COMPUTER SCIENCES (COMP SCI)

COMP SCI 200 — PROGRAMMING I
3 credits.

Learn the process of incrementally developing small (200-500 lines) programs along with the fundamental Computer Science topics. These topics include: problem abstraction and decomposition, the edit-compile-run cycle, using variables of primitive and more complex data types, conditional and loop-based flow control, basic testing and debugging techniques, how to define and call functions (methods), and IO processing techniques. Also teaches and reinforces good programming practices including the use of a consistent style, and meaningful documentation. Intended for students who have no prior programming experience.

Requisites: Satisfied Quantitative Reasoning (QR) A requirement
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 202 — INTRODUCTION TO COMPUTATION
3 credits.

An introduction to the principles that form the foundation of computer science. Suitable for students with a general background who wish to study the key principles of computer science rather than just computer programming. MATH 118 does not fulfill the prerequisite. Not open to students with credit for COMP SCI 300 or 367
Requisites: MATH 096 or placement into MATH 141.
Course Designation: Gen Ed - Quantitative Reasoning Part A
Breadth - Natural Science
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/MATH 240 — INTRODUCTION TO DISCRETE MATHEMATICS
3 credits.

Requisites: MATH 217, 221, or 275
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 250 — DIGITAL SOCIETY: THE IMPACT OF COMPUTERS AND COMPUTER TECHNOLOGY
3 credits.

Introduction to computers in the digital society; social changes they influence, and choices they present. Topics include: digital divide, role of computers in improving quality of life, electronic voting and governance, digital intellectual property rights, privacy, computers and the environment.

Requisites: None
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/ECE 252 — INTRODUCTION TO COMPUTER ENGINEERING
2 credits.

Logic components built with transistors, rudimentary Boolean algebra, basic combinational logic design, basic synchronous sequential logic design, basic computer organization and design, introductory machine- and assembly-language programming.

Requisites: None
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 270 — FUNDAMENTALS OF HUMAN-COMPUTER INTERACTION
3 credits.

User-centered software design including principles and methods for understanding user needs, designing and prototyping interface solutions, and evaluating their usability covered through lectures and hands-on in-class activities. Meets with COMP SCI 570.
Requisites: Not open to students with credit for COMP SCI 570
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 298 — DIRECTED STUDY IN COMPUTER SCIENCE
1-3 credits.

Undergraduate directed study in computer sciences.
Requisites: Consent of instructor
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
COMP SCI 300 — PROGRAMMING II
3 credits.

Introduces students to Object-Oriented Programming using classes and objects to solve more complex problems. Introduces array-based and linked data structures: including lists, stacks, and queues. Programming assignments require writing and developing multi-class (file) programs using interfaces, generics, and exception handling to solve challenging real world problems. Topics reviewed include reading/writing data and objects from/to files and exception handling, and command line arguments. Topics introduced: object-oriented design; class vs. object; create and define interfaces and iterators; searching and sorting; abstract data types (List,Stack,Queue,PriorityQueue(Heap),Binary Search Tree); generic interfaces (parametric polymorphism); how to design and write test methods and classes; array based vs. linked node implementations; introduction to complexity analysis; recursion. Enroll Info: Not open to students with credit for COMP SCI 367
Requisites: Satisfied QR-A requirement and (Score of 3 on Computer Science (A) AP Exam, COMP SCI 200, 301, 302 or 310) or (COMP SCI/E C/E COMP SCI 252 and E C/E 203) or graduate or professional standing; or declared in the Professional Capstone Program in Computer Sciences
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI 301 — INTRODUCTION TO DATA PROGRAMMING
3 credits.

Instruction and experience in the use of a programming language for beginners. Program design; development of good programming style. No previous computing experience required. Recommended for non-CS and undecided majors.
Requisites: Satisfied Quantitative Reasoning (QR) A requirement or enrollment in the Professional Capstone Program in Computer Sciences
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI 304 — WES-CS GROUP MEETING
1 credit.

Small group meetings for Wisconsin Emerging Scholars - Computer Science (WES-CS) students. Meets in small groups to work together on problems related to the COMP SCI 200 course material. For information about WES-CS membership, contact the computer sciences department.
Requisites: Concurrent enrollment in COMP SCI 200 and member of Wisconsin Emerging Scholars program in Computer Science
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI 310 — PROBLEM SOLVING USING COMPUTERS
3 credits.

Gives students an introduction to computer and analytical skills to use in their subsequent course work and professional development. Discusses several methods of using computers to solve problems, including elementary programming techniques, symbolic manipulation languages, and software packages. Techniques will be illustrated using sample problems drawn from elementary engineering. Emphasis is on introduction of algorithms with the use of specific tools to illustrate the methods.
Requisites: MATH 222, graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI/E C/E 352 — DIGITAL SYSTEM FUNDAMENTALS
3 credits.

Logic components, Boolean algebra, combinational logic analysis and synthesis, synchronous and asynchronous sequential logic analysis and design, digital subsystems, computer organization and design.
Requisites: COMP SCI/E C/E COMP SCI 252
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI/E C/E 354 — MACHINE ORGANIZATION AND PROGRAMMING
3 credits.

An introduction to fundamental structures of computer systems and the C programming language with a focus on the low-level interrelationships and impacts on performance. Topics include the virtual address space and virtual memory, the heap and dynamic memory management, the memory hierarchy and caching, assembly language and the stack, communication and interrupts/signals, compiling and assemblers/linkers.
Requisites: COMP SCI/E C/E COMP SCI 252 and (COMP SCI 300 or 302) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Gen Ed - Quantitative Reasoning Part B
Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI 368 — LEARNING A PROGRAMMING LANGUAGE
1 credit.

For students interested in learning a particular programming language. Focuses on a specific language offered at one of three levels: beginner, intermediate, and advanced. Students may repeat the course if the topic title is different.
Requisites: None
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018
COMP SCI 369 — WEB PROGRAMMING
3 credits.
Covers web application development end-to-end: languages and frameworks for client- and server-side programming, database access, and other topics. Involves hands-on programming assignments. Students attain a thorough understanding of and experience with writing web applications using tools popular in industry.
Requisites: (COMP SCI 300 or 367), graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/INFO SYS 371 — TECHNOLOGY OF COMPUTER-BASED BUSINESS SYSTEMS
3 credits.
Overview of computers, their attendant technology, and the implications of this technology for large-scale, computer-based information systems. Topics include hardware, system software, program development, files and data communications.
Requisites: COMP SCI 301
Course Designation: Breadth - Social Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 400 — PROGRAMMING III
3 credits.
The third course in our programming fundamentals sequence. It presumes that students understand and use functional and object-oriented design and abstract data types as needed. This course introduces balanced search trees, graphs, graph traversal algorithms, hash tables and sets, and complexity analysis and about classes of problems that require each data type. Students are required to design and implement using high quality professional code, a medium sized program, that demonstrates knowledge and use of latest language features, tools, and conventions. Additional topics introduced will include as needed for projects: inheritance and polymorphism; anonymous inner classes, lambda functions, performance analysis to discover and optimize critical code blocks. Students learn about industry standards for code development. Students will design and implement a medium size project with a more advanced user-interface design, such as a web or mobile application with a GUI and event-driven implementation; use of version-control software.
Requisites: COMP SCI 300, graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 402 — INTRODUCING COMPUTER SCIENCE TO K-12 STUDENTS
2 credits.
Work in teams to lead Computer Science clubs and workshops for K-12 students at sites in the Madison area. Design and lead activities to help K-12 students learn computational thinking and computer programming.
Requisites: (COMP SCI 200, 202, 300, 301, 302, 310, or 367), graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 407 — FOUNDATIONS OF MOBILE SYSTEMS AND APPLICATIONS
3 credits.
Design and implementation of applications, systems, and services for mobile platforms with (i) constraints, such as limited processing, memory, energy, interfaces, variable bandwidth, and high mobility, and (ii) features, such as touchscreens, cameras, electronic compasses, GPS, and accelerometers.
Requisites: (COMP SCI 300 or 367), graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 412 — INTRODUCTION TO NUMERICAL METHODS
3 credits.
Interpolation, solution of linear and nonlinear systems of equations, approximate integration and differentiation, numerical solution of ordinary differential equations, Data fitting (such as least squares) by polynomials and splines. Knowledge of matrix algebra recommended, such as MATH 340.
Requisites: MATH 222 and (COMP SCI/MATH/COMP SCI 240 or MATH 234) and (COMP SCI 200, 300, 301, 302, or 310) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

Last Taught: Fall 2017
COMP SCI/I SY E/MATH 425 — INTRODUCTION TO COMBINATORIAL OPTIMIZATION
3 credits.
Focuses on optimization problems over discrete structures, such as shortest paths, spanning trees, flows, matchings, and the traveling salesman problem. We will investigate structural properties of these problems, and we will study both exact methods for their solution, and approximation algorithms.
Requisites: (MATH 320, 340, 341, or 375) or graduate or professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/E C/E/MATH 435 — INTRODUCTION TO CRYPTOGRAPHY
3 credits.
Cryptography is the art and science of transmitting digital information in a secure manner. This course will provide an introduction to its technical aspects.
Requisites: MATH 320, 340, 341, or 375
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/STAT 471 — INTRODUCTION TO COMPUTATIONAL STATISTICS
3 credits.
Classical statistical procedures arise where closed-form mathematical expressions are available for various inference summaries (e.g. linear regression; analysis of variance). A major emphasis of modern statistics is the development of inference principles in cases where both more complex data structures are involved and where more elaborate computations are required. Topics from numerical linear algebra, optimization, Monte Carlo (including Markov chain Monte Carlo), and graph theory are developed, especially as they relate to statistical inference (e.g., bootstrapping, permutation, Bayesian inference, EM algorithm, multivariate analysis).
Requisites: (MATH/STAT/MATH 310 and STAT 333) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/MATH 475 — INTRODUCTION TO COMBINATORICS
3 credits.
Requisites: (MATH 320, 340, 341, or 375) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/CURRIC 502 — THEORY AND PRACTICE IN COMPUTER SCIENCE EDUCATION
1 credit.
Computer science educational pedagogy and general teaching practices. Practical experience gained through tutoring students. Knowledge of object-oriented programming required.
Requisites: COMP SCI 300 or 302 or declared in Computer Science graduate program
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/E C E 506 — SOFTWARE ENGINEERING
3 credits.
Ideas and techniques for designing, developing, and modifying large software systems. Topics include software engineering processes; requirements and specifications; project team organization and management; software architectures; design patterns; testing and debugging; and cost and quality metrics and estimation. Students will work in large teams on a substantial programming project.
Requisites: (COMP SCI 367 or 400) and (COMP SCI 407, 536, 537, 545, 559, 564, 570, 679 or COMP SCI/E C E/COMP SCI 552) or graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/MATH 513 — NUMERICAL LINEAR ALGEBRA
3 credits.
Requisites: (MATH 340, 341, or 375) and (COMP SCI 200, 300, 301, 302 or 310) or graduate or professional standing
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
COMP SCI/MATH 514 — NUMERICAL ANALYSIS
3 credits.


**Requisites:** MATH 340 and (COMP SCI 200, 300, 301, or 310) or graduate or professional standing

**Course Designation:** Breadth - Natural Science

**Level:** Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Grad 50%:** Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2017

COMP SCI 520 — INTRODUCTION TO THEORY OF COMPUTING
3 credits.

Basics about the notion, capabilities, and limitations of computation: elements of finite automata and regular languages, computability theory, and computational complexity theory. Additional topics include context-free grammars and languages, and complexity-theoretic cryptography.

**Requisites:** (COMP SCI/MATH/COMP SCI 240 or COMP SCI/MATH/STAT/COMP SCI/MATH 475) and (COMP SCI 367 or 400), or graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals

**Course Designation:** Breadth - Natural Science

**Level:** Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

**Last Taught:** Fall 2017

COMP SCI/E C E/I SY E 524 — INTRODUCTION TO OPTIMIZATION
3 credits.

Introduction to mathematical optimization from a modeling and solution perspective. Formulation of applications as discrete and continuous optimization problems and equilibrium models. Survey and appropriate usage of basic algorithms, data and software tools, including modeling languages and subroutine libraries.

**Requisites:** (COMP SCI 200, 300, 301, 302, or 310) and (MATH 320, 340, 341, or 375) or graduate or professional standing

**Course Designation:** Breadth - Natural Science

**Level:** Intermediate

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

COMP SCI/I SY E/MATH/STAT 525 — LINEAR PROGRAMMING METHODS
3 credits.

Real linear algebra over polyhedral cones; theorems of the alternative for matrices. Formulation of linear programs. Duality theory and solvability. The simplex method and related methods for efficient computer solution. Perturbation and sensitivity analysis. Applications and extensions, such as game theory, linear economic models, and quadratic programming.

**Requisites:** (MATH 320, 340, 341, 375, or 443) or graduate or professional standing

**Course Designation:** Breadth - Natural Science

**Level:** Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

COMP SCI/I SY E 526 — ADVANCED LINEAR PROGRAMMING
3-4 credits.


**Requisites:** COMP SCI/ISYE/MATH/STAT/COMP SCI/I SY E/MATH 525 and (COMP SCI 200, 300, 301, 302, or 310) or graduate or professional standing

**Course Designation:** L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

**Last Taught:** Fall 2015

COMP SCI/E C E/M E 532 — THEORY AND APPLICATIONS OF PATTERN RECOGNITION
3 credits.

Pattern recognition systems and components; decision theories and classification; discriminant functions; supervised and unsupervised training; clustering; feature extraction and dimensional reduction; sequential and hierarchical classification; applications of training, feature extraction, and decision rules to engineering problems.

**Requisites:** MATH 222 and (E C E 203, COMP SCI 200, 300 or 302) or graduate or professional standing

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

**Level:** Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Grad 50%:** Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2017
COMP SCI/E C E 533 — IMAGE PROCESSING
3 credits.
Mathematical representation of continuous and digital images; models of image degradation; picture enhancement, restoration, segmentation, and coding; pattern recognition, tomography.
Requisites: E C E 330 and (MATH 320 or 340) or graduate or professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 534 — COMPUTATIONAL PHOTOGRAPHY
3 credits.
Study of sensing and computational techniques that enhance or extend the capabilities of digital photography by using methods from computer vision and computer graphics to create new visual representations. Algorithms for analyzing, improving, manipulating, combining, and synthesizing images.
Requisites: (COMP SCI 300 or 367) and (MATH 217, 221 or 275) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 536 — INTRODUCTION TO PROGRAMMING LANGUAGES AND COMPILERS
3 credits.
Introduction to the theory and practice of compiler design. Comparison of features of several programming languages and their implications for implementation techniques. Several programming projects required.
Requisites: COMP SCI/E C E/COMP SCI 354 and (COMP SCI 367 or 400) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 537 — INTRODUCTION TO OPERATING SYSTEMS
4 credits.
Input-output hardware, interrupt handling, properties of magnetic tapes, discs and drums, associative memories and virtual address translation techniques. Batch processing, time sharing and real-time systems, scheduling resource allocation, modular software systems, performance measurement and system evaluation.
Requisites: COMP SCI/E C E/COMP SCI 354 and (COMP SCI 367 or 400) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 538 — INTRODUCTION TO THE THEORY AND DESIGN OF PROGRAMMING LANGUAGES
3 credits.
Design and theory of programming languages: procedural, object-oriented, functional and logic paradigms. Serial and concurrent programming. Execution models and formal specification techniques.
Requisites: COMP SCI/E C E/COMP SCI 354 and (COMP SCI 367 or 400) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/E C E/M E 539 — INTRODUCTION TO ARTIFICIAL NEURAL NETWORK AND FUZZY SYSTEMS
3 credits.
Theory and applications of artificial neural networks and fuzzy logic: multi-layer perceptron, self-organization map, radial basis network, Hopfield network, recurrent network, fuzzy set theory, fuzzy logic control, adaptive fuzzy neural network, genetic algorithm, and evolution computing. Applications to control, pattern recognition, nonlinear system modeling, speech and image processing.
Requisites: COMP SCI 200, 301, 302, or 310 or graduate or professional standing
Course Designation: L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 540 — INTRODUCTION TO ARTIFICIAL INTELLIGENCE
3 credits.
Principles of knowledge-based search techniques, automatic deduction, knowledge representation using predicate logic, machine learning, probabilistic reasoning. Applications in tasks such as problem solving, data mining, game playing, natural language understanding, computer vision, speech recognition, and robotics.
Requisites: (COMP SCI 300 or 367) and (MATH 211, 217, 221, or 275) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 545 — NATURAL LANGUAGE AND COMPUTING
3 credits.
The course covers basic techniques and tools in natural language processing: generative grammars, parsing, dictionary construction, semantic networks, generation of text from a knowledge base, natural language interfacing, and machine translation.
Requisites: COMP SCI 536, 537, or 564 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2014
COMP SCI 547 — COMPUTER SYSTEMS MODELING FUNDAMENTALS
3 credits.

An introduction to basic tools and applications for modeling and analysis of computer systems. Fundamentals of network flow graphs, graph models of computation and stochastic models of computer system performance. Network delay analysis and capacity planning, reachability analysis for deadlock detection in distributed systems, Markov Chains, elementary queueing theory, basic concepts of queueing network models and associated analyses.

**Requisites:** MATH 234 and (COMP SCI 300 or 367) and COMP SCI/ECE/COMP SCI 354 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals

**Course Designation:** Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No
**Last Taught:** Spring 2012

COMP SCI/ECE 552 — INTRODUCTION TO COMPUTER ARCHITECTURE
3 credits.

The design of computer systems and components. Processor design, instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchies; and interrupts and I/O structures. ECE 551 or knowledge of Verilog is recommended.

**Requisites:** (COMP SCI/ECE/COMP SCI 352 and COMP SCI/ECE/COMP SCI 354) or graduate or professional standing

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

COMP SCI/ISY/E/M 558 — INTRODUCTION TO COMPUTATIONAL GEOMETRY
3 credits.

Introduction to fundamental geometric computations and algorithms, and their use for solving engineering and scientific problems. Computer representations of simple geometric objects and paradigms for algorithm design. Applications from areas of engineering analysis, design and manufacturing, biology, statistics, and other sciences.

**Requisites:** (COMP SCI 367 or 400) and MATH 234 or graduate or professional standing

**Course Designation:** L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

COMP SCI 559 — COMPUTER GRAPHICS
3 credits.

Survey of computer graphics. Image representation, formation, presentation, composition and manipulation. Modeling, transformation, and display of geometric objects in two and three dimensions. Representation of curves and surfaces. Rendering, animation, multimedia and visualization. Fluency with vector mathematics (e.g., from MATH 234 or a linear algebra class) is recommended.

**Requisites:** (MATH 222 or MATH 276) and (COMP SCI 367 or 400) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals

**Course Designation:** Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

COMP SCI 564 — DATABASE MANAGEMENT SYSTEMS: DESIGN AND IMPLEMENTATION
4 credits.

What a database management system is; different data models currently used to structure the logical view of the database: relational, hierarchical, and network. Hands-on experience with relational and network-based database systems. Implementation techniques for database systems. File organization, query processing, concurrency control, rollback and recovery, integrity and consistency, and view implementation.

**Requisites:** (COMP SCI/ECE/COMP SCI 354 and (COMP SCI 367 or 400) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

COMP SCI/BMI 567 — MEDICAL IMAGE ANALYSIS
3 credits.

Present introductory medical image processing and analysis techniques. Topics include medical imaging formats, segmentation, registration, image quantification, classification. Strongly encourage Matlab experience, such as COMP SCI 310 or 368-Matlab.

**Requisites:** (MATH 320 or 340) and (BMI/STAT/BMI 511, 541, BMI/POP HLTH/BMI 551, STAT 324, 371, or FW ECOL/HORT/STAT/FW ECOL/HORT 571) or graduate or professional standing

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No
COMP SCI 570 — INTRODUCTION TO HUMAN-COMPUTER INTERACTION
4 credits.

User-centered software design; (1) principles of and methods for understanding user needs, designing and prototyping interface solutions, and evaluating their usability, (2) their applications in designing web-based, mobile, and embodied interfaces through month long group projects. Meets with Comp Sci 270. Not open to students who have completed COMP SCI 270.

Requisites: (COMP SCI 200, 202, 300, 301, or 302) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals.
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI/B M I 576 — INTRODUCTION TO BIOINFORMATICS
3 credits.

Algorithms for computational problems in molecular biology. The course will study algorithms for problems such as: genome sequencing and mapping, pairwise and multiple sequence alignment, modeling sequence classes and features, phylogenetic tree construction, and gene-expression data analysis.

Requisites: (COMP SCI 300 or 367) and MATH 222 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 577 — INTRODUCTION TO ALGORITHMS
4 credits.

Basic paradigms for the design and analysis of efficient algorithms: greedy, divide-and-conquer, dynamic programming, reductions, and the use of randomness. Computational intractability including typical NP-complete problems and ways to deal with them.

Requisites: (COMP SCI/MATH/COMP SCI 240 or COMP SCI/MATH/STAT/COMP SCI/MATH 475) and (COMP SCI 367 or 400), or graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 578 — CONTEST-LEVEL PROGRAMMING
1 credit.

Training in computer programming for competitions: assessing the coding difficulty and complexity of computational problems, recognizing the applicability of known algorithms, fast coding and testing, team work. COMP SCI 577 is suggested but not required.

Requisites: (COMP SCI 300 or 367), graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI/DS 579 — VIRTUAL REALITY
3 credits.

Introduces students to the field of virtual reality and focuses on creating immersive, interactive virtual experiences. Survey topics include historical perspectives on virtual reality technology, computer graphics and 3D modeling, human perception and psychology, human computer interaction and user interface design. This course is designed for students with backgrounds in Computer Science, Engineering, Art, Architecture and Design. Students will work in interdisciplinary teams on projects, culminating in a final event that will be showcased to the public. While not an official site, the class will be technologically motivated; therefore students should be comfortable learning new software. The class will utilize publicly available game design software which provides tools and services for the creation of interactive content. While not necessary, students may find it helpful to have taken classes in programming and computer graphics (such COMP SCI 559: Computer Graphics) or in 3D modeling (such as ART 429: 3D Digital Studio I or DS 242: Visual Communication II).

Requisites: Sophomore standing
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2016

COMP SCI/L I S 611 — USER EXPERIENCE DESIGN 1
3 credits.

Introduces students to the user experience design process, key stages involved in designing for user experience, and tasks, methods, and tools involved at each stage at an introductory level, including understanding and modeling users, needs, and context and performing basic design, prototyping, and formative evaluation.

Requisites: Declared in the Capstone Certificate in User Experience Design
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/L I S 612 — USER EXPERIENCE DESIGN 2
3 credits.

Students advance their understanding of the UX design process by learning and applying tools and techniques at an intermediate level, including conceptual and interaction design, more advanced methods for prototyping of design solutions, and iterative design based on user models and evaluation. Students apply skills learned in the course to develop and iteratively improve prototypes for a project.

Requisites: L I S/COMP SCI/L I S 611 and declared in the Capstone Certificate in User Experience Design
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
COMP SCI/L IS 613 — USER EXPERIENCE DESIGN 3
3 credits.
Hone skills in assessment of digital user experience design including assessment of accessibility, information architecture, interactions, contribution to organizational goals, content workflows, trace data and advanced usability assessment. Students learn and apply core concepts of information architecture to improve digital design. Students gain understanding of how to find, analyze and interpret data to assess design. Students apply understanding of social aspects of digital media through exploration and application of participatory and value sensitive design approaches and analysis methods, broader stakeholder analysis and analysis that examine the fit between culture and task.
Requisites: L I S/COMP SCI/L I S 612 and declared in the Capstone Certificate in User Experience Design
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/L I S 614 — USER EXPERIENCE DESIGN CAPSTONE
1 credit.
Applies a design studio critique approach to produce a learning environment of collaborative and interdisciplinary peer critique and learning, in addition to provide expert feedback and suggestions. Students will present and defend the latest iteration of the user experience design project they developed in earlier courses while learning about the professions associated with digital user experience design.
Requisites: L I S/COMP SCI/L I S 613 and declared in the Capstone Certificate in User Experience Design
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/I SY E 635 — TOOLS AND ENVIRONMENTS FOR OPTIMIZATION
3 credits.
Formulation and modeling of applications from computer sciences, operations research, business, science and engineering involving optimization and equilibrium models. Survey and appropriate usage of software tools for solving such problems, including modeling language use, automatic differentiation, subroutine libraries and web-based optimization tools and environments.
Requisites: (MATH 320, 340, 341, or 375) and (COMP SCI 200, 202, 300, 301, or 302) or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2015

COMP SCI 638 — UNDERGRADUATE TOPICS IN COMPUTING
1-4 credits.
Selected topics in computing. Each offering of the course will cover a topic selected by the instructor and may cover one or more topics from all of computer science.
Requisites: (COMP SCI 200, 202, 300, 301, 302, 310, or 367), graduate or professional standing, or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018

COMP SCI 639 — UNDERGRADUATE ELECTIVE TOPICS IN COMPUTING
3-4 credits.
Selected topics in computing. Each offering of the course will cover a topic selected by the instructor. Offerings of this course will provide sufficient depth into their subject to count as electives to meet CS Major requirements.
Requisites: None
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018

COMP SCI 640 — INTRODUCTION TO COMPUTER NETWORKS
3 credits.
Architecture of computer networks and network protocols, protocol layering, reliable transmission, congestion control, flow control, naming and addressing, unicast and multicast routing, network security, network performance widely used protocols such as Ethernet, wireless LANs, IP, TCP, and HTTP.
Requisites: COMP SCI 537 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI 642 — INTRODUCTION TO INFORMATION SECURITY
3 credits.
Senior level undergraduate course covering various topics on information security. Covers a wide range of topics, such as cryptographic primitives, security protocols, system security, and emerging topics. Elementary knowledge of mathematical logic and discrete probability theory needed, such as COMP SCI/MATH/COMP SCI 240.
Requisites: COMP SCI 537 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No

COMP SCI/COMP SC 644 — SELECTED TOPICS IN COMPUTER SCIENCES
3 credits.
Senior level undergraduate course covering various topics on information security. Covers a wide range of topics, such as cryptographic primitives, security protocols, system security, and emerging topics. Elementary knowledge of mathematical logic and discrete probability theory needed, such as COMP SCI/MATH/COMP SCI 240.
Requisites: COMP SCI 537 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No
COMP SCI 679 — COMPUTER GAME TECHNOLOGY
3 credits.
Survey of software technology important to computer games and other forms of interactive technology. Real-time image generation, managing complex geometric models, creating virtual characters, simulating physical phenomenon, networking technology for distributed virtual environments.
Requisites: COMP SCI 559 or graduate or professional standing or declared in the Capstone Certificate in Computer Sciences for Professionals
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No

COMP SCI 681 — SENIOR HONORS THESIS
3 credits.
Individual study for seniors completing theses for honors in the Computer Sciences major as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 682 — SENIOR HONORS THESIS
3 credits.
Individual study for seniors completing theses for honors in the Computer Sciences major as arranged with a faculty member. Continuation of COMP SCI 681
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 691 — SENIOR THESIS
2-3 credits.
Individual study for seniors completing theses as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 692 — SENIOR THESIS
2-3 credits.
Individual study for seniors completing theses as arranged with a faculty member, continuation of COMP SCI 691
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 698 — DIRECTED STUDY
1-6 credits.
Directed study projects for juniors and seniors as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 701 — CONSTRUCTION OF COMPILERS
3 credits.
Principles of the design and implementation of programming languages. Topics include: Principles of compilation, static program analysis, compilation methods to support profiling, and code-generation methods. Knowledge of programming languages and compiler design strongly encouraged, such as COMP SCI 536.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 703 — ADVANCED TOPICS IN PROGRAMMING LANGUAGES AND COMPILERS
3 credits.
Formal methods for program verification. Model-checking techniques; linear temporal logic; computational tree logic; logic/automata connection; bisimulations; probabilistic model-checking. Special topics include: program synthesis, verification of synthesis and privacy properties. Knowledge of programming languages and compiler design strongly encouraged, such as COMP SCI 536.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 704 — PRINCIPLES OF PROGRAMMING LANGUAGES
3 credits.
Introduction to principles of advanced programming languages and programming-language theory. Topics include: lambda-calculus, functional languages, polymorphic functions, type inference, structural induction, lazy evaluation, operational semantics, denotational semantics, and axiomatic semantics. Students are strongly encouraged to have knowledge of programming languages, such as from COMP SCI 536.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
COMP SCI 706 — ANALYSIS OF SOFTWARE ARTIFACTS
3 credits.

Advanced course covering various analysis techniques used in software engineering. Covers techniques for analyzing various software artifacts. Some of the topics that will be covered are: model checking, testing, program analysis, requirements analysis, and safety analysis. Students are strongly encouraged to have knowledge of programming languages and compiler design, such as COMP SCI 536, and a basic knowledge of mathematical logic.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/E CE 707 — MOBILE AND WIRELESS NETWORKING
3 credits.

Design and implementation of protocols, systems, and applications for mobile and wireless networking, particularly at the media access control, network, transport, and application layers. Focus is on the unique problems and challenges presented by the properties of wireless transmission, various device constraints such as limited battery power, and node mobility. Knowing of computer networking is strongly encouraged, such as from COMP SCI 640 or E CE 537.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 710 — COMPUTATIONAL COMPLEXITY
3 credits.

Study of the capabilities and limitations of efficient computation. Relationships between models representing capabilities such as parallelism, randomness, quantum effects, and non-uniformity; and models based on the notions of nondeterminism, alternation, and counting, which capture the complexity of important problems.

Knowledge of the theory of computation is strongly encouraged, such as COMP SCI 520.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/MATH 714 — METHODS OF COMPUTATIONAL MATHEMATICS I
3 credits.

Development of finite difference methods for hyperbolic, parabolic and elliptic partial differential equations. Analysis of accuracy and stability of difference schemes. Direct and iterative methods for solving linear systems. Introduction to finite volume methods. Applications from science and engineering. Students are strongly encouraged to have programming skills (e.g. COMP SCI 200) and some undergraduate numerical analysis (e.g. MATH/COMP SCI 514 or COMP SCI 412), analysis and differential equations (e.g. MATH 322 and MATH 521) and linear algebra (e.g. MATH 341).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/MATH 715 — METHODS OF COMPUTATIONAL MATHEMATICS II
3 credits.

Introduction to spectral methods (Fourier, Chebyshev, Fast Fourier Transform), finite element methods (Galerkin methods, energy estimates and error analysis), and mesh-free methods (Monte-Carlo, smoothed-particle hydrodynamics) for solving partial differential equations. Applications from science and engineering. Students are strongly encouraged to have programming skills (e.g. COMP SCI 200), undergraduate numerical analysis (e.g. MATH/COMP SCI 514 or COMP SCI 412), analysis (MATH 322 and math 521) and linear algebra (e.g. MATH 341 or equiv.)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/ISyE 719 — STOCHASTIC PROGRAMMING
3 credits.

Stochastic programming is concerned with decision making in the presence of uncertainty, where the eventual outcome depends on a future random event. Topics include modeling uncertainty in optimization problems, risk measures, stochastic programming algorithms, approximation and sampling methods, and applications. Students are strongly encouraged to have knowledge of linear programming (e.g., CS/ISyE/MATH/COMP SCI/ISY E/STAT 525) and probability and statistics (e.g., MATH/STAT 431). Knowledge of integer optimization (CS/ISY E/MATH/COMP SCI/ISY E 728) is helpful, but not required.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016
COMP SCI/I SY E 723 — DYNAMIC PROGRAMMING AND ASSOCIATED TOPICS  
3 credits.

General and special techniques of dynamic programming developed by means of examples. Shortest-path algorithms. Deterministic equipment replacement models. Resource allocation problem. Traveling-salesman problem. Knapsack problem. Analysis of inventory systems. General stochastic formulations. Markovian decision processes. Students are strongly encouraged to have knowledge of mathematical optimization (e.g., COMP SCI/I SY E/MATH/STAT 525, I SY E 623, COMP SCI/I SY E/MATH/STAT 726), knowledge of analysis (e.g., MATH/STAT 431 or 521) and programming ability (e.g., COMP SCI 200 or 301)  
Requisites: Graduate or professional standing  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  

COMP SCI/I SY E/MATH/STAT 726 — NONLINEAR OPTIMIZATION I  
3 credits.

Theory and algorithms for nonlinear optimization, focusing on unconstrained optimization. Line-search and trust-region methods; quasi-Newton methods; conjugate-gradient and limited-memory methods for large-scale problems; derivative-free optimization; algorithms for least-squares problems and nonlinear equations; gradient projection algorithms for bound-constrained problems; and simple penalty methods for nonlinearly constrained optimization. Students are strongly encouraged to have knowledge of linear algebra (e.g. MATH 320, MATH 433) and familiarity with basic mathematical analysis.  
Requisites: Graduate or professional standing  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  

COMP SCI/I SY E 727 — CONVEX ANALYSIS  
3 credits.

Convex sets in finite-dimensional spaces: relative interiors, separation, set operations. Convex functions: conjugacy, subdifferentials and directional derivations, functional operations, Fenchel-Rockafellar duality. Applications to operations research and related areas. Students taking this course are strongly encouraged to have had a course in basic analysis (e.g. MATH 521) and a course in linear algebra (e.g., MATH 340).  
Requisites: Graduate or professional standing  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  
Last Taught: Fall 2017  

COMP SCI/I SY E/MATH 728 — INTEGER OPTIMIZATION  
3 credits.

Introduces optimization problems over integers, and surveys the theory behind the algorithms used in state-of-the-art methods for solving such problems. Special attention is given to the polyhedral formulations of these problems, and to their algebraic and geometric properties. Applicability of Integer Optimization is highlighted with applications in combinatorial optimization. Key topics include: formulations, relaxations, polyhedral theory, cutting planes, decomposition, enumeration. Students are strongly encouraged to have knowledge of Linear Programming (e.g., COMP SCI/I SY E/MATH/COMP SCI/I SY E/STAT 525), including algorithms, duality and polyhedral theory.  
Requisites: Graduate or professional standing  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  

COMP SCI/I SY E/MATH 730 — NONLINEAR OPTIMIZATION II  
3 credits.

Requisites: COMP SCI/I SY E/MATH/STAT/COMP SCI/I SY E/MATH 726  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  
Last Taught: Spring 2017  

COMP SCI 731 — ADVANCED ARTIFICIAL INTELLIGENCE  
3 credits.

Learning and hypothesis formation; knowledge acquisition; deductive and inductive inference systems; reasoning techniques involving time, nonmonotonic reasoning, spatial reasoning, truth maintenance systems; planning strategies.  
Requisites: Comp Sci 540 or cons inst  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No  
Last Taught: Spring 2011  

COMP SCI 733 — COMPUTATIONAL METHODS FOR LARGE SPARSE SYSTEMS  
3 credits.

Algorithms and theory for large scale systems in engineering and science, with emphasis on sparse matrices and iterative methods. Students are strongly encouraged to have knowledge of data structures (e.g., COMP SCI 367 or COMP SCI 300), numerical analysis (e.g., COMP SCI 412, ECE 334), and linear and matrix algebra (e.g., MATH 340).  
Requisites: Graduate or professional standing  
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement  
Repeatable for Credit: No
COMP SCI 736 — ADVANCED OPERATING SYSTEMS
3 credits.

Advanced topics in operating systems, including process communication, resource allocation, multiprocess and network operating systems, kernel philosophies, fault-tolerant systems, virtual machines, high-level language systems, verifiability and proof techniques.

Requisites: COMP SCI 537 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 739 — DISTRIBUTED SYSTEMS
3 credits.

Basic concepts; distributed programming; distributed file systems; atomic actions; fault tolerance, transactions, program and data replication, recovery; distributed machine architectures; security and authentication; load balancing and process migration; distributed debugging; distributed performance measurement; distributed simulation techniques; distributed applications; correctness considerations and proof systems.

Requisites: COMP SCI 736
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 740 — ADVANCED COMPUTER NETWORKS
3 credits.

Advanced topics in computer communications networks: congestion and flow control; routing; rate-based protocols; high speed interfaces and technologies: metropolitan area networks; fast packet switching technologies; advanced applications; network services: name service, authentication, resource location. Students are strongly encouraged to have knowledge of computer network design and protocols (e.g., COMP SCI 640)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 744 — BIG DATA SYSTEMS
3 credits.

Issues in the design and implementation of big data processing systems, including: an overview of cluster architecture, key design goals (flexibility, performance and fault tolerance), popular execution frameworks, basic abstractions, and applications (e.g., batch analytics, stream processing, graph processing, and machine learning).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 747 — ADVANCED COMPUTER SYSTEMS ANALYSIS TECHNIQUES
3 credits.

A survey of advanced analytical modeling techniques for performance analysis of computer systems. Techniques covered include discrete-parameter (embedded) Markov Chains, M/G/1 queues, stochastic Petri nets, queueing networks, renewal theory, and sample path analysis. Application areas include high performance computer architectures, databases, and operating system resource allocation policies. Students are strongly encouraged to have knowledge of computer system modeling (e.g., COMP SCI 547)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Spring 2011

COMP SCI/E C E 750 — REAL-TIME COMPUTING SYSTEMS
3 credits.

Introduction to the unique issues in the design and analysis of computer systems for real-time applications. Hardware and software support for guaranteeing timeliness with and without failures. Resource management, time-constrained communication, scheduling and imprecise computations, real-time kernels and case studies. Students are strongly encouraged to have knowledge of computer architecture (e.g., COMP SCI/E C E/COMP SCI 552) and operating system functions (e.g., COMP SCI 537)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Fall 2016

COMP SCI/E C E 752 — ADVANCED COMPUTER ARCHITECTURE I
3 credits.

Processor design, computer arithmetic, pipelining, multi-operation processors, vector processors, control units, precise interrupts, main memory, cache memories, instruction set design, stack machines, busses and I/O, protection and security. Students are strongly encouraged to have knowledge of computer architecture (e.g., COMP SCI/E C E/COMP SCI 552).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Fall 2017

COMP SCI/E C E 755 — VLSI SYSTEMS DESIGN
3 credits.

Overview of MOS devices and circuits; introduction to integrated circuit fabrication; topological design of data flow and control; interactive graphics layout; circuit simulation; system timing; organizational and architectural considerations; alternative implementation approaches; design project. E C E 555 or equivalent experience is strongly recommended.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
COMP SCI/ECE 756 — COMPUTER-AIDED DESIGN FOR VLSI
3 credits.
Broad introduction to computer-aided design tools for VLSI, emphasizing implementation algorithms and data structures. Topics covered: design styles, layout editors, symbolic compaction, module generators, placement and routing, automatic synthesis, design-rule checking, circuit extraction, simulation and verification. Students are strongly encouraged to have programming skills and to have taken a course in Digital System Fundamentals such as ECE/COMP SCI 352.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/ECE 757 — ADVANCED COMPUTER ARCHITECTURE II
3 credits.
Parallel algorithms, principles of parallelism detection and vectorizing compilers, interconnection networks, SIMD/MIMD machines, processor synchronization, data coherence, multi's, dataflow machines, special purpose processors. Students are strongly encouraged to have knowledge of computer architecture (e.g., COMP SCI/ECE 552).
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 758 — ADVANCED TOPICS IN COMPUTER ARCHITECTURE
3 credits.
Advanced topics in computer architecture that explore the implications to architecture of forthcoming evolutionary and revolutionary changes in application demands, software paradigms, and hardware implementation technologies. Students are strongly encouraged to have knowledge of computer architecture (e.g., COMP SCI/ECE/COMP SCI 552).
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/ECE M/EE/P/M E 759 — HIGH PERFORMANCE COMPUTING FOR APPLICATIONS IN ENGINEERING
3 credits.
An overview of hardware and software solutions that enable the use of advanced computing in tackling computationally intensive engineering problems. Hands-on learning promoted through programming assignments that leverage emerging hardware architectures and use parallel computing programming languages. Students are strongly encouraged to have completed COMP SCI 367 or COMP SCI 400 or to have equivalent experience.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 760 — MACHINE LEARNING
3 credits.
Computational approaches to learning: including inductive inference, explanation-based learning, analogical learning, connectionism, and formal models. What it means to learn. Algorithms for learning. Comparison and evaluation of learning algorithms. Cognitive modeling and relevant psychological results. Students are strongly encouraged to have knowledge of introductory artificial intelligence (e.g., COMP SCI 540).
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/ECE 761 — MATHEMATICAL FOUNDATIONS OF MACHINE LEARNING
3 credits.
Mathematical foundations of machine learning theory and algorithms. Probabilistic, algebraic, and geometric models and representations of data, mathematical analysis of state-of-the-art learning algorithms and optimization methods, and applications of machine learning. Students should have taken a course in statistics and a course in linear algebra (e.g., STAT 302 and MATH 341).
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 764 — TOPICS IN DATABASE MANAGEMENT SYSTEMS
3 credits.
Implementation of database management systems, the impact of new technology on database management systems, back-end database computers, distributed database management systems, concurrency control, and query execution in both distributed and centralized systems, implementation of multiple user views, roll-back and recovery mechanisms, database translation. Students are strongly encouraged to have knowledge of database design (e.g., COMP SCI 564).
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI 765 — DATA VISUALIZATION
3 credits.
Principles of the visual presentation of data. Survey of Information Visualization, Scientific Visualization, and Visual Analytics. Design and evaluation of visualizations and interactive exploration tools. Introduction to relevant foundations in visual design, human perception, and data analysis. Encodings, layout and interaction. Approaches to large data sets. Visualization of complex data types such as scalar fields, graphs, sets, texts, and multi-variate data. Use of 2D, 3D and motion in data presentations. Implementation issues.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017
COMP SCI 766 — COMPUTER VISION
3 credits.

Fundamentals of image analysis and computer vision; image acquisition and geometry; image enhancement; recovery of physical scene characteristics; shape-from techniques; segmentation and perceptual organization; representation and description of two-dimensional objects; shape analysis; texture analysis; goal-directed and model-based systems; parallel algorithms and special-purpose architectures. Students are strongly encouraged to have basic proficiency in calculus and linear algebra, such as MATH 340, and basic programming such as COMP SCI 300 or COMP SCI 367.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/B MI 767 — COMPUTATIONAL METHODS FOR MEDICAL IMAGE ANALYSIS
3 credits.

Study of computational techniques that facilitate automated analysis, manipulation, denoising, and improvement of large-scale and high resolution medical images. Design and implementation of methods from computer Vision and Machine Learning to efficiently process such image data to answer biologically and clinically meaningful scientific questions. Students are strongly encouraged to have programming skills and basic proficiency in calculus and linear algebra, such as MATH 340.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 769 — ADVANCED NATURAL LANGUAGE PROCESSING
3 credits.

Develop algorithms and mathematical models for natural language processing tasks, including text categorization, information retrieval, speech recognition, machine translation, and information extraction. Focus is on the state-of-the-art computational techniques as they are applied to natural language tasks. Students are strongly encouraged to have knowledge of introductory artificial intelligence (e.g., COMP SCI 540).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI/ED PSYCH/PSYCH 770 — HUMAN-COMPUTER INTERACTION
3 credits.

Principles of human-computer interaction (HCI); human subjects research methods and procedures, qualitative and quantitative data analysis; and semester-long research project situated in critical domains of HCI, including applications in ubiquitous, affective, assistive, social, and embodied computing.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

COMP SCI/B MI 776 — ADVANCED BIOINFORMATICS
3 credits.

Advanced course covering computational problems in molecular biology. The course will study algorithms for problems such as: modeling sequence classes and features, phylogenetic tree construction, gene-expression data analysis, protein and RNA structure prediction, and whole-genome analysis and comparisons.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

COMP SCI 777 — COMPUTER ANIMATION
3 credits.

Survey of technical issues in the creation of moving and dynamic computer imagery. Principles of animation. Manual motion specification and keyframing. Procedural and simulation-based motion synthesis. Motion capture processing, editing and use. Animation systems. Modeling, rendering and video issues relating to animation. Image-based animation methods and warping. Applications of animation such as games and virtual environments. Basic introduction to artistic issues in animation, such as cinematography. Special effects for film and video. Students are strongly encouraged to have knowledge of computer graphics (e.g., COMP SCI 559)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2013

COMP SCI 784 — FOUNDATIONS OF DATA MANAGEMENT
3 credits.

Foundational concepts in databases and data management. The first part of the course discusses topics on query languages (conjunctive queries, Datalog), their expressivity and complexity of evaluation. The second part studies advanced topics in modern data management, including data streams, massive parallelism, provenance, uncertain data management and privacy. There are no specific course prerequisites. It is strongly encouraged that the students are familiar with databases and relational algebra (COMP SCI 564 or equivalent). Knowledge of algorithms, complexity theory and probability will also be helpful.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

COMP SCI 787 — ADVANCED ALGORITHMS
3 credits.

Advanced paradigms for the design and analysis of efficient algorithms, including the use of randomness, linear programming, and semi-definite programming. Applications to data structures, approximating NP-hard optimization problems, learning, on-line and distributed problems. Students are strongly encouraged to have introductory knowledge of algorithms (e.g., COMP SCI 577)

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
COMP SCI 790 — MASTER'S THESIS
1-9 credits.

**Requisites:** Grad st; Master's candidates only
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions

COMP SCI 799 — MASTER'S RESEARCH
1-9 credits.

Survey of algorithms and design paradigms for exact arithmetic, as used in public-key cryptography, computer algebra, and pseudo-random number generation. Topics include primality testing, factorization of integers and polynomials, discrete logarithms, and (optionally) elliptic curves and integer lattices. Students are strongly encouraged to have knowledge of basic abstract algebra (e.g., MATH 541), and intermediate programming ability (e.g., COMP SCI 367 or COMP SCI 300).

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions

COMP SCI 809 — MATHEMATICAL TECHNIQUES IN THE ANALYSIS OF ALGORITHMS
3 credits.

Techniques for quantitative analysis of algorithms. Charging arguments, amortization, probabilistic methods. Adversary and information lower bounds. Use of methods from combinatorics, complex analysis, and asymptotics in obtaining precise analyses of quicksort, chained hashing, and other algorithms. Students are strongly encouraged to have knowledge of algorithms (e.g., COMP SCI 577) or applied math analysis (e.g., MATH 321) and theory of probability (e.g., MATH/STAT 431).

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No

**Last Taught:** Spring 2009

COMP SCI 812 — ARITHMETIC ALGORITHMS
3 credits.

Survey of algorithms and design paradigms for exact arithmetic, as used in public-key cryptography, computer algebra, and pseudo-random number generation. Topics include primality testing, factorization of integers and polynomials, discrete logarithms, and (optionally) elliptic curves and integer lattices. Students are strongly encouraged to have knowledge of basic abstract algebra (e.g., MATH 541), and intermediate programming ability (e.g., COMP SCI 367 or COMP SCI 300).

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No

**Last Taught:** Spring 2017

COMP SCI/MATH 837 — TOPICS IN NUMERICAL ANALYSIS
3 credits.

Advanced topics in numerical analysis relevant to current research at UW. Each offering of the course will cover a topic selected by the instructor. Topics vary and may include fluid dynamics, computational methods, mathematical biology and others.

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Fall 2011

COMP SCI 838 — TOPICS IN COMPUTING
1-3 credits.

Advanced topics of special interest to students in various areas of Computer Science. Each offering of the course will cover a topic selected by the instructor. Credit varies by offering — check with the department to determine how an offering counts toward degree requirements.

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2018

COMP SCI 839 — CORE TOPICS IN COMPUTING
3 credits.

Topics selected from advanced areas.

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2018

COMP SCI/B M I/PSYCH 841 — COMPUTATIONAL COGNITIVE SCIENCE
3 credits.

Studies the biological and computational basis of intelligence, by combining methods from cognitive science, artificial intelligence, machine learning, computational biology, and cognitive neuroscience. Requires ability to program.

**Requisites:** Graduate or professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No

**Last Taught:** Fall 2017

COMP SCI/E C E/STAT 861 — THEORETICAL FOUNDATIONS OF MACHINE LEARNING
3 credits.


**Requisites:** COMP SCI/E C E COMP SCI 761 or E C E 830
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
COMP SCI 880 — TOPICS IN THEORETICAL COMPUTER SCIENCE
3 credits.

Advanced topics in algorithms, complexity, and cryptography. The exact topic varies.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2018

COMP SCI 899 — PRE-DISSERTATOR RESEARCH
1-9 credits.

Independent research supervised by a faculty member for students who have completed a master's degree but have not reached dissertator status.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 900 — ADVANCED SEMINAR IN COMPUTER SCIENCE
1 credit.

Seminar on recent research on various aspects of computer science.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI/B M E/B M I/BIOCHEM/CBE/GENETICS 915 — COMPUTATION AND INFORMATICS IN BIOLOGY AND MEDICINE
1 credit.

Participants and outside speakers will discuss current research in computation and informatics in biology and medicine. This seminar is required of all CIBM program trainees.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 990 — DISSERTATION
1-6 credits.

Advanced level mentored reading and research for students with dissertator status.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

COMP SCI 999 — DISSERTATOR RESEARCH
1-6 credits.

Advanced level mentored reading and research for dissertators.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions