MATHEMATICS AND COMPUTER SCIENCE

The Department of Mathematics and Computer Science offers undergraduate majors in mathematics and in computer science. We also participate in the Informatics and Modeling Certificate Program. The department's graduate programs include a PhD in mathematics and MA programs in mathematics and in computer science.

Each student's course of study is designed to provide an introduction to the basic areas of mathematics or computer science and to provide the technical tools that will be useful later in the student's career. The course of study is planned in consultation with the student's faculty advisor and the department's advisory committees, DADCOM for mathematics and CADCOM for computer science.

The department's graduate programs include a PhD program in mathematics and MA programs in mathematics and in computer science. The research emphasis at Wesleyan at the doctoral level is in pure mathematics and theoretical computer science. One of the distinctive features of our department is the close interaction between the computer science faculty and the mathematics faculty, particularly those in logic and discrete mathematics.

Graduate students at Wesleyan enjoy small classes and close interactions with faculty and fellow graduate students. Graduate students normally register for three classes a semester and are expected to attend departmental colloquia and at least one regular seminar. The number of graduate students ranges from 17 to 21, with an entering class of three to six each year. There have always been both male and female students, graduates of small colleges and large universities, and U.S. and international students, including, in recent years, students from Bulgaria, Chile, China, Germany, India, Iran, and Sri Lanka. All of the department's recent PhD recipients have obtained faculty positions. Some have subsequently moved to mathematical careers in industry and government.

For additional information, please visit wesleyan.edu/mathcs/graduate/ (http://www.wesleyan.edu/mathcs/graduate/).

FACULTY

Ilesanmi Adeboye
PHD, University of Michigan
Associate Professor of Mathematics

Wai Kiu Chan
BS, University of Hong Kong; MPHIL, University of Hong Kong; PHD, The Ohio State University
Professor of Mathematics

Karen L. Collins
BA, Smith College; PHD, Massachusetts Institute of Technology
Edward Burr Van Vleck Professor of Mathematics; Professor of Mathematics; Chair, Mathematics and Computer Science; Professor, Integrative Sciences

David Constantine
BS, Eastern Nazarene College; PHD, University of Michigan
Associate Professor of Mathematics

Norman Danner
BA, University of California, Berkeley; PHD, Indiana University Bloomington
Associate Professor of Computer Science; Vice-Chair, Mathematics and Computer Science

Adam Fieldsteel
BA, Brown University; MAA, Wesleyan University; PHD, University of California, Berkeley
Professor of Mathematics

Cameron Donnay Hill
BA, Yale University; PHD, University of California, Berkeley
Assistant Professor of Mathematics; Assistant Professor, Integrative Sciences

Mark A. Hovey
BS, Ohio State University; PHD, Massachusetts Institute of Technology
Associate Provost; Professor of Mathematics; Professor, Integrative Sciences

Sara Kalisnik Verovsek
PHD, Stanford University
Assistant Professor of Mathematics

Daniel Krizanc
BS, University of Toronto; PHD, Harvard University
Edward Burr Van Vleck Professor of Computer Science; Professor of Computer Science; Professor, Integrative Sciences; Professor, Environmental Studies; Co-Coordinator, Informatics and Modeling

Alex Kruckman
PHD, University of California, Berkeley; SB, Brown University
Assistant Professor of Mathematics

Constance Leidy
BS, Tulane University; PHD, Rice University
Associate Professor of Mathematics

Han Li
BS, Nankai University; PHD, Yale University
Assistant Professor of Mathematics

Dan Licata
BS, Brown University; PHD, Carnegie Mellon University
Assistant Professor of Computer Science

James Lipton
BS, U Nebraska Lincoln; MSC, Cornell University; PHD, Cornell University
Professor of Computer Science; Professor, Integrative Sciences

Victoria Ursula Manfredi
BA, Smith College; MS, University of Massachusetts Amherst; PHD, University of Massachusetts Amherst
Assistant Professor of Computer Science

David Pollack
MA, Harvard University; PHD, Harvard University; SB, University of Chicago
Associate Professor of Mathematics

Felipe A. Ramírez
BS, Colorado St University; PHD, University of Michigan
Assistant Professor of Mathematics

Christopher Rasmussen
BA, University of Virginia; MS, University of Virginia; PHD, University of Arizona
Associate Professor of Mathematics

Saray Shai
BS, Israel Institute of Technology; PHD, University of St Andrews
Assistant Professor of Computer Science

Emily R Stark
Assistant Professor of Mathematics

Sebastian Zimmeck
LLM, University of California, Berkeley; MS, Columbia University; PHD, University of Kiel; PHD, Columbia University
Assistant Professor of Computer Science

AFFILIATED FACULTY

Tsampikos Kottos
BA, University of Crete; MS, University of Crete; PHD, University of Crete
Lauren B. Dachs Professor of Science and Society; Professor of Physics; Professor, Integrative Sciences; Professor, Mathematics

VISITING FACULTY

Alyson Hildum
BA, Colorado School Mines; PHD, Brandeis University
Visiting Assistant Professor of Mathematics

Pippin Wolfe
BA, Brown University; BS, Brown University; PHD, University of Massachusetts Amherst
Postdoctoral Fellow in Computer Science

EMERITI

Ethan M. Coven
BA, University of Rochester; MA, Yale University; MAA, Wesleyan University; PHD, Yale University
Professor of Mathematics, Emeritus

Anthony W. Hager
BS, Pennsylvania State University; PHD, Pennsylvania State University
Professor of Mathematics, Emeritus

Michael S. Keane
BA, University of Texas Austin; MS, University of Gottingen; PHD, University of Erlangen-Nurnber
Professor of Mathematics, Emeritus

Michael D. Rice
BS, Western Mich University; MS, Western Mich University; PHD, Wesleyan University
Professor of Computer Science, Emeritus

Philip H. Scowcroft
BA, Harvard University; MA, Cornell University; PHD, Cornell University
Edward Burr Van Vleck Professor of Mathematics, Emeritus

Carol S. Wood
AB, Randolph Macon W College; MAA, Wesleyan University; PHD, Yale University
Edward Burr Van Vleck Professor of Mathematics, Emerita

DEPARTMENTAL UNDERGRADUATE ADVISING EXPERTS

DADCOM provides advice and transfer credit approval for students in mathematics. CADCOM provides advice and transfer credit approval for students in computer science.

- Undergraduate Computer Science Major (catalog.wesleyan.edu/departments/math/ugrd-comp/)
- Undergraduate Mathematics Major (catalog.wesleyan.edu/departments/math/ugrd-math/)
- Doctor of Philosophy in Mathematics (catalog.wesleyan.edu/departments/math/grad-math-phd/)
- Master of Arts in Mathematics and Computer Science (catalog.wesleyan.edu/departments/math/grad-ma/)

COMPUTER SCIENCE

COMP112 Introduction to Programming
The course will provide an introduction to a modern, high-level programming language including a discussion of input/output, basic control structures, types, functions, and classes. The lectures will also discuss a variety of algorithms as well as program design issues.

The second meeting time for each section is a computer lab.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

COMP112Z Introduction to Programming
The course will provide an introduction to a modern, high-level programming language including a discussion of input/output, basic control structures, types, functions, and classes. The lectures will also discuss a variety of algorithms as well as program design issues.

The second meeting time for each section is a computer lab.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: [MB&B181 or BIOL181]

COMP113 Bioinformatics Programming
This course is an introduction to bioinformatics and programming for students with interest in the life sciences. It introduces problem areas and conceptual frameworks in bioinformatics. The course assumes little or no prior programming experience and will introduce the fundamental concepts and mechanisms of computer programs and examples (e.g., sequence matching and manipulation, database access, output parsing, dynamic programming) frequently encountered in the field of bioinformatics.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL265, MB&B265, CIS265
Prereq: [MB&B181 or BIOL181]
COMP114 How to Talk to Machines
How do we tell robots and computers how to do what they do? Getting a handle on this question is the goal of this course. Since telling a device how to do something depends a lot on what that device can do, along the way we will learn a bit about what is ‘in the box.’ We will start with the kind of programming one might use to instruct a robot how to interact with the world around it. That will lead us to the Turing machine, a beautiful mathematical model of a computer. We will adapt that model to something that is closer to how most computer systems today are designed. We will end with an introduction to high-level programming, learning the fundamentals of programming in a language such as Python or Java.

The goal of the course is to understand not just programming, but how computers are designed, and how those designs are reflected in the way we program them. After passing this course, students will have a basic knowledge of programming and how a computer works. COMP 114 can be used to satisfy the COMP 211 prerequisite and also the mathematics major ‘elementary knowledge of algorithms and computer programming’ requirement.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

COMP115 How to Design Programs
In this course, students will learn to systematically design programs, going from a problem statement to a well-organized solution in a step-by-step fashion. We will apply these program design skills to many applications within computer science and in other disciplines. Students will develop their mathematical skills, because we will use a symbolic view of computation that explains the process of running a program as simple manipulations of its text. Students will also develop their technical reading and writing skills, such as understanding complex problem descriptions and precisely articulating the design of solutions. No prior experience with programming or computer science is expected.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

COMP211 Computer Science I
This is the first course in a two-course sequence (COMP211-212) that is the gateway to the computer science major. It is intended for prospective computer science majors and others who want an in-depth understanding of programming and computer science. Topics to be covered in COMP211-212 include an introduction to the fundamental ideas of programming in imperative and functional languages, correctness and cost specifications, and proof techniques for verifying specifications.

Specifics such as choice of programming language, which topics are covered in which semesters, etc., will vary according to the tastes of the faculty offering the courses.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP211

COMP260 Special Topics in Computer Science
This course is designed for nonmajors who wish to pursue some topic in computer science beyond introduction to programming. Topics will vary according to the instructor.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Identical With: QAC260
Prereq: COMP112

COMP260A Software Design and Engineering
Programming is only one ingredient for creating industry-grade software. Eliciting requirements from stakeholders, modeling the architecture of a system, selecting appropriate development tools, and testing and maintaining a codebase are some of the aspects that elevate programming to software engineering. Focusing on the development of mobile and web apps, students in this course will gain expertise in common front-end and back-end technologies as well as related tooling. We will also cover the organization of software projects and their social implications, which are so important to recognize for the modern software engineer.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: COMP112

COMP260B Scientific Computing
This course will introduce students from various disciplines to computing as applied to scientific problems. The course aims to provide a theoretical background in computational sciences and insight in understanding how popular algorithms and advances in hardware are used to solve problems drawn from chemistry, physics, biology, and bioinformatics. Topics covered will include simulation techniques, analysis of trajectories, clustering, probabilistic modeling, networks, artificial intelligence, neural networks, population dynamics, and high performance computing.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP112

COMP266 Bioinformatics
This course is an introduction to bioinformatics for students with interest in the life sciences. The course is similar to BIOL265 but only meets in the second half of the semester (with BIOL265) and is designed for students with programming background, ideally in Python. The course introduces problem areas and conceptual frameworks in bioinformatics and discusses programming approaches used in bioinformatics such as sequence matching and manipulation algorithms using dynamic programming, clustering analysis of gene expression data, analysis of genetic nets using Object Oriented Programming, and sequence analysis using Hidden Markov Models, Regular Expressions, and information theory.
through bioinformatic analysis of gene sequences, we can now reconstruct
the evolutionary history of physiology, even though no traces of physiology
exist in the fossil record. We can determine the adaptive history of one gene
and all the gene’s descendants. We can now construct the evolutionary tree
of all of life. Bioinformatics is particularly promising for analysis of the ecology
and biodiversity of microbial communities, since well over 99 percent of
microorganisms cannot be cultured; our only knowledge of these organisms
is through analysis of their gene sequences and gene expression patterns. For
example, even when we cannot culture most of a microbial community, we
can determine which metabolic pathways are of greatest significance through
analysis of community-level gene expression. All these research programs are
made accessible not only by breakthroughs in molecular technology but also by
innovation in the design of computer algorithms. This course, team-taught by an
evolutionary biologist and a computer scientist, will present how bioinformatics
is revolutionizing evolutionary and ecological investigation and will present
the design and construction of bioinformatic computer algorithms underlying
the revolution in biology. Students will learn algorithms for reconstructing
phylogeny, for sequence alignment, and for analysis of genomes, and students
will have an opportunity to create their own algorithms.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-BIOL
Identical With: BIOL266, MB&B266, CIS266
Prereq: [MB&B181 OR BIOL181]

COMP301 Automata Theory and Formal Languages
This course is an introduction to formalisms studied in computer science
and mathematical models of computing machines. The language formalisms
discussed will include regular, context-free, recursive, and recursively
enumerable languages. The machine models discussed include finite-state
automata, pushdown automata, and Turing machines.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Identical With: COMP500
Prereq: COMP211 AND COMP212 AND MATH228

COMP312 Algorithms and Complexity
The course will cover the design and analysis of efficient algorithms. Basic
topics will include greedy algorithms, divide-and-conquer algorithms, dynamic
programming, and graph algorithms. Some advanced topics in algorithms may be
selected from other areas of computer science.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Identical With: COMP510
Prereq: COMP212 AND MATH228

COMP321 Design of Programming Languages
This course is an introduction to concepts in programming languages. Topics
include parameter passing, type checking and inference, control mechanisms,
data abstraction, module systems, and concurrency. Basic ideas in functional,
object-oriented, and logic programming languages will be discussed.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Identical With: COMP521
Prereq: COMP212 AND MATH228

COMP323 Programming Language Implementation
This course is an introduction to the implementation of programming languages.

Students will learn how to formally describe and implement major components
of the implementation pipeline. Topics may include lexical analysis and parsing
(checking whether source code is well-formed and converting it to an internal
programmatic representation), type-checking and -inference (static program
analysis for safety features), interpretation (direct execution of a high-level
language program), and compilation (translation to a low-level language such as
assembly or bytecode).

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Identical With: COMP523
Prereq: COMP212 AND MATH228

COMP327 Evolutionary and Ecological Bioinformatics
Bioinformatic analysis of gene sequences and gene expression patterns has
added enormously to our understanding of ecology and evolution. For example,
through bioinformatic analysis of gene sequences, we can now reconstruct
The first part of the course will cover developing software in teams as well as learning the languages and tools used in the course, including Ruby, Rails, Cucumber, RSpec, Pivotal Tracker, and gitHub.

The second part of the course will continue to present software engineering concepts but will also focus on developing a team service-learning software development project for an external customer.

Offering: Host
Grading: A-F
Credits: 1.50
Gen Ed Area: NSM-MATH
Prereq: COMP211 AND COMP212

COMP350 Computational Media: Videogame Development
This course examines the interplay of art and science in the development of contemporary video games using 'game tool' applications to achieve a variety of purposes. It combines a detailed understanding of computational media, including legal and commercial aspects, with hands-on experience in the creative process. There will be discussions with invited industry leaders in various subject areas. Students will have the opportunity to work as part of development teams and create working prototypes to understand the challenges and rewards of producing video games in a professional context.

Offering: Crosslisting
Grading: A-F
Credits: 2.00
Gen Ed Area: NSM-IDEA
Identical With: IDEA350, FILM250
Prereq: None

COMP360 Special Topics in Computer Science: Information Security and Privacy
This course explores principles and practical applications of computer security and privacy. Some of the topics covered include static and dynamic code analysis, secure authentication, privacy enhancing technologies, usable privacy and security, and web tracking. We will also touch upon theoretical areas, such as basic cryptographic concepts as well as differential privacy. The course has the objective to provide students with the conceptual knowledge and technical skills to identify and resolve privacy and security issues in the design, development, and evaluation of information systems.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360A Special Topics in Computer Science
This course covers special topics in computer science. Topics will vary according to the instructor.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360B Special Topics in Computer Science
This course covers special topics in computer science. Topics will vary according to the instructor.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360C Special Topics in Computer Science: Network Science
Network science is an emerging field that focuses on the analysis of real-world complex systems arising in the social, biological, and physical sciences by abstracting them into networks (or graphs). The size and complexity of real networks has produced a deep change in the way that graphs are approached, and led to the development of new mathematical and computational tools.

This course provides an introduction to network science by walking through modern techniques for modeling, analyzing, and simulating the structures and dynamics of complex networks. Specific topics to be discussed will include: network models and measures, graph algorithms, visualization and simulation, models of dynamic/adaptive networks, network modularity and community detection, and some applications. Python and NetworkX will be used for modeling and analysis of networks, in addition to other computational tools. Students should have a reasonable amount of experience in Python programming or willingness to learn ‘on the go.’

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360D Special Topics in Computer Science: Artificial Intelligence
An introduction to creating programs which appear to behave intelligently.
Topics will include search algorithms for problem solving, as well as probabilistic reasoning including regression, classification and decision making. Sample topics include Bayesian Networks, basic Neural Networks and Reinforcement Learning.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360E Special Topics in Computer Science: Functional Data Structures
Advanced data structures from a functional programming perspective. The focus will be on the use of lazy evaluation as a technique for designing efficient data structures, especially in the presence of persistence (when the state of the structure must be preserved even after updates). Assessment will consist primarily of programming and written assignments.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: COMP212 AND MATH228

COMP360F Special Topics in Computer Science
This course covers special topics in Computer Science.
Topics vary according to the instructor.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: COMP212 AND MATH228

COMP361 Advanced Topics in Computer Science
This course covers advanced topics in Computer Science. The precise topics will vary with the offering, but will typically have prerequisites beyond COMP 211-212. This course may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228 AND COMP212

COMP401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Grading</th>
<th>Offering</th>
<th>Credits</th>
<th>Gen Ed Area</th>
<th>Prereq</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP402</td>
<td>Individual Tutorial, Undergraduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMP403</td>
<td>Department/Program Project or Essay</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMP404</td>
<td>Department/Program Project or Essay</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMP407</td>
<td>Senior Tutorial (downgraded thesis)</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.</td>
</tr>
<tr>
<td>COMP408</td>
<td>Senior Tutorial (downgraded thesis)</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.</td>
</tr>
<tr>
<td>COMP409</td>
<td>Senior Thesis Tutorial</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP410</td>
<td>Senior Thesis Tutorial</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP411</td>
<td>Group Tutorial, Undergraduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP412</td>
<td>Group Tutorial, Undergraduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP419</td>
<td>Student Forum</td>
<td>Cr/U</td>
<td>Host</td>
<td></td>
<td></td>
<td>Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.</td>
</tr>
<tr>
<td>COMP420</td>
<td>Student Forum</td>
<td>Cr/U</td>
<td>Host</td>
<td></td>
<td></td>
<td>Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.</td>
</tr>
<tr>
<td>COMP421</td>
<td>Undergraduate Research, Sciences</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Individual research projects for undergraduate students supervised by faculty members.</td>
</tr>
<tr>
<td>COMP422</td>
<td>Undergraduate Research, Sciences</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Individual research projects for undergraduate students supervised by faculty members.</td>
</tr>
<tr>
<td>COMP423</td>
<td>Advanced Research Seminar, Undergraduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Advanced research tutorial; project to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP424</td>
<td>Advanced Research Seminar, Undergraduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Advanced research tutorial; project to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP429</td>
<td>Teaching Apprentice Tutorial</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.</td>
</tr>
<tr>
<td>COMP430</td>
<td>Teaching Apprentice Tutorial</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.</td>
</tr>
<tr>
<td>COMP500</td>
<td>Automata Theory and Formal Languages</td>
<td>A-F</td>
<td>Crosslisting</td>
<td>1.00</td>
<td>NSM-MATH</td>
<td>This course is an introduction to formalisms studied in computer science and mathematical models of computing machines. The language formalisms discussed will include regular, context-free, recursive, and recursively enumerable languages. The machine models discussed include finite-state automata, pushdown automata, and Turing machines.</td>
</tr>
<tr>
<td>COMP501</td>
<td>Individual Tutorial, Graduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP502</td>
<td>Individual Tutorial, Graduate</td>
<td>OPT</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
<tr>
<td>COMP503</td>
<td>Selected Topics, Graduate Sciences</td>
<td>A-F</td>
<td>Host</td>
<td></td>
<td></td>
<td>Topic to be arranged in consultation with the tutor.</td>
</tr>
</tbody>
</table>
Bioinformatic analysis of gene sequences and gene expression patterns has added enormously to our understanding of ecology and evolution. For example, even when we cannot culture most of a microbial community, we can determine which metabolic pathways are of greatest significance through analysis of community-level gene expression. All these research programs are made accessible not only by breakthroughs in molecular technology but also by innovation in the design of computer algorithms. This course, team-taught by an evolutionary biologist and a computer scientist, will present how bioinformatics is revolutionizing evolutionary and ecological investigation and will present the design and construction of bioinformatic computer algorithms underlying the revolution in biology. Students will learn algorithms for reconstructing phylogeny, for sequence alignment, and for analysis of genomes, and students will have an opportunity to create their own algorithms.
MATH117 Introductory Calculus
This course is designed to introduce basic ideas and techniques of differential calculus. Students should enter with sound precalculus skills but with very limited or no prior study of calculus. Topics to be considered include differential calculus of algebraic, exponential, and logarithmic functions. (Integral calculus will be introduced in MATH118.)
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH118 Introductory Calculus II: Integration and Its Applications
This course continues MATH117 and is designed to introduce basic ideas and techniques of calculus. Students should enter MATH118 with sound precalculus skills and with very limited or no prior study of integral calculus. Topics to be considered include differential and integral calculus of algebraic, exponential, and logarithmic functions.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH119 Elements of Calculus, Part I
This course is the first half of a two-semester calculus sequence (MATH119, MATH120). This sequence is designed for students who have not previously studied calculus. The course, together with MATH120, will cover limits, derivatives, and integrals. Exponential, logarithmic, and trigonometric functions will be introduced and their calculus will be studied. Applications of calculus to biology, economics, physics, and/or other fields will be emphasized.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH120 Elements of Calculus, Part II
This course is the second half of a two-semester calculus sequence. This sequence is designed for students who have not previously studied calculus. The course, together with MATH119, will cover limits, derivatives, and integrals. Exponential, logarithmic, and trigonometric functions will be introduced and their calculus will be studied. Applications of calculus to biology, economics, physics, and/or other fields will be emphasized.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH119

MATH121 Calculus I
MATH121, together with MATH122, will cover both theoretical and practical aspects of limits, derivatives, and integrals; the calculus of exponential, logarithmic, trigonometric, and inverse trigonometric functions; techniques of integration; plane analytic geometry; various applications of calculus; and sequences and series, including power series and intervals of convergence.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH

MATH122 Calculus II
The continuation of MATH121. Topics covered include techniques and applications of integration and an introduction to sequences and series.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH123F Mathematical Deduction with Calculus (FYS)
This course is a first-year seminar (FYS). Topics covered include techniques and applications of integration and an introduction to sequences and series, with an emphasis on mathematical writing. Weekly papers will be required. It is suitable for students who have already taken calculus and are interested in pursuing the mathematics major. Students may not receive credit for both MATH 122 and MATH 123.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH121

MATH132 Elementary Statistics
Topics included in this course are organizing data, central measures, measures of variation, distributions, sampling, estimation, conditional probability (Bayes' theorem), hypothesis testing, simple regression and correlation, and analysis of variation.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH133 Intermediate Statistics
This class continues the study of statistics begun in MATH 132. Topics will include experimental design, ANOVA, multiple regression, non-parametric tests, and further topics as time permits. This course is an ideal continuation for students who have taken MATH 132 or who got a 4 or 5 on the AP Statistics exam and who wish to deepen their statistics knowledge.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH132

MATH211 Problem Solving for the Putnam
This course is designed to introduce basic ideas and techniques of differential and integral calculus. Students should enter with sound precalculus skills but with very limited or no prior study of integral calculus. Topics to be considered include differential and integral calculus of algebraic, exponential, and logarithmic functions.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-MATH
Prereq: None

MATH221 Vectors and Matrices
This is a course in the algebra of matrices and Euclidean spaces that emphasize the concrete and geometric. Topics to be developed include the rank of a matrix. These ideas are used to develop basic ideas of Euclidean geometry. Abstract finite dimensional real vector spaces; dimension of vector spaces; and the rank of a matrix. These ideas are used to develop basic ideas of Euclidean spaces.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None
geometric and to illustrate the behavior of linear systems. We conclude with a
discussion of eigenvalues and the diagonalization of matrices.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH122

MATH222 Multivariable Calculus
This course treats the basic aspects of differential and integral calculus of
functions of several real variables, with emphasis on the development of
calcutional skills. The areas covered include scalar- and vector-valued functions
of several variables, their derivatives, and their integrals; the nature of extremal
values of such functions and methods for calculating these values; and the
theorems of Green and Stokes.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH223 Linear Algebra
An alternative to MATH221, this course will cover vector spaces, inner-product
spaces, dimension theory, linear transformations and matrices, determinants,
eigenvalues and eigenvectors, Hermitian and unitary transformations, and
elementary spectral theory. It will present applications to analytic geometry,
quadric forms, and differential equations as time permits. The approach here is
more abstract than that in MATH221, though many topics appear in both.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH225 Fundamentals of Analysis: An Introduction to Real Analysis
In this rigorous treatment of calculus, topics will include, but are not limited to,
real numbers, limits, sequences and series, continuity and uniform continuity,
differentiation, the Riemann integral, sequences and series of functions,
poinwise and uniform convergence of functions, and interchange of limiting
processes. MATH228 or comparable experience in writing mathematical proofs is
strongly recommended for success in this course.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH122

MATH226 Complex Analysis
This course will present the basic properties of complex analytic functions. We
begin with the complex numbers themselves and elementary functions and
their mapping properties, then discuss Cauchy’s integral theorem and Cauchy’s
integral formula and applications, Taylor and Laurent series, zeros and poles and
residue theorems, the argument principle, and Rouche’s theorem. In addition
to a rigorous introduction to complex analysis, students will gain experience in
communicating mathematical ideas and proofs effectively.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: (MATH222 AND MATH221) OR (MATH222 AND MATH223)

MATH228 Discrete Mathematics
This course is a survey of discrete mathematical processes. Students will be
introduced to the process of writing formal mathematical proofs, including
mathematical induction. Topics may include set theory, logic, number theory,
finite fields, permutations, elementary combinatorics, or graph theory.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH229 Differential Equations
This course is an introduction to the theory of ordinary differential equations.
Many aspects of mathematics and computer science are important in this
discipline, and a broad view will be presented, in agreement with modern theory
and practice. The only prerequisite for the course is multivariable calculus; all
other necessary tools will be developed as the course proceeds.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: (MATH221 AND MATH222) OR (MATH222 AND MATH223)

MATH231 An Introduction to Probability
This course teaches the basic theory of probability. Although the notions are
simple and the mathematics involved require only a basic knowledge of the ideas
differential and integral calculus, a certain degree of mathematical maturity is
necessary. The fundamental concepts to be studied are probability spaces and
random variables, the most important ideas being conditional probability and
independence. The main theorems we will study are the law of large numbers
and the central limit theorem.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH222 AND MATH228

MATH232 Mathematical Statistics
This course covers the basic notions of estimation, hypothesis testing, regression,
analysis of variance, experimental design, and other topics in statistics from
a rigorous mathematical perspective. This material will be supplemented by
various case studies.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH231

MATH241 Set Theory
This course covers ordinal and cardinal numbers, cardinal arithmetic, theorems
of Cantor and Schroeder-Bernstein, introduction to Zermelo-Fraenkel set theory,
Axiom of Choice, and some infinitary combinatorics.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH242 Topology
This course is an introduction to topology, the study of space in a general sense.
We will approach topology through knot theory, the study of embeddings of a
circle in a 3-dimensional space.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None
MATH243 Mathematical Logic
This course is an introduction to mathematical logic, including first-order logic and model theory, axiomatic set theory, and, as time permits, Goedel’s incompleteness theorem.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228 OR MATH241 OR MATH261

MATH244 Topology: Point Set
This is an introduction to general topology, the study of topological spaces. We will begin with the most natural examples, metric spaces, and then move on to more general spaces. This subject, fundamental to mathematics, enables us to discuss notions of continuity and approximation in their broadest sense. We will illustrate topology’s power by seeing important applications to other areas of mathematics.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH245 Algebraic Topology
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: (MATH221 AND MATH222) OR (MATH223 AND MATH222)

MATH246 Applied Topology
This course teaches the main concepts in Applied Topology. Students will learn to apply nonlinear methods to analyze the shape of data sets. These approaches are drawn from classical topology and focus on the shape in one of two ways: they either ‘measure’ it, that is count the occurrences of patterns within the data set; or build combinatorial representations of the data set. As an example of the former, we will look at persistent homology, whereas the latter will be represented by mapper. The topics covered include: basic notions from topology, simplicial complexes (Cech complexes, Vietoris-Rips complexes, etc.), homology, persistent homology and applications, mapper.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH223

MATH252 Differential Forms
This class will be an introduction to differential forms, a central tool in modern topology, geometry, and physics. The course begins where MATH222 ends, with Green’s theorem, the divergence theorem, and Stokes’ theorem. All of these theorems are special cases of one theorem, known as the general Stokes’ theorem, about integration of differential forms. The objective of the first part of the course will be to understand and prove this theorem. We will then discuss manifolds and what can be learned about them using differential forms, concentrating on de Rham cohomology.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH221 OR MATH223 OR MATH222 OR MATH225

MATH255 Fundamentals of Analysis II
Topics to be addressed include convergence of sequences and series of functions, spaces of functions and their topologies, the Lebesgue integral (on the line) and its basic convergence theorems, and Fourier series.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228 OR MATH241 OR MATH261

MATH261 Abstract Algebra: Groups, Rings, and Fields
This course is an introduction to abstract algebra, a core area of mathematics: the study of the basic properties of structures, with emphasis on fundamental results about groups and rings. MATH228, or comparable experience in writing proofs and in abstract reasoning, is strongly recommended.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: (MATH221 AND MATH222) OR (MATH223 AND MATH222)

MATH262 Abstract Algebra
This second course in abstract algebra will cover fields and polynomial rings, as well as Galois theory and the insolvability of the quintic polynomial. Additional topics will be covered as time permits.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH261

MATH264 Algebraic Geometry
This course is an introduction to algebraic geometry, the study of the geometric structure of solutions to systems of polynomial equations.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: None

MATH271 Error-Correcting Codes
Nowadays messages are sent electronically through different kinds of communication channels. Most of these channels are not perfect and errors are created during the transmission. The object of an error-correcting code is to encode the data so that the message can be recovered if not too many errors have occurred. The goal of this course is to introduce the basic mathematical ideas behind the design of error-correcting codes. It makes use of algebraic techniques involving vector spaces, finite fields, and polynomial rings. These techniques will be developed in this course so that prior knowledge is not necessary.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH221 OR MATH223

MATH272 Elementary Number Theory
This is a course in the elements of the theory of numbers. Topics covered include divisibility, congruences, quadratic reciprocity, Diophantine equations, and a brief introduction to algebraic numbers.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228

MATH273 Combinatorics
This course will present a broad, comprehensive survey of combinatorics. Topics may include partitions, the topic of inclusion-exclusion, generating
functions, recurrence relations, partially ordered sets, trees, graphs, and minimax theorems.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228

MATH274 Graph Theory
A graph is a set V of elements called vertices and a set E of pairs of elements of V called edges. From this simple definition, many elegant models have been developed. Indeed, graph theory is essential to applications of computer science to network analysis and planar mapping.

This course will be an introduction to graph theory and its applications.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH228

MATH275 Probabilistic Graphical Models
Graphical models are used to represent complex, uncertain relationships among several, possibly very many, variables. They are fundamental in many domains of application, including medical diagnosis and prognosis, vision and image processing, robotics, and computational biology. This course will familiarize students with the graph theory and probability theory needed to discuss graphical models. After that, students will investigate exact and approximate statistical inference for graphical models, learning/inference of parameters, and possibly learning of graph structure.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: MATH222

MATH283 Differential Geometry
This course is an introduction to the classical differential geometry of curves and surfaces in Euclidean 3-space. Topics from global differential geometry and extensions to higher dimensions will be considered as time and the background of the students permit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MATH
Prereq: (MATH222 AND MATH221) OR (MATH222 AND MATH223)

MATH401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH407 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

MATH408 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

MATH409 Senior Thesis Tutorial
Topics to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH419 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.

Offering: Host
Grading: Cr/U

MATH421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.

Offering: Host
Grading: OPT

MATH422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.

Offering: Host
Grading: OPT

MATH423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH465 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.

Offering: Host
Grading: OPT

MATH466 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.

Offering: Host
Grading: OPT

MATH469 Education in the Field, Undergraduate
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
MATH470 Independent Study, Undergraduate
Credit may be earned for an independent study during a summer or authorized
leave of absence provided that (1) plans have been approved in advance, and (2)
all specified requirements have been satisfied.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH491 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity
to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

MATH492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity
to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

MATH495 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: Host
Grading: Cr/U

MATH496 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: Host
Grading: Cr/U

MATH501 Individual Tutorial, Graduate
Topic to be arranged in consultation with tutor.
Offering: Host
Grading: OPT

MATH502 Individual Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MATH503 Selected Topics, Graduate Sciences
Topic to be arranged in consultation with the tutor. A seminar primarily
cconcerned with papers taken from current research publications designed for,
and required of, graduate students.
Offering: Host
Grading: OPT

MATH504 Selected Topics, Graduate Sciences
Topic to be arranged in consultation with the tutor. A seminar primarily
cconcerned with papers taken from current research publications designed for,
and required of, graduate students.
Offering: Host
Grading: OPT

MATH507 Topics in Combinatorics
Each year the topic will change.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH509 Model Theory
This course will emphasize model theoretic algebra. We will consider the model
theory of fields, including algebraically closed, real-closed, and p-adically closed
fields; algebraically closed valued fields; and also general questions of definability
in fields. As time permits, we will consider more recent applications of model
theory in number theory and arithmetic geometry. Ideally, the student should
understand what it means to be first-order definable and should have the
equivalent of a year's study of abstract algebra. To study various applications, it
will be necessary to assume certain results from the areas of application—that is,
without proving them ab initio.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH510 Topics in Real Analysis
One semester will be devoted
to real analysis, covering such
topics as Lebesgue measure and integration on the line, abstract measure
spaces and integrals, product measures, decomposition and differentiation of
measures, and elementary functional analysis. One semester will be devoted
to complex analysis, covering such topics as analytic functions, power series,
Mobius transformations, Cauchy's integral theorem and formula in its general
form, classification of singularities, residues, argument principle, maximum
modulus principle, Schwarz's lemma, and the Riemann mapping theorem.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH511 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MATH512 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MATH513 Analysis I
MATH513 and MATH514 constitute the first-year graduate course in real and
complex analysis. One semester will be devoted to real analysis, covering such
topics as Lebesgue measure and integration on the line, abstract measure
spaces and integrals, product measures, decomposition and differentiation of
measures, and elementary functional analysis. One semester will be devoted
to complex analysis, covering such topics as analytic functions, power series,
Mobius transformations, Cauchy's integral theorem and formula in its general
form, classification of singularities, residues, argument principle, maximum
modulus principle, Schwarz's lemma, and the Riemann mapping theorem.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH514 Analysis II

MATH514 Analysis I
MATH513 and MATH514 constitute the first-year graduate course in real and complex analysis. One semester will be devoted to real analysis, covering such topics as Lebesgue measure and integration on the line, abstract measure spaces and integrals, product measures, decomposition and differentiation of measures, and elementary functional analysis. One semester will be devoted to complex analysis, covering such topics as analytic functions, power series, Mobius transformations, Cauchy's integral theorem and formula in its general form, classification of singularities, residues, argument principle, maximum modulus principle, Schwarz's lemma, and the Riemann mapping theorem.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH515 Analysis II
This is a topics course in analysis and varies from year to year. It may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH516 Analysis II
This is a topics course in analysis and varies from year to year. It may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH523 Topology I
This course is an introduction to topological spaces and the fundamental group; topological spaces, continuous maps, metric spaces; product and quotient spaces; compactness, connectedness, and separation axioms; and introduction to homotopy and the fundamental group.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH524 Topology I
A continuation of MATH523, this course will be an introduction to algebraic topology, concentrating on the fundamental group and homology.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH525 Topology II: Topics in Topology
This is a topics course in topology that varies from year to year. This course may be repeated for credit. Recent topics have included knot theory, homotopy theory, Lie groups, and topological graph theory.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH526 Topology II
This is a topics course in topology that varies from year to year. It may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH543 Algebra I
This course covers group theory including Sylow theorems, and basic ring and module theory, including structure of finitely generated modules over principal-ideal domains.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH544 Algebra I
This course studies Galois theory, finitely generated modules over principal-ideal domains, and other topics as time permits.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH545 Algebra II: Topics in Algebra
This is a topics course in algebra that varies from year to year. This course may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH546 Algebra II
This is a topics course in algebra that varies from year to year. It may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None

MATH549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

MATH572 Special Topics in Mathematics
This is a supervised reading course on advanced topics in number theory. This course may be repeated for credit.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: None