receives a placement of MAT-112 Calculus II.
- Any student starting in MAT-112 Calculus II (by the AP exam or our internal placement) who gets a B- or better will receive retroactive credit for MAT-111 Calculus I.
- A student who gets a 4 or 5 on the BC calculus exam receives immediate credit for MAT-111 Calculus I and MAT-112 Calculus II, and receives a placement of MAT-223 Linear Algebra.
- A student who gets a 4 or 5 on the statistics AP exam receives immediate credit for MAT-103 Probability and MAT-104 Statistics.
- A student who gets a 4 or 5 on the Computer Science A AP exam receives immediate credit for CSC-111 Intro to Programming.
- A student who gets a 4 or 5 on the Computer Science principles AP exam receives immediate credit for CSC-101 Intro to Computer Science.

Student Learning Goals

To give all students who take mathematics courses a sense of the nature of mathematics and its place in society.

To give mathematics majors an understanding and appreciation of the fundamental nature of mathematics, and to prepare them to become effective users of mathematics in their careers.

To give mathematics minors an understanding and appreciation of the fundamental nature of mathematics, and to prepare them to become effective users of mathematics in their careers.

To give students interested in pursuing graduate study in mathematics (or related disciplines) an adequate preparation to succeed in that study.

To prepare students to excel in their academic pursuits beyond mathematics. This includes students who take mathematics distribution courses, math minors, and students with additional majors, who will gain deeper insights into their other majors.

Mathematics majors may opt for the Pure Mathematics track, the Computational Mathematics track, or the Financial Mathematics track. There is a great deal of overlap among these choices, and all include the four core courses.

Major in Mathematics

Code	Title	Credits
Mathematics Core Courses		
MAT-111	Calculus I	1
MAT-112	Calculus II	1
MAT-223	Linear Algebra	1
MAT-331	Abstract Algebra I	1
Track		
Select one of the following tracks:		5
Pure Mathematics		
Computational Mathematics		
Financial Mathematics		
Total Credits		**9**

Mathematics majors should complete the four core courses by the end of the sophomore year, if possible; they must be completed by the end of the junior year.

Incoming freshmen interested in pursuing mathematics at Wabash College will typically take MAT-111 Calculus I or MAT-112 Calculus II in the fall (depending on placement) and MAT-112 Calculus II or MAT-223 Linear Algebra in the spring. Course choices in the fall of the sophomore year will usually depend on the direction the student sees himself headed. Students should plan to take MAT-331 Abstract Algebra I in the spring of their sophomore year. Potential mathematics majors should discuss their plans with a member of the department and review the flow chart describing prerequisites among the courses for the major (https://www.wabash.edu/academics/uploads/math/math_flow_chart_(2010).pdf). Several courses are offered in alternate years; majors must plan accordingly.

Pure Mathematics Track

Code	Title	Credits
MAT-333	Funct Real Variable I	1
or MAT-341	Topology	
Mathematics Electives		4
Total Credits		**5**

Computational Mathematics Track

Code	Title	Credits
CSC-111	Intro to Programming [1]	1
MAT-337	Numerical Analysis	1
or MAT-338	Topics Computational Math	
Mathematics Electives		4
Total Credits		**5**

[1] This does not count toward the major, but it is a prerequisite for MAT-337 Numerical Analysis and MAT-338 Topics Computational Math, and should be taken by the sophomore year, if possible.

Financial Mathematics Track

Code	Title	Credits
MAT-251	Mathematical Finance	0.5
MAT-252	Mathematical Interest Theory	0.5
MAT-253	Probability Models	0.5

MAT-353	Probability Models II	0.5
MAT-254	Statistical Models	0.5
MAT-354	Mathematical Statistics	0.5
or MAT-355	Regression Models	
Mathematics Electives		2
Total Credits		**5**

The requirements for the financial mathematics major are good preparation for the initial actuarial exams.

Electives may not include MAT-100 Math Modeling and Precalculus, MAT-103 Probability, MAT-104 Statistics, MAT-106 Topics in Contemporary Math, or MAT-108 Intro to Discrete Structures.

Additional Courses

Additional courses to consider, especially for students who are considering graduate school:

Pure Mathematics

Code	Title	Credits
MAT-219	Combinatorics	1
MAT-221	Geometry	1
MAT-222	Number Theory	1
MAT-224	Differential Equations	1
MAT-225	Multivariable Calculus	1
MAT-323	Topics in Linear Algebra	1
MAT-324	Topics in Differential Equations	1
MAT-332	Abstract Algebra II	1
MAT-334	Funct Real Variable II	1
MAT-344	Complex Analysis	1

Computational Mathematics

Code	Title	Credits
MAT-219	Combinatorics	1
MAT-222	Number Theory	1
MAT-224	Differential Equations	1
MAT-225	Multivariable Calculus	1
MAT-226	Operations Research	1
MAT-235	Stochastic Simulation	1
MAT-314	Modeling With Differential Equations	1
MAT-324	Topics in Differential Equations	1
MAT-332	Abstract Algebra II	1

Financial Mathematics

Code	Title	Credits
MAT-224	Differential Equations	1
MAT-324	Topics in Differential Equations	1
MAT-333	Funct Real Variable I	1

Mathematics Minor

Code	Title	Credits
MAT-111	Calculus I	1
MAT-112	Calculus II	1
MAT-223	Linear Algebra	1
Mathematics Electives [1]		2
Total Credits		**5**

[1] Excluding MAT-100 Math Modeling and Precalculus, MAT-103 Probability, MAT-104 Statistics, MAT-106 Topics in Contemporary Math and MAT-108 Intro to Discrete Structures.

MAT-100 Math Modeling and Precalculus
This course develops problem solving skills fundamental to further study in higher mathematics through mathematical modeling and applications. Students will study algebraic and graphical properties of polynomial, rational, exponential, logarithmic, and trigonometric functions, with a focus on using these to build and understand mathematical models. With a dual emphasis on sharpening core skills and understanding applications, this course provides a review of material relevant for continuing to a full course in calculus. This course is limited to students who intend to continue to MAT-111 as a requirement for his major, but whose placement indicates that a precalculus course is advisable. While it satisfies the Quantitative Literacy (QL) distribution requirement, enrollment in MAT 100 is only available through instructor permission. For students who need distribution credit in QL but do not require a subsequent course in calculus, MAT-103, MAT-104, MAT-106, and MAT-108 are recommended. MAT-100 does not count toward a major or minor in mathematics.
Prerequisites: none
Corequisites: Prerequisite: MAT-100 placement
Credit: 1
Distribution: Quantitative Literacy

MAT-103 Probability
The course introduces students to key measures of uncertainty (probability) and long-run average (expected value). Probabilistic reasoning is applied to a wide variety of interesting in the areas of medical testing, gambling, game theory, sports, asset-price modelling, financial derivatives, insurance, and retirement annuities. MAT-103 does not count toward the mathematics major or minor. Credit cannot be given for both MAT-103 and MAT-253. The course is offered most semesters.
Prerequisites: none
Credits: 0.5
Distribution: Quantitative Literacy

MAT-104 Statistics
The course looks briefly at some standard statistics: averages, variances, standard deviations, medians, and proportions. Correlation coefficients are introduced and used for prediction. The classical p-value approach to claim testing is presented and applied to a wide variety of testing situations. In addition, the classical confidence interval approach to estimation is examined. MAT-104 does not count toward the mathematics major or minor. (MAT-103 is not a prerequisite for MAT-104). Credit cannot be given for both MAT-104 and MAT-254. The course is offered most semesters.
Prerequisites: none
Credits: 0.5
Distribution: Quantitative Literacy

MAT-106 Topics in Contemporary Math
A study of selected topics dealing with the nature of mathematical ideas. This course focuses on mathematics as a creative endeavor. Through participation and discovery, students will consider an articulation of mathematics that focuses on patterns, abstraction, and inquiry. Topics will vary, but could include logic, Euclidean geometry, algorithms, etc. This course does not count toward the major or minor in mathematics.Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credit: 1
Distribution: Quantitative Literacy

MAT-108 Intro to Discrete Structures
An introduction to discrete mathematics for students not planning to major in mathematics. Topics include sets and logic, proof methods, counting arguments, recurrence relations, graphs, and trees. This course may be used to meet the mathematics requirement for the computer science minor. However, it does not count toward the mathematics major or minor. Students may not present both MAT 108 and 219 for credit toward graduation.
Prerequisites: none
Credit: 1
Distribution: Quantitative Literacy

MAT-111 Calculus I
This course studies the fundamentals of single-variable calculus, developing analytical and computational skills appropriate for students in quantitatively rigorous disciplines. Topics include limits, continuity, techniques of differentiation, applications of derivatives, the Mean Value Theorem, the Intermediate Value Theorem, the Fundamental Theorem of Calculus, and the method of substitution for integration.
Prerequisites: MAT-100 with a minimum grade of C-, or MAT-111 placement, or permission of the instructor
Credit: 1
Distribution: Quantitative Literacy
Equated Courses: MAT-110

MAT-112 Calculus II
This course continues the study of calculus from MAT-111, developing analytical and computational skills appropriate for students in quantitatively rigorous disciplines. Topics include techniques and applications of integration, numerical integration, improper integrals, infinite sequences and series, Taylor series, and an introduction to multivariable calculus including partial derivatives and multiple integrals.
Prerequisites: MAT-110 or MAT-111 with a minimum grade of C-, or MAT-112 placement
Credit: 1
Distribution: Quantitative Literacy
Equated Courses: APCR

MAT-178 Special Topics
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credits: 0.5-1
Distribution: Quantitative Literacy

MAT-219 Combinatorics
This course is an introduction to combinatorial reasoning and discrete mathematics. Topics include enumeration, combinatorial identities, graph theory, generating functions, and recurrence relations. Additional topics may include graph algorithms, partitions, and partially ordered sets. Students may not present both MAT 108 and 219 for credit towards graduation. This course is offered in the spring semester.
Prerequisites: MAT-223
Credit: 1

MAT-221 Geometry
This course studies aspects of the development of Euclidean and non-Euclidean geometries from a modern and/or historical viewpoint.
Prerequisites: MAT-112
Credit: 1

MAT-222 Number Theory
A study of elementary number theory. Topics include divisibility, congruences, properties of prime numbers, linear Diophantine equations, the Euler phi function, primitive roots, and additional topics. Such topics may include public key cryptography, quadratic reciprocity, and Pythagorean triples. This course is offered in the spring semester.
Prerequisites: MAT-112
Credit: 1

MAT-223 Linear Algebra
An introduction to linear equations and vector spaces. Topics include solving linear equations, matrix algebra, row operations, determinants, vector spaces, bases and dimension, linear transformations, eigenvalues and eigenvectors, and orthogonality. Optional topics include least squares problems, matrix factorization, and other applications. An important aspect of the course is to introduce the student to abstract thinking and proofs.
Prerequisites: MAT-112 with a minimum grade of C-, or MAT-223 placement
Credit: 1
Distribution: Quantitative Literacy
Equated Courses: CR

MAT-224 Differential Equations
An introduction to ordinary differential equations. Special solution techniques and some theory for first-order and linear equations including integrating factors, constant coefficients, undetermined coefficients, variation of parameters, power series solutions, Laplace transforms, and systems of differential equations with applications. This course is offered in the spring semester.
Prerequisites: MAT-112 with a minimum grade of C-, and MAT-223.
Credit: 1
Equated Courses: CR

MAT-225 Multivariable Calculus
This course builds on the introduction to calculus in higher dimensions in MAT-112. Topics covered include limits, continuity, differentiability, directional derivatives, constrained and unconstrained optimization, geometry of curves, multiple integrals, general coordinate systems, path and surface integrals, vector calculus, theorems of Green and Stokes, and applications. This course is offered in the fall semester.
Prerequisites: MAT-112 with a minimum grade of C-, and MAT-223
Credit: 1
Distribution: Quantitative Literacy

MAT-226 Operations Research
Linear and nonlinear optimization, linear programming, integer programming, duality, combinatorics, the simplex method and related algorithms, game theory, Markov chains, queuing theory.
Prerequisites: MAT-223
Credit: 1

MAT-235 Stochastic Simulation
Interesting real world phenomena often involve randomness at some level, and this course develops mathematical and computational tools for studying these systems. In particular, students will study and implement computer simulation models of continuous and discrete stochastic processes with potential applications in physics, economics, epidemiology, networks, sports, elections, and industrial engineering. Specific topics for study include: basic probability models, pseudo-random number generation, queueing models, discrete event simulations, Poisson processes, random walks, Markov chains, Monte Carlo methods, and statistical analysis of simulated data.
Prerequisites: MAT-112 and CSC-111
Credit: 1

MAT-251 Mathematical Finance
This course gives an overview of the mathematical reasoning behind the pricing of financial derivatives. Special emphasis is given to replication arguments and using risk-neutral distributions in the binomial pricing model and using risk neutral distributions in the geometric Brownian motion model. A probabilistic derivation of the Black-Scholes pricing formula for gap call options is given. Other topics covered include put-call parity, delta hedging, value at risk, and compound options. The course is typically offered every fall semester.
Prerequisites: MAT-112
Credits: 0.5

MAT-252 Mathematical Interest Theory
This course gives a thorough treatment of the mathematical theory of interest, with special attention paid to calculating present and accumulation values for annuities (series of payments made at regular time intervals). Some topics include nominal and effective rates of interest and discount, force of interest, amortization schedules, sinking funds, bonds, duration, and the use of modified duration to measure bonds' sensitivity to changes in the yield rate. This course is typically offered every fall semester.
Prerequisites: MAT-112
Credits: 0.5

MAT-253 Probability Models
This course is a standard calculus-based introduction to discrete and continuous random variables. Discrete distributions considered include the hypergeometric, binomial, geometric, Poisson, and discrete uniform. Continuous distributions considered include the gamma, chi-square, normal, beta, t and F. The Central Limit Theorem is covered, as well as multivariate distributions (including the bivariate normal and multinomial distributions), and transformations of random variables. Credit cannot be given for both MAT-103 and MAT-253. This course is typically offered in the fall semester.
Prerequisites: MAT-112
Credits: 0.5

MAT-254 Statistical Models
This course gives an overview of confidence intervals and classical hypothesis testing procedures: z-tests, t-tests, F-tests, Chi-square tests, and regression. An intuitive but mathematical treatment is given for all the distributions and procedures involved. Credit cannot be given for both MAT-104 and MAT-254. This course is typically offered in the spring semester.
Prerequisites: MAT-112
Credits: 0.5

MAT-277 Special Topics
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credit: 1

MAT-287 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

MAT-314 Modeling With Differential Equations
A course to develop the basic skills of formulation, simplification, and analysis of mathematical models for describing and predicting phenomena in the natural and social sciences, with special emphasis in modeling with differential equations. Topics may be taken from fields such as physics, chemistry, biology, psychology, economics, and political science. This course is offered in the fall semester of even-numbred years.
Prerequisites: MAT-224
Credit: 1

MAT-323 Topics in Linear Algebra
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: MAT-223
Credit: 1

MAT-324 Topics in Differential Equations
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: MAT-224
Credit: 1

MAT-331 Abstract Algebra I
This course is a first course in algebraic structures and higher abstract mathematics. The algebraic structures studied are groups and rings, which generalize symmetry and familiar number systems like the integers or real numbers. Topics include modular arithmetic, subgroups, quotient groups, isomorphism theorems, and permutation groups. This course has a strong emphasis placed on writing and reading mathematical proofs. This course is offered in the spring semester.
Prerequisites: MAT-223 with a minimum grade of C-
Credit: 1

MAT-332 Abstract Algebra II
This course is a continuation of MAT-331. Topics will depend on the instructor but may include fields, modules, Galois theory, algebraic geometry, Gröbner bases, or advanced topics in groups and rings. This course has a strong emphasis placed on writing and reading mathematical proofs.
Prerequisites: MAT-331
Credit: 1

MAT-333 Funct Real Variable I
A first course in the foundations of modern analysis. Topics include set theory, topology of the real numbers, sequences, series, differentiation, integration, and rigorous proofs of the major theorems of single-variable calculus. This course is offered in the fall semester.
Prerequisites: MAT-223
Credit: 1

MAT-334 Funct Real Variable II
A continuation of MAT 333. Topics will depend on the instructor but may include sequences and series of functions, Fourier analysis, elementary functional analysis, advanced multivariable calculus or metric spaces.
Prerequisites: MAT-333
Credit: 1

MAT-337 Numerical Analysis
This course provides a broad introduction to the field of numerical analysis. Topics of study include rootfinding, numerical linear algebra, function approximation, numerical differentiation and integration, and numerical methods for differential equations. The primary focus involves the derivation, analysis and implementation of numerical methods, but the course also includes discussion of uses and implications of these methods in applications. This course is offered in the fall semester of even-numbered years.
Prerequisites: CSC-111 and MAT-223
Credit: 1

MAT-338 Topics Computational Math
This course develops mathematical and computational techniques in areas of mathematics or interdisciplinary study in which computation plays a central and essential role. Topics vary by semester but they may include computational geometry, computer algebra, scientific computing, and symbolic computation. This course is offered in the fall. Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: CSC-111 and MAT-112
Credit: 1

MAT-341 Topology
An introduction to point-set topology. Topics include topological spaces, continuous functions, product and quotient spaces, metric spaces, connectedness, and compactness.
Prerequisites: MAT-223
Credit: 1

MAT-344 Complex Analysis
This course develops the core analytical framework for complex functions of one variable. Topics include basic operations and properties of the complex plane, transformations of elementary functions, analytic functions, contour integrals, theory of residues, and conformal mapping. This course is offered in the spring semester of odd-numbered years.
Prerequisites: MAT-223
Credit: 1

MAT-353 Probability Models II
This course is a continuation of MAT-253 (Probability Models) with a focus on applications to financial problems. Brownian motion and Ito integrals are introduced and used for ruin theory calculations and applied to some simple investment models with continuous trading. The compound Poisson, mixed, and mixture distributions are used for some insurance settings. Expected present value and variance of present value are calculated for a wide variety of life insurance and annuity problems. The course is typically offered in the fall semester.
Prerequisites: MAT-253
Credits: 0.5

MAT-354 Mathematical Statistics
This course takes a more theoretical look at estimation and hypothesis testing than MAT-254 (Statistical Models). Classical estimation topics include method of moment estimators, maximum likelihood estimators (MLE's), the information inequality, and the asymptotic theory of MLE's. Classical hypothesis testing topics include using the Neyman-Pearson Lemma to find most powerful tests and uniformly most powerful tests, Likelihood ratio tests (LRT's), and the asymptotic theory of LRT's. The course also looks at the Bayesian approach to statistical inference, in particular, the situation with binomial data and beta priors. This course is typically offered in the spring semester, loosely alternating with MAT-355 Regression Models.
Prerequisites: MAT-253 and MAT-254
Credits: 0.5

MAT-355 Regression Models
This course takes a mathematical, matrix-based look at regression (introduced in MAT-254, Statistical Models). The probabilistic machinery needed when working with linear combinations of normal random variables is developed, including orthant probability calculation and several results involving the chi-square distribution. A general method for hypothesis testing is presented and used in a variety of testing situations. Time series models are also looked at and maximum likelihood estimation in both regression and time series settings is considered. This course is typically offered in the spring semester, loosely alternating with MAT-354 Mathematical Statistics.
Prerequisites: MAT-223, MAT-253, and MAT-254
Credits: 0.5

MAT-377 Special Topics
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credits: 0.5-1

MAT-378 Special Topics
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credits: 0.5-1

MAT-387 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

MAT-388 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

MAT-400 Senior Seminar
Topics in the history and foundations of mathematics, the special emphasis varying from year to year. Every student will be expected to write a term paper. Please refer to the Registrar's page for course description.
Prerequisites: none
Credits: 0.5

Computer Science (CSC)

CSC-101 Intro to Computer Science
An introduction to the field of computer science: the study of algorithmic processes and the machines that implement them. Students will study the history of computing as well as ethical issues raised by computing and automation. Students will study fundamental areas of the discipline, including basic digital circuits, computer hardware and architecture, data representation, issues of computability, and algorithm design and analysis. Students will also engage in hands-on activities involving basic digital circuits, hardware and programming.
Prerequisites: none
Credit: 1
Distribution: Quantitative Literacy
Equated Courses: APCR

CSC-106 Topics in Introduct Comp Sci
A reflective examination of basic ideas in contemporary computer science. Through participation and discovery, students will consider an articulation of computer science that focuses on procedural units, algorithms, and abstractions. Topics will vary, but could include programming in various contexts, history of computing, etc. This course does not count toward the major or minor in computer science. This course will suffice as a pre-requisite for CSC-111. Topics vary with each scheduled offering. Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credits: 0.5-1
Distribution: Quantitative Literacy

CSC-111 Intro to Programming
This course provides an introduction to programming and problem solving in a higher-level, general-purpose language. Programming topics include primitive data types, simple data types such as arrays, program constructs such as conditionals, loops, and functions, and the fundamentals of object-oriented programming. (Note: CSC-111 does not count as a laboratory science.)
Prerequisites: CSC-101, CSC-106, or MAT-112; or permission of the instructor.
Credit: 1
Distribution: Quantitative Literacy

CSC-171 Special Topics in Comp. Sci.
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credit: 1
Distribution: Quantitative Literacy

CSC-187 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-188 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-211 Intro to Data Structures
This course studies structured ways of storing and organizing data and algorithms designed for these structures. Attention is given to both theory and practical implementation of data structures and algorithms. Analytical techniques will be developed to study algorithm complexity, comparisons between iterative and recursive algorithms, and theory for searching, sorting, and traversing data. Computational studies will provide practical validation of analytical results and will develop an intuition for understanding tradeoffs between competing methods. Data structures covered include lists, stacks, queues, trees, hash tables, graphs, and related data types.
Prerequisites: CSC-111 with a minimum grade of C-
Credit: 1

CSC-235 Stochastic Simulation
Interesting real world phenomena often involve randomness at some level, and this course develops mathematical and computational tools for studying these systems. In particular, students will study and implement computer simulation models of continuous and discrete stochastic processes with potential applications in physics, economics, epidemiology, networks, sports, elections, and industrial engineering. Specific topics for study include: basic probability models, pseudo-random number generation, queueing models, discrete event simulations, Poisson processes, random walks, Markov chains, Monte Carlo methods, and statistical analysis of simulated data.
Prerequisites: Prereq of MAT-112 and CSC-111
Credit: 1

CSC-241 Introduction to Machine Organization
This course studies the various levels at which a computer can be studied, both in hardware and software. These levels include transistor level digital circuits, higher-level architectural circuits, and the hierarchy of machine code, assembly code, and high-level programming languages. Students will comparatively study different modern and historical computer architectures, including examples of both RISC and CISC architectures. Students will become proficient in programming in a modern assembly language (e.g. ARM64 or x86-64). This course is offered in the fall semester.
Prerequisites: CSC-111 with a minimum grade of C-
Credit: 1
Distribution: Quantitative Literacy
Equated Courses: CSC-311

CSC-242 Theory of Programming Languages
A study of the paradigms of programming languages, including procedural languages such as Pascal or 'C', object-oriented languages such as C++ or Smalltalk, functional languages such as ML or Scheme, logic-oriented languages such as Prolog, and concurrency such as in Ada. Consideration of how concepts are implemented, such as modules, parameter passing, function evaluation, data types and type checking, memory management, exception handling, and threads. This course is offered in the spring semester.
Prerequisites: CSC-111
Credit: 1
Equated Courses: CSC-321

CSC-243 Algorithm Design and Analysis
This course studies how algorithms are designed, analyzed, implemented and proven to work correctly. Common algorithmic design paradigms will be examined -- divide and conquer, dynamic programming, greedy, as well as the strategy of reducing from one type of problem to another. Standard techniques for studying algorithmic efficiency will be utilized throughout the course, including asymptotic analysis and recurrence relations. Additional specialized topics may be surveyed such as graph algorithms, linear programming, parallel algorithms, approximation algorithms, randomized algorithms, computational geometry and lower bound analysis. This course is offered in the spring semester.
Prerequisites: MAT-111 or equivalent, CSC-211
Corequisites: Either MAT-108 (previously) or MAT-219 (previously or concurrently)
Credit: 1
Equated Courses: CSC-331

CSC-244 Theory of Computing
How do we know if a problem is computationally hard to solve? In this course, computational problems will be studied as formal languages and classified according to their solvability under various theoretical computation models and resource constraints. The models to be studied will include finite-state automata, pushdown automata, linear-bounded automata and Turing Machines. Alternative characterizations of these models will also be examined, such as those of grammars, circuits, restricted programming languages and Kleene-Godel-Herbrand functions. Complexity classes (e.g., L, P, NP, Co-NP and PSPACE) will be introduced to study time and space constraints, along with the notions of complete problems, efficient reductions and hierarchy theorems. Along the way, many difficult open problems that continue to vex theoretical computer scientists will be explored, such as the infamous P versus NP problem. This course is offered in the fall semester.
Prerequisites: CSC-111 with a minimum grade of C-; CSC-243 with a minimum grade of C-; either MAT-108 or MAT-219 with a minimum grade of C-.
Credit: 1
Equated Courses: CSC-341

CSC-271 Special Topics in Computer Science
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: CSC-111 or permission of the instructor
Credits: 0.5-1

CSC-287 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-288 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-337 Numerical Analysis
Advanced-This course will address topics such as numerical solution of non-linear equations in one variable, interpolation, approximation, differentiation, integration, difference equations, differential equations and their applications, boundary value problems, linear systems, matrices, and optimization. This course is offered in the fall semester of even-numbered years.
Prerequisites: CSC-111 and MAT-223
Credit: 1

CSC-338 Topics in Computational Math
An advanced course to develop mathematical and computational techniques in areas of mathematics or interdisciplinary study in which computation plays a central and essential role. Topics vary by semester but may include computational geometry, computer algebra, scientific computing, and symbolic computation. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings. This course is typically offered in the fall semesters of odd-numbered years.
Prerequisites: CSC-111 and MAT-112
Credit: 1

CSC-361 Database System Design
Database management is a central component of a modern computing environment. This course introduces the fundamental concepts of database design and database languages. Topics include relational databases, SQL, formal relational query languages, the E-R model, relational database design, storage and file structures, indexing and hashing, query processing, transactions, and data warehousing and mining.
Prerequisites: Take CSC-211 with a minimum grade of C-
Credit: 1

CSC-362 Operating Systems
At age 21, Linus Torvalds had created his own operating system. Do you want to follow in his footsteps? This course explores the design and implementation of computer operating systems. Topics may include historical aspects of operating systems development, systems programming, process scheduling, synchronization of concurrent processes, virtual machines, memory management and virtual memory, I/O and file systems, system security, OS/architecture interaction, and distributed operating systems. This course will involve working on projects with large amounts of code written in the C programming language.
Prerequisites: CSC-211 with a minimum grade of C-; CSC-241 with a minimum grade of C-
Credit: 1

CSC-363 Compiler Design
This course explores principles and practices used for designing and implementing compilers and interpreters. Students will build a compiler for a programming language designed for the course. The major stages of compilation will be studied in-depth -- lexical analysis, syntax analysis, semantic analysis, and code generation. Additional topics such as advanced parsing techniques and specific compiler-construction tools may be covered at the instructor's discretion.
Prerequisites: Take CSC-211 with a minimum grade of C-
Credit: 1

CSC-364 Parallel Programming
This course provides an introduction to high-performance computing through the study of different ways that a large problem can be divided into separate tasks which are solved simultaneously by parallel processing elements. Topics include the study of different types of parallel computing, the design and implementation of parallel algorithms, hardware that supports parallelism, and analysis of scalability.
Prerequisites: Take CSC-211 with a minimum grade of C-
Credit: 1

CSC-371 Special Topics in Comp. Sci.
Topics vary with each scheduled offering. Refer to Student Planning's section information for descriptions of individual offerings, and applicability to distribution requirements.
Prerequisites: none
Credit: 1

CSC-387 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-388 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-400 Senior Capstone
This course is a senior capstone course, which all computer science majors should take in their senior year. This is a project-based course that develops skills in individual and team software development, including reading, documenting, presenting, and critiquing software systems.
Prerequisites: CSC-211 with a minimum grade of C-
Credit: 1

CSC-487 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

CSC-488 Independent Study
Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.
Prerequisites: none
Credits: 0.5-1

Mathematics Faculty

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