

KALAMAZOO COLLEGE
2014-2015 ACADEMIC CATALOG

Computer Science

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The study of computer science enriches a liberal arts education by fostering skills in the organization and representation of ideas, the development and application of practical problem-solving techniques, the modeling of complex systems, and the use of formal languages to express ideas succinctly and unambiguously. Increasingly, computational approaches are the driving force behind progress in a wide range of disciplines, ranging from the arts to engineering and scientific research.

The computer science program at Kalamazoo College is designed to expose students to the central themes of this rapidly evolving discipline, and to generate an understanding of the principle techniques and algorithms necessary to support meaningful applications. Students who graduate from this program are prepared for graduate study or a wide range of computing careers. Students whose major interest lies in another field might consider electing the minor in computer science.

Advanced Placement

A student with a score of 4 or 5 on the computer science A exam will be awarded credit for COMP 110 (Introduction to Programming). Students interested in the major or minor must still take one of the Introduction to the Discipline courses (COMP 105, 107, or 108). Computer Science majors are strongly encouraged to take advantage of advanced placement to take additional courses in the major.

Transfer, Dual Enrollment, Study Abroad Credit

Courses taken at other institutions will be awarded credit in computer science if they meet one of the following criteria: 1) the course is similar in content and rigor to an existing course in the Computer Science department, or 2) the course covers some important topic of computer science not offered at Kalamazoo College.

Students are responsible for meeting with the director of the computer science program in advance to determine whether a course offered elsewhere will transfer back as a computer science credit.

Typically up to two computer science units from outside courses (AP, transfer, dual enrollment, or study abroad) may count towards the major or minor in computer science. Students who wish to apply additional external units toward the major must consult with the department. External credits may also be used to satisfy the mathematics cognates for the major or minor.

Requirements for the Major in Computer Science

Number of Units

Nine units are required, plus the cognate courses in mathematics, all of which must be earned at a grade of C- or above. Under exceptional circumstances, the department may allow a student to count one unit of a computer science SIP toward the major. Taking the comprehensive exam in computer science is required for program assessment purposes, and results are considered in determining honors in the major.

Required Courses

Introduction to the Discipline: COMP 105 Introduction to Computer Science (recommended), or COMP 107 Pictures and Sounds, or COMP 108 Introduction to Scientific Computing
COMP 110 Introduction to Programming
COMP 210 Data Structures
COMP 215 Design and Analysis of Algorithms
COMP 230 Computer Organization

Four additional computer science courses at the 300-level or higher. With departmental permission, students may take MATH 240 (linear algebra) as a fourth mathematics cognate in place of the fourth computer science elective.

Required Cognates

MATH 112 Calculus I
MATH 113 Calculus II
MATH 250 Discrete Mathematics
MATH 240, 330, 362 and 365 are strongly recommended

Students interested in computational science should consider COMP 255, MATH 305, COMP 415, and MATH 280. Students who plan graduate work in computer science should take COMP 300, 320, 430, MATH 240, 330, and additional computer science and mathematics courses of interest. All majors should consider some course work in an applications area such as physics or economics.

Requirements for the Minor in Computer Science

Number of Units

Six units are required, plus the cognate courses in mathematics, all of which must be earned at a grade of C- or above.

Required Courses

Introduction to the Discipline: COMP 105 Introduction to Computer Science (recommended), or COMP 107 Pictures and Sounds, or COMP 108 Introduction to Scientific Computing
COMP 110 Introduction to Programming
COMP 210 Data Structures
COMP 230 Computer Organization or COMP 215 Design and Analysis of Algorithms

Two additional computer science courses at the 200-level or higher.

Required Cognates

MATH 112 Calculus I
MATH 250 Discrete Mathematics

Recommended courses for those students desiring additional work are COMP 300, 320, 430, and MATH 240. Statistics courses such as MATH 260-360 or MATH 362-365 are also suggested. Interested students should consult with a member of the computer science faculty to plan a suitable program of study.

Computer Science courses

COMP 105 Introduction to Computer Science with Lab

Computers have had an impact on almost every aspect of modern life. Why is this? What has been their impact on other disciplines and on the society in which we live? What do we need to know about computing so that we control the technology rather than being controlled by it? This course will address these and other questions while giving hands-on practice in a particular context, such as creating animations or web applications. Topics include fundamental computer programming concepts and constructs, how computers represent information, limits to what is computable, human-machine interaction, and ethical and social issues raised by the widespread use of computers.

COMP 107 Pictures and Sounds: Programming with Multimedia with Lab

This course provides an introduction to multimedia programming: developing programs that create and manipulate text, pictures, sound, and movies. Topics include creating negative and gray-scale images, reversing and splicing sounds, creating sound visualizations, and creating animations. Students will learn some of the concepts and techniques underlying software applications like Photoshop or SoundEdit as well as fundamental concepts underlying all of computing, such as algorithms, abstractions, and how computers represent numbers, text, images, and sound. Hands-on programming is a central component of the course, embodied in weekly labs and frequent programming assignments. No previous programming experience is required.

COMP 108 Introduction to Scientific Computing

The purpose of this course is to give students an introduction to the field of computer science with an emphasis on scientific modeling and data analysis. The course will provide an introduction to computer programming in both Matlab and C/C++. We will discuss fundamental computer science topics including the limits of computation and algorithm analysis. We will also cover a selection of topics relevant to scientific research, including data visualization, representation of numbers, and random number generation. This course requires no previous programming experience. There is no formal math prerequisite, but students should be comfortable with basic mathematical notation.

COMP 110 Introduction to Programming w/Lab

An introduction to programming and design concepts using a modern object-oriented programming language. Topics include the basic features of the language, modular programming techniques, and appropriate design methods. Students will have ample opportunity to revise existing programs and develop new software. Some previous exposure to programming or strong math skills are recommended; see a faculty member if you have questions about taking this course.

Prerequisite: COMP 105, 107, or 108, or 1 200-level Math course, or 1 200-level Physics course, or instructor permission All course prerequisites must be met with a minimum grade of C-.

COMP 210 Data Structures

Provides students an opportunity to refine programming and design skills. Emphasis is on techniques of data abstraction, including encapsulation and inheritance; implementation and appropriate use of common data structures (such as lists, stacks, queues, trees, and graphs); recursion; and the close relationship between data structures and algorithms. Students considering a major or minor in computer science should take the required introduction to the discipline course (COMP 105, 107, or 108) before taking this course.

Prerequisite: COMP-110 All course prerequisites must be met with a minimum grade of C-.

COMP 215 Design and Analysis of Algorithms

Introduction to a variety of algorithms and algorithm design techniques that recur in computer science literature and applications. These include common sorting and searching algorithms, divide-and-conquer and dynamic programming algorithms, and algorithms in the areas of string processing, geometry, and graph theory. This course also provides an introduction to the mathematical analysis of the complexity and performance of algorithms.

Prerequisite: COMP-210 and MATH-250 All course prerequisites must be met with a minimum grade of C-.

COMP 230 Computer Organization

Introduction to computer organization; gates, truth tables, and logic design; number representation and arithmetic; assembly-language programming and the assembly process; and current techniques for improving computer performance.

Prerequisite: COMP-210 All course prerequisites must be met with a minimum grade of C-.

COMP 230I IS: Computer Organization

Independent Study of COMP-230 course

COMP/PHYS 255 Computer Programming and Simulation

Computer modeling of physical phenomena. Programming skills will be developed in the context of doing physics. Topics include numerical integration of Newton's equations, cellular automata, and random walks, including Monte Carlo methods.

Prerequisite: PHYS-150 All course prerequisites must be met with a minimum grade of C-.

COMP/PSYC 265 Cognitive Science

Cognitive science is the interdisciplinary study of mind and the nature of intelligence. It is a rapidly evolving field that deals with information processing, intelligent systems, complex cognition, and large-scale computation. The scientific discipline lies in the overlapping areas of neuroscience, psychology, computer science, linguistics and philosophy. Students will learn the basic physiological and psychological mechanisms and computational algorithms underlying different cognitive phenomena. This course is designed mostly for psychology and computer science students, but other students interested in interdisciplinary thinking might take the course.

Prerequisite: PSYC-101 or COMP-105 All course prerequisites must be met with a minimum grade of C-.

COMP/MATH 300 Automata, Formal Languages, and Computability

Study of automata as mathematical models of computation; of formal languages, which play a central role in the specification and translation of programming languages; and of the fundamental capabilities and limitations of computers.

Prerequisite: MATH-250 or MATH-330, and 1 COMP course. All course prerequisites must be met with a minimum grade of C-.

COMP 320 Principles of Programming Languages

Study of programming language concepts and comparative evaluation of several programming languages. Typical topics include imperative, functional, and object-oriented programming paradigms, programming language syntax, type theory, static and dynamic binding of variables, and scope rules.

Prerequisite: COMP-210 All course prerequisites must be met with a minimum grade of C-.

COMP/PSYC 415 Computational Neuroscience

Study of mathematical models, computational algorithms, and simulation methods that contribute to our understanding of neural mechanisms. Brief introduction to neurobiological concepts and mathematical techniques. Both normal and pathological behaviors will be analyzed by using neural models.

Prerequisite: PSYC-101 and MATH-113 All course prerequisites must be met with a minimum grade of C-.

COMP 430 Operating Systems and Networking

Study of operating system concepts such as processes and threads, CPU, memory, and I/O management; concurrency control; network protocols, structure, and administration; and distributed computing.

Prerequisite: COMP-230 All course prerequisites must be met with a minimum grade of C-.

COMP 481 Topics: Comp Networking & Internet

Open standards for communications between computers (and similar devices) are defined by the Open Systems Interconnection (OSI) model. The seven layer OSI model will be used as a structure to explore the hardware and software most commonly used to interconnect devices to form computer networks. The INTERNET will be used as an example of how these concepts are used to create real world networks using TCP/IP. Many of the most important high-level protocols that comprise the current INTERNET will be explored to aid in understanding why

the INTERNET works and what can be done to protect the INTERNET from some common attacks.

COMP 482 Special Topics: Software Engineering

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: COMP-210 All course prerequisites must be met with a minimum grade of C-.

COMP 483 Special Topics: Cryptography

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: COMP-110 and MATH-250 or MATH-316 or MATH-330 All course prerequisites must be met with a minimum grade of C-.

COMP 485/MATH 450 Special Topics: Numerical Methods

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: Vary with topic

COMP 486 Special Topics: Machine Learning

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: COMP-110 All course prerequisites must be met with a minimum grade of C-.

COMP 487/COMP 490 Special Topics: Software Development

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: Usually COMP-210, although specific prerequisites depend on the topic. All course prerequisites must be met with a minimum grade of C-.

COMP 489/COMP 490 Special Topics: Mobile Computing

Special Topics offerings focus upon topics not addressed in the department's regular offerings. Check the course schedule to see when Special Topics courses are being offered.

Prerequisite: COMP-210 All course prerequisites must be met with a minimum grade of C-.

COMP 490/COMP 487 CS Senior Seminar: Collaborative Software Development

This course is a combination of advanced seminar and software development work environment, in which teams of students develop software products in support of a community, whether that is the college community, an organization in the larger, local community, or the online open-source community. In addition to collaborating on a specific project, students present material on a wide range of software development topics, including software engineering, professional ethics, web-based development, open source, and current trends in languages, tools, and methodologies.

Prerequisite: COMP-210 and Seniors Only

COMP 490/COMP 489 CS Senior Seminar: Mobile Computing

This course is a combination of advanced seminar and software development work environment, in which teams of students develop software products in support of a community, whether that is the college community, an organization in the larger, local community, or the online open-source community. In addition to collaborating on a specific project, students present material on a wide range of software development topics, including software engineering, professional ethics, web-based development, open source, and current trends in languages, tools, and methodologies.

Prerequisite: CS Senior major or minor or permission

COMP 593 Senior Individualized Project

Each program or department sets its own requirements for Senior Individualized Projects done in that department, including the range of acceptable projects, the required background of students doing projects, the format of the SIP, and the expected scope and depth of projects. See the Kalamazoo Curriculum -> Curriculum Details and Policies section of the Academic Catalog for more details.

Prerequisite: Permission of department and SIP supervisor required.

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