

COMPUTER SCIENCE

Computing technology has become an essential part of nearly every profession even as new research in computer science continues to reinvent how we communicate and work. The Computer Science majors (<https://www.bethel.edu/undergrad/academics/math-cs/>) at Bethel prepare students for leadership roles in this ever-changing academic discipline as they learn current programming languages, network technology, databases, software engineering techniques, hardware, operating systems, and security. Electives are also offered in graphics, compilers, artificial intelligence, and high-performance computing. Students can gain work experience through employment in Bethel's computing support services and can earn course credit through internships at local companies. Bethel conforms to the Association for Computing Machinery (ACM) model for a liberal arts university computing degree with coursework in computing ethics and a balance of practical and theoretical study in computer science.

Advanced Placement: The Computer Science Department (<https://www.bethel.edu/undergrad/academics/math-cs/>) requires a score of 3 or better on the AP exam in order for the exam to be used to fulfill course requirements in the majors and minors it offers. Students should consult the department chair with questions on AP exams and requirements for majors.

Majors in Computer Science

- B.A. in Computer Science (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/computer-science/computer-science-ba/>)
- B.A. in Computer Science with Software Project Management (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/computer-science/computer-science-ba-software-project-management/>)
- B.S. in Actuarial Science and Finance (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/actuarial-science-and-finance/>)
- B.S. in Computer Engineering (http://catalog.bethel.edu/arts-sciences/academic-programs-departments/engineering/computer_engineering-bs/)
- B.S. in Computer Science (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/computer-science/computer-science-bs/>)
- B.S. in Software Engineering (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/computer-science/software-engineering/>)

Minor in Computer Science

- Computer Science (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/computer-science/computer-science-minor/>)

COS 100 • Introduction to Programming 3 Credits

An introduction to programming using a current procedural (imperative) programming language. Standard data types and control structures are introduced.

Offered: Fall, January.

COS 105 • Object-oriented Design and Programming 4 Credits

Introduction to object-oriented design methodologies and programming, fundamental search and sort algorithms, and recursion. Strong emphasis on theory. Extensive programming assignments in a current object-oriented computer language.

Prerequisites: COS 100, COS 205, or equivalent proficiency; Mathematics (M-tag) course (may be taken concurrently). Offered: Spring.

Computer Science 2

COS 205 • Scientific Computing 3 Credits

An introduction to programming using both a procedural (C language) and object-oriented (C++) programming language. Basic data types and control structures are introduced and the fundamentals of OOP (encapsulation, inheritance, and polymorphism) are covered. Issues relevant to scientific computing are considered including performance, numerical representation, and machine error.

Prerequisites: MAT 124M with C- or higher (can be taken concurrently) or Consent of instructor. Offered: Fall, Spring.

COS 212 • Data Structures 4 Credits

Elementary data structures such as arrays, linked lists, stacks, queues, heaps, hash tables, and trees. Extensive programming assignments in a current computer language.

Prerequisites: COS 105 with C- or higher or COS 205 with an A- or higher. Offered: Fall, Spring.

COS 216 • Algorithms and Advanced Data Structures 3 Credits

Fundamental algorithms, algorithm analysis, and advanced data structures.

Prerequisites: COS 212 with C- or higher and MAT 241 with C- or higher. Offered: Fall, Spring.

COS 235 • Computer Systems 4 Credits

Assembly and machine language to study computer organization and structure, including addressing techniques, digital logic and representation of numbers and arithmetic, structure of operating systems, memory management, process management, resource allocation, and operating system monitors. Also includes an introduction to C.

Prerequisites: COS 212 with C- or higher. Offered: Spring.

COS 313 • Database Systems 3 Credits

Relational and object-oriented databases, schemas, and normalization. Database management systems, SQL, concurrent transactions, logging/disaster recovery, and query optimization. Application program interaction with database management systems.

Prerequisites: COS 216 with C- or higher. Offered: Fall, even # years.

COS 318 • Web Programming 3 Credits

An examination of the foundational technologies used for creating web applications. Includes client and server programming, as well as fundamentals of cloud services, including security, storage, and reliability.

Prerequisites: COS 216 with a C- or higher. Special Notes: Some knowledge of HTML and the basics of JavaScript are expected. Offered: Fall.

COS 320 • Computer Graphics Programming 3 Credits

Introduces the drawing methods, geometrical transforms, and illumination models that are fundamental to computer graphics programming. Modeling of 2D and 3D objects, local and global illumination simulation, shading, color models, procedural modeling, and discrete (fragment) techniques, including texture mapping. A current graphics API is used, including custom shaders.

Prerequisites: COS 216 with C- or higher. Offered: Fall, odd # years.

COS 334 • Data Mining and Machine Learning 3 Credits

An introduction to widely-used techniques for extracting information from large data sets such as medical databases, credit reports, weather history, and the stock market. Includes algorithms for nominal and ordinal data and metrics to measure their performance. Students implement common algorithms with real data and choose appropriate algorithms for different applications.

Prerequisites: COS 216 with C- or higher. Offered: Spring, even # years.

COS 335 • Computer Security 3 Credits

An introduction to the concepts of security as applied to areas such as programming, databases, networks, systems, and applications. General concepts and specific instances of security-related threats are presented. Security risks are discussed in the context of several computer operating system and architecture components.

Prerequisites: COS 235 with C- or higher (COS 386 is a recommended prerequisite). Offered: Spring, odd # years.

COS 341 • Computability and Complexity 3 Credits

Investigate two big questions: How efficiently can computers solve problems? Are there problems that cannot be solved by computers at all? Computability theory: formal models of computation, Turing machines, universality, reductions, nondeterminism, and the Church–Turing thesis. Complexity theory: polynomial-time mapping reductions, NP-completeness, and the famous "P versus NP" problem.

Prerequisites: COS 100 with C- or higher or equivalent and MAT 241 with C- or higher. *Offered:* Fall, even # years.

COS 351 • High-Performance Computing 3 Credits

Fundamental concepts and techniques for parallel computation in C/C++ (load balancing, communication, synchronization, serial program decomposition) using an industry-standard parallel computing library.

Prerequisites: COS 205 with C- or higher or COS 235 with C- or higher. *Offered:* Fall, odd # years, January, odd # years.

COS 371 • Organization of Programming Languages 3 Credits

Formal programming language specification using various grammars and the Backus-Naur Form. Data types and structures, control structures, and data flow of several programming languages, including interpreters and compilers. Introduction to parsing and lexical analysis.

Prerequisites: COS 216 with C- or higher. *Offered:* Spring, even # years.

COS 386 • Data Communications and Computer Networks 3 Credits

Data communications including interprocess communication, computer networking, and associated software protocols. Topics include network topologies, point-to-point network protocols, local area networks, and interconnection of networks.

Prerequisites: COS 235 with C- or higher. *Offered:* Fall, even # years.

COS 389 • Artificial Intelligence 3 Credits

Basic concepts and techniques of artificial intelligence, including representation, notational structures, searches, control structures, and logic programming languages. Samples of current work in several application areas including natural language systems, expert systems, and neural networks.

Prerequisites: COS 216 with C- or higher. *Offered:* Spring, odd # years.

COS 420 • Software Process 3 Credits

Balancing the various real-world challenges that a software engineer encounters, including ambiguity, conflicting requirements, task-time estimation, team dynamics, requests from customers, product managers or architects. A team-based software project on a modern computer science topic is developed during the semester.

Prerequisites: COS 216 with C- or higher. *Special Notes:* Carries cross credit in engineering. COS 477 is a recommended prerequisite. *Offered:* Spring, odd # years.

COS 450 • Humans and Computers 3 Credits

Examines the ways that humans and computers interact. Issues in user experience and human-machine interaction are explored. Christian and professional ethics in the development and application of computing technology are extensively examined.

Prerequisites: COS 216 with C- or higher. *Offered:* January, even # years.

COS 477 • Software Engineering 3 Credits

Formal approach to the design and development of software. Multiple process models discussed and compared. Other topics include design patterns, project management and estimation, team management, formal methods, documentation, system and data description, verification and validation, and process improvement.

Prerequisites: COS 216 with C- or higher. *Special Notes:* Carries cross credit in engineering. *Offered:* Spring, even # years.

COS 490 • Topics in Computer Science 3 Credits

An in-depth survey of a recent trend or field in the rapidly changing discipline of computer science. Students work on a significant project and explore the future implications of the current topic.

Prerequisites: COS 216 with C- or higher. *Offered:* Occasionally.