

# Computer Science (CS)

## College of Engineering and Mines

Department of Computer Science (<https://www.cs.uaf.edu/>)  
907-474-2777

### CS F103 Introduction to Computer Programming

3 Credits

Offered Fall and Spring

Computer programming for students without the background for CS F201. Concepts of object-oriented programming and algorithm design using the Python programming language.

**Prerequisites:** Math placement at the 100-level.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F180 Introduction to Programming and Algorithmic Thinking

1 Credit

Offered As Demand Warrants

Introduction to fundamental concepts across different programming languages including: variables, looping, conditional statements, flow, maintainable code, searching and sorting algorithms. This course is designed as an advance layer over the materials and activities associated with the T3 Alliance grant funded program (T3.alliance.org).

**Lecture + Lab + Other:** 1 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F201 Computer Science I

3 Credits

Offered Fall and Spring

The discipline of computer science including problem solving, algorithm development, good programming style, control flow, I/O and elementary data structures. Concepts implemented with extensive programming experience in C++, and a group programming project.

**Prerequisites:** Mathematics placement at the F100-level.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F202 Computer Science II

3 Credits

Offered Fall and Spring

The discipline of computer science including classes, object-oriented programming, operators, RAI, inheritance, exceptions and generic programming with templates. Concepts implemented with extensive programming experience in C++ and a group programming project.

**Prerequisites:** CS F201.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F241 Computer Hardware Concepts

4 Credits

Offered Spring

A programmer-centric approach to electrical circuits and microcontroller interfacing, with applications to smart devices and robotics. Covers bit-level arithmetic and logic, microcontrollers, battery-powered systems, sensor and actuator interfacing, and interdevice communication. These technologies form the foundation for smart vehicles, devices and buildings.

**Prerequisites:** CS F201, ES F201.

**Corequisites:** CS F241L.

**Lecture + Lab + Other:** 3 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F241L Computer Hardware Concepts Lab

0 Credit

Offered Spring

Laboratory section for CS F241 Computer Hardware Concepts. Activities may include simulated and physical electronic circuits, microcontroller programming, digital and analog circuits.

**Corequisites:** CS F241.

**Lecture + Lab + Other:** 0 + 0 + 0

**Grading System:** Non-Graded

### CS F254 Unmanned Aircraft Systems (UAS) Design

3 Credits

Offered As Demand Warrants

A multidisciplinary team of students will design, build, test and deliver an unmanned aircraft system (UAS) in support of university research mission requirements. Students will learn basic concepts related to the systems engineering design process. Graded events include team briefings, written reports, multimedia products and a finished UAS product.

**Prerequisites:** AERO F254; ME F254.

**Cross-listed with** AERO F256, ME F256.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F258 Unmanned Aircraft Systems (UAS) Operations

3 Credits

Offered As Demand Warrants

Covers the use of unmanned aircraft systems (UAS), sensors, and support infrastructure required to conduct a selected mission set. Emphasis is on mission analysis, planning, and conduct, including definition of requirements/constraints, identification of appropriate assets, flight planning considerations, and data analysis requirements. Teams coordinate resources for mission and report results.

**Cross-listed with** AERO F258; GEOS F258; and ME F258.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F301 Assembly Language Programming

3 Credits

Offered Fall

The low level structure of a modern computer: hardware instruction set architecture, registers, the call stack, pointers, the heap and threads.

Applications include performance and security.

**Prerequisites:** CS F202; CS F241, CSCE A241 or EE F243 (may be taken concurrently).

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

### CS F311 Data Structures and Algorithms

3 Credits

Offered Fall

Data structures and the algorithms for their manipulation. Algorithmic efficiency and asymptotic notation. Algorithms for searching and sorting. Abstract data types and container data structures: arrays, linked lists, stacks, queues, trees, tables, heaps, balanced search trees, hash tables.

**Prerequisites:** CS F202.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F321 Operating Systems**

3 Credits

Offered Spring

The software stack in a modern computer: thread, process, container, kernel, hypervisor and network. Enforcing access control and securing communication between these layers, and designing services to use them effectively.

**Prerequisites:** CS F301.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F331 Programming Languages**

3 Credits

Offered Spring

Syntax and semantics of widely differing programming languages. Syntax specification, lexical analysis, parsing and interpretation. Comparison of diverse languages such as Python, Haskell, Forth and Prolog.

**Prerequisites:** CS F311.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F371 Computer Ethics and Technical Communication**

3 Credits

Offered Fall

This course explores the social, legal and ethical issues aggravated, transformed or created by computer technology. Additional focus is on technical communication skills needed in the computer industry.

**Prerequisites:** COM F121X, COM F131X or COM F141X; CS F202; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F372 Software Construction**

3 Credits

Offered Spring

Methods for programming and construction of complete computer applications, including refractoring, performance measurement, process documentation, unit testing, version control, integrated development environments, debugging and debuggers, interpreting requirements, and design patterns.

**Prerequisites:** CS F311.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F392 Seminar**

1-6 Credits

**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**Repeatable for Credit:** May be taken unlimited times for up to 6 credits**CS F404 Data Science**

3 Credits

Offered As Demand Warrants

Range of topics of data science placing it in the larger context of computer science and software development targeting multidisciplinary students. Through hands-on experience with computer programming and cutting-edge libraries, learn fundamental analytic concepts of statistics and machine learning and apply them through a real-world group project.

**Prerequisites:** CS F103; junior standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F405 Introduction to Artificial Intelligence**

3 Credits

Offered Spring

Examine diverse branches of AI placing AI in the context of computer science. Knowledge representation formalism and search technology. Programming methodologies; procedural systems such as expert systems and blackboard systems and non-procedural systems such as neural networks.

**Prerequisites:** CS F311.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F406 Data Engineering**

3 Credits

Offered As Demand Warrants

Presents techniques for designing, building and managing information at scale with big data cyber-infrastructure, and distributed programming concepts. Provides hands-on experiences in High-Performance Computing, Cloud, virtualization/containerization techniques, archiving big data using NoSQL database, processing big data utilizing open source middleware and creating CI/CD pipelines.

**Prerequisites:** CS F103; junior standing.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F411 Analysis of Algorithms**

3 Credits

Offered Fall

Analysis of classic algorithms, their implementation and efficiency. Topics from combinatorics (sets, graphs), algebra (integer arithmetic, primes, polynomial arithmetic, GCD, Diophantine equations, encryption), systems (parsing searching, sorting) and theory (recursion, Turing machines). The complexity classes P, NP and NP complete.

**Prerequisites:** MATH F307, CS F311.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F425 Database Systems**

3 Credits

Offered Fall

Data independence, modeling, relationships and organization. Hierarchical, network and relational data models; canonical schema. Data description languages, SQL, query facilities, functional dependencies, normalization, data integrity and reliability. Review of current database software packages.

**Prerequisites:** CS F311; CS F321.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F441 System Architecture**

3 Credits

Offered Spring

Computer design fundamentals, performance and cost, pipelining, instruction-level parallelism, memory hierarchy design, storage systems, and parallel processing.

**Prerequisites:** CS F321; CS F241 or EE F243.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus

**CS F453 Robotics & 3D Printing**

3 Credits

Offered As Demand Warrants

Covers self-driving cars, 3D printers, and computer-controlled machine tools as modern applications of a common software core of path planning and motion control. Includes mathematical background in 3D computational geometry, hands-on applications such as designing and fabricating resilient robot parts, and online algorithms for robot driving.

**Prerequisites:** MATH F253X; CS F311 or equivalent experience programming complex applications in a modern language like C++ or Python.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F454 Systems Design Seminar**

1 Credit

Offered As Demand Warrants

The interdisciplinary design of autonomous robots and other advanced systems using a rigorous systems engineering approach. Systems will be taken from concept studies to a preliminary design through the fabrication, assembly and testing phases. Uses computer science tools such as integrated 3D simulations and parametric computer-aided design (CAD).

**Prerequisites:** CS F201 or ES F201.

**Cross-listed with** AERO F455.

**Special Notes:** Each semester will be at a different phase of a different design, so this course may be repeated multiple times for credit.

**Lecture + Lab + Other:** 1 + 0 + 0

**Grading System:** Pass/Fail Grades

**Repeatable for Credit:** May be taken 6 times for up to 6 credits

**CS F463 Cryptography and Data Security**

3 Credits

Offered As Demand Warrants

Specialized study of cryptography and its application in securing data systems, with an emphasis on applied cryptography. Topics include history of cryptography, encryption, digital signatures, authentication, electronic commerce, key distribution and management, private and public key cryptography, and protocols.

**Prerequisites:** MATH F307; CS F311.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F465 Computer and Network Security**

3 Credits

Offered As Demand Warrants

Analyzes computer software, hardware and network vulnerabilities. Mechanisms to detect and defend against attacks, including authentication, access control and cryptography. Includes code vulnerabilities like buffer overflow, web issues like command injection, network protocol design and storage security. Legal and ethical issues concerning privacy, intellectual property and computer crime.

**Prerequisites:** CS F202, CS F301(may be taken concurrently).

**Stacked with** CS F665.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F471 Senior Capstone I**

3 Credits

Offered Fall

Introduction to software engineering and project management principles, techniques, methods and standards for software system development. Additional topics include technical communication, computer ethics and legal issues.

**Prerequisites:** CS major; senior standing; CS F311; CS F371.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F472 Senior Capstone II**

3 Credits

Offered Spring

Group projects in a real computer industry environment and produce appropriate documentation and reports. Nature, ethics and legal considerations of the computer science profession are discussed with an emphasis on ethics. Additional topics include project management, design methodologies, technical presentation, human-machine interface and programming team interactions.

**Prerequisites:** CS F372; CS F471.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F480 Topics in Computer Science**

3 Credits

Offered As Demand Warrants

Topics include, but are not limited to; computational linear algebra, cryptography, parallel algorithm development and analysis.

**Special Notes:** Course may be repeated when topics change.

**Lecture + Lab + Other:** 0 + 3 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**Repeatable for Credit:** May be taken 15 times for up to 45 credits

**CS F484 Computer Graphics Fundamentals**

3 Credits

Offered Fall

Creation of computer-generated images using 3D graphics hardware. Mathematics and data structures in 3D graphics. Sprites, Tiles, Typography, and Vector Graphics in 2D graphics. Color, lighting, textures, hidden surface removal. Loading and saving scene graphs; Using physically based and nonphotorealistic shading. Software design principles to create interactive applications.

**Prerequisites:** CS F202; MATH F253X.

**Stacked with** CS F684.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F485 Computer Graphics Rendering**

3 Credits

Offered As Demand Warrants

Designing graphics engines for realtime rendering of computer generated imagery; physically based approaches to shading and shadows; artistic approaches to shading and nonphotorealistic rendering; algorithms for rendering an image including ray tracing, deferred rendering, and global illumination; image space algorithms for simulation of camera effects.

**Prerequisites:** CS F202; MATH F253X.

**Stacked with** CS F685.

**Lecture + Lab + Other:** 3 + 0 + 0

**Grading System:** Letter Grades with option of Plus/Minus

**CS F486 Computer Graphics Animation and Simulation**

3 Credits

Offered As Demand Warrants

Creation of computer graphics animation and simulation of physically based phenomena; designing simulation systems for computer graphics applications; physically based phenomena using particle systems, fluid simulation, and rigid body dynamics; key frame animation, bones, and rigging; and other related topics.

**Prerequisites:** CS F202; MATH F253X; PHYS F212X.**Stacked with** CS F686.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F600 Professional Software Development**

4 Credits

Offered Fall

Participate in a group project to explore the technical, social and ethical aspects of software development. Topics include: requirements engineering, enterprise-level data storage, software architecture, security, software testing, legal issues, computer ethics, risk management and project management.

**Prerequisites:** CS F472.**Lecture + Lab + Other:** 4 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F601 Algorithms, Architecture and Languages**

4 Credits

Offered Spring

Current research on, and cross-cutting interrelationships between computer algorithms, machine architecture and languages. Covers asymptotic performance analysis including NP-completeness, modern parallel hardware including multicore, and grammars and parsing from regular expressions to BNF.

**Prerequisites:** CS F331; CS F411; CS F441 or EE F443.**Lecture + Lab + Other:** 4 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F605 Artificial Intelligence**

3 Credits

Offered Spring

Study and writing of AI programs: expert systems, expert system shells, blackboard systems, neural networks. Representation of knowledge, pattern analysis, inference networks, neural network training. Study of software engineering aspects of AI software.

**Prerequisites:** Graduate standing or permission of CS graduate advisor.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F658 Unmanned Aircraft Systems (UAS) Operations**

3 Credits

Offered Spring

Covers application of unmanned aircraft systems (UAS) to satisfy scientific research or public service missions. Students analyze mission requirements and recommend appropriate UAS vehicles, subsystems, sensors and data analysis tools to accomplish a specified mission. Students design mission profiles, conduct representative missions, produce required data products and present mission results.

**Prerequisites:** Graduate standing.**Cross-listed with** AERO F658; EE F658.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F660 Rocket Systems Design**

3 Credits

Offered As Demand Warrants

A multidisciplinary team of students will perform the design, construction and flights of a simple rocket system. Design considerations will include requirements for project management, rocket vehicle design, performance, thrust, stability, recovery system, telemetry and payload data.

**Prerequisites:** Graduate standing in engineering or physics.**Cross-listed with** AERO F660; EE F660; ME F660.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F665 Computer and Network Security**

3 Credits

Offered As Demand Warrants

Analyzes computer software, hardware and network vulnerabilities.

Mechanisms to detect and defend against attacks, including authentication, access control and cryptography. Includes code vulnerabilities like buffer overflow, web issues like command injection, network protocol design and storage security. Legal and ethical issues concerning privacy, intellectual property and computer crime.

**Stacked with** CS F465.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F680 Topics in Computer Science**

1-4 Credits

Offered As Demand Warrants

Example topics include, but are not limited to, software requirements engineering, cryptography, parallel algorithm development and analysis. May be repeated for credit with change of topic.

**Prerequisites:** Varies with each topic.**Recommended:** Varies with each topic.**Lecture + Lab + Other:** 1-4 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**Repeatable for Credit:** May be taken 15 times for up to 45 credits**CS F681 Topics in Computer Graphics**

3 Credits

Offered Fall

Hardware, software and techniques used in computer graphics taken from topics such as refresh, storage, raster scan technology, volume rendering, particle systems, shading, image processing, computer aided design, video effects, animation and virtual environments.

**Prerequisites:** CS F202 and MATH F253X.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**Repeatable for Credit:** May be taken 3 times for up to 12 credits**CS F684 Computer Graphics Fundamentals**

3 Credits

Offered Fall

Creation of computer-generated images using 3D graphics hardware. Mathematics and data structures in 3D graphics. Sprites, Tiles, Typography, and Vector Graphics in 2D graphics. Color, lighting, textures, hidden surface removal. Loading and saving scene graphs; Using physically based and nonphotorealistic shading. Software design principles to create interactive applications.

**Prerequisites:** CS F202; MATH F253X.**Stacked with** CS F484.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus

**CS F685 Computer Graphics Rendering**

3 Credits

Offered As Demand Warrants

Designing graphics engines for realtime rendering of computer generated imagery; physically based approaches to shading and shadows; artistic approaches to shading and nonphotorealistic rendering; algorithms for rendering an image including ray tracing, deferred rendering, and global illumination; image space algorithms for simulation of camera effects.

**Prerequisites:** CS F202; MATH F253X.**Stacked with** CS F485.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F686 Computer Graphics Animation and Simulation**

3 Credits

Offered As Demand Warrants

Creation of computer graphics animation and simulation of physically based phenomena; designing simulation systems for computer graphics applications; physically based phenomena using particle systems, fluid simulation, and rigid body dynamics; key frame animation, bones, and rigging; and other related topics.

**Prerequisites:** CS F202 and PHYS F212X.**Stacked with** CS F486.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**CS F690 Graduate Seminar and Project**

3 Credits

Offered Fall

First semester of two-semester seminar in which students will work on and present the results of major programming or literature survey projects in computer science. Written and oral reports will be required.

**Prerequisites:** 12 credits in graduate computer science courses; or permission of Computer Science graduate advisor.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Pass/Fail Grades**CS F691 Graduate Seminar and Project**

3 Credits

Offered Spring

Second semester of a two-semester seminar in which students will work on and present the results of major programming or literature survey projects in computer science. Written and oral reports will be required.

**Prerequisites:** CS F690; 12 credits in graduate computer science courses; or permission of Computer Science advisor.**Lecture + Lab + Other:** 3 + 0 + 0**Grading System:** Pass/Fail Grades**CS F692 Seminar**

1-6 Credits

**Lecture + Lab + Other:** 1-6 + 0 + 0**Grading System:** Letter Grades with option of Plus/Minus**Repeatable for Credit:** May be taken unlimited times for up to 6 credits**CS F698 Non-thesis Research/Project**

1-9 Credits

**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Pass/Fail Grades**Repeatable for Credit:** May be taken unlimited times for up to 99 credits**CS F699 Thesis**

1-9 Credits

**Lecture + Lab + Other:** 0 + 0 + 0**Grading System:** Pass/Fail Grades**Repeatable for Credit:** May be taken unlimited times for up to 99 credits