**COMPUTER SCIENCE (CS)**

**CS F101**  Computers and Society  (m)  3 Credits  
Computer literacy for everyone. Overview of computing machines and automatic data processing. Interaction between social institutions and automated decision-making. Introduction to business applications software and electronic mail. Some programming for understanding, not for skill development.  
Prerequisites: Two years of high school mathematics, including at least one year of algebra.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F103**  Introduction to Computer Programming  3 Credits  
Programming for non-majors and for those computer science students without the background for CS F201. Concepts of object-oriented programming and algorithm design within the context of the JAVA programming language.  
Prerequisites: Math placement at the 100-level.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F201**  Computer Science I  3 Credits  
The discipline of computer science including problem solving, algorithm development, structured programming, top-down design, good programming style, object-oriented programming and elementary data structures. Concepts implemented with extensive programming experience in a structured language and with a group programming project.  
Prerequisites: One year high school level programming or CS F103; mathematics placement at the F200-level.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F202**  Computer Science II  3 Credits  
The discipline of computer science including problem solving, algorithm development, structured programming, top-down design, good programming style, object-oriented programming and elementary data structures. Concepts implemented with extensive programming experience in a structured language and with a group programming project.  
Prerequisites: CS F201.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F301**  Assembly Language Programming  3 Credits  
Offered Fall  
Organization of computer registers, I/O and control. Digital representation of data. Symbolic coding, instructions, addressing modes, program segmentation, linkage, macros and subroutines.  
Prerequisites: CS F201.  
Lecture + Lab + Other: 3 + 0 + 0  

**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  

**CS F321**  Operating Systems  3 Credits  
Offered Spring  
Functions of files and operating systems. Review of required architectural features. The PROCESS concept. Storage management, access methods and control, interrupt processing, scheduling algorithms, file organization and management, and resource accounting.  
Prerequisites: CS F301.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F331**  Programming Languages  3 Credits  
Offered Spring  
Syntax and semantics of widely differing programming languages. Syntax specification, block structure, binding, data structures, operators and control structures. Comparison of several languages such as ALGOL, LISP, SNOBOL and APL.  
Prerequisites: CS F311.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F361**  Systems Security and Administration  3 Credits  
Offered Alternate Fall Odd-numbered Years  
Advanced systems programming including privileged instructions and system services, authentication technologies, host-based and network-based security issues. Applications to asynchronous I/O, process control and communication, device drivers and file management.  
Prerequisites: CS F301.  
Lecture + Lab + Other: 3 + 0 + 0  

**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: WRTG F211X or WRTG F213X; COJO F131X or COJO F141X; CS F202.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F372**  Software Construction  3 Credits  
Offered Spring  
Methods for programming and construction of complete computer applications, including refactoring, 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  

**CS F381**  Computer Graphics  3 Credits  
Offered Fall  
Creation of computer-generated images on programmable 3-D graphics hardware. Color, lighting, textures, hidden surfaces, 3-D geometric transformations, curve and surface representations, 2-D and 3-D user interfaces, and the visual modeling of physical phenomena.  
Prerequisites: CS F202; MATH F253X or MATH F314.  
Lecture + Lab + Other: 3 + 0 + 0  

**CS F392**  Seminar  1-6 Credits  
Lecture + Lab + Other: 0 + 0 + 0
CS F405  Introduction to Artificial Intelligence
3 Credits
Offered Spring Even-numbered Years
Examine diverse branches of AI placing AI in larger context of computer science and software engineering. 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. Software engineering aspects of problem selection, knowledge acquisition, verification and validation. Individual projects.
Prerequisites: CS F311 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

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

CS F421  Distributed Operating Systems  (W)
3 Credits
Offered Fall
Detailed level study of distributed operating system algorithms, functions and associated implementation. Distributed operating system tuning methods and security. Role of distributed operating systems in network-centric computing. Programming, documentation and evaluation of distributed operating system segments as projects.
Prerequisites: CS F321; WRTG F111X; WRTG F211X or WRTG F213X; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CS F425  Database Systems
3 Credits
Offered Spring Odd-numbered Years
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

CS F431  Programming Language Implementation  (W)
3 Credits
Offered As Demand Warrants
Design and implementation of major phases of high level language translators including scanning, parsing, translation, code generation and optimization. Students develop a compiler for a language in a group project which emphasizes good software engineering practices in structured design, testing and documentation.
Prerequisites: CS F331; WRTG F111X; WRTG F211X or WRTG F213X; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CS F441  System Architecture
3 Credits
Offered Spring
Computer design fundamentals, performance and cost, pipelining, instruction-level parallelism, memory hierarchy design, storage systems, and vector processing.
Prerequisites: CS F321; EE F341.
Lecture + Lab + Other: 3 + 0 + 0

CS F442  Computer Communication and Networks
3 Credits
Offered Fall Even-numbered Years
Study of computer networks using the ISO/OSI layered model as a framework. Design issues and trade-offs, protocols and selected standards. Emphasis on ISO/OSI Layers 1-4/(Physical, Data Link, Network and Transport Layers), plus medium access sublayers (LAN's, etc.).
Prerequisites: CS F321.
Lecture + Lab + Other: 3 + 0 + 0

CS F460  Introduction to Digital Forensics
3 Credits
Offered Fall Odd-numbered Years
Takes a hands-on approach to the forensics examination of computer technology. Focuses on the forensic process, methods, and tools utilized to collect and preserve and examine digital evidence. Course topics include: collection, preservation and examination of evidence from computers including file systems, email and malicious code.
Prerequisites: CS F321; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CS F462  Intrusion Detection Systems
3 Credits
Offered Fall Even-numbered Years
Focus on IDS theory and practice and its importance; the origin and resolution of common security threats and vulnerabilities; host and network approaches to IDS implementation; and the legal, ethical, and privacy issues associated with IDS use and policies.
Prerequisites: CS F361; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CS F463  Cryptography and Data Security
3 Credits
Offered Spring Odd-numbered Years
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; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

CS F471  Senior Capstone I  (W)
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
CS F472  Senior Capstone II  (O, W)
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

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. Note: Course may be repeated when topics change.
Lecture + Lab + Other: 0 + 3 + 0

CS F481  Graphics Rendering
3 Credits
Offered Spring Even-numbered Years
High-quality rendering techniques used in computer graphics: raytracing, shadows, antialiasing, volume rendering, radiometry and radiosity. Also topics such as particle systems, shading, image processing, computer-aided design, video effects, animation and virtual environments.
Prerequisites: CS F381.
Lecture + Lab + Other: 3 + 0 + 0

CS F482  Simulations in Computer Graphics
3 Credits
Offered Spring Odd-numbered Years
Software to simulate physical phenomena for use in interactive visualization, such as particle systems, Naiver-Stokes fluid dynamics, and finite element solid mechanics. Includes Lagrangian and Eulerian meshes, stability, and discretization order. Our focus is high performance qualitatively correct simulations, rather than high-precision solutions.
Prerequisites: CS F381 and PHYS F212X.
Lecture + Lab + Other: 3 + 0 + 0

CS F605  Artificial Intelligence
3 Credits
Offered Spring Even-numbered Years
Prerequisites: Graduate standing or permission of CS graduate advisor.
Lecture + Lab + Other: 3 + 0 + 0

CS F611  Complexity of Algorithms
3 Credits
Offered Fall
Theoretical analysis of various algorithms: topics include sorting, searching, selection, polynomial evaluation, NP completeness, decidability.
Prerequisites: CS F411.
Lecture + Lab + Other: 3 + 0 + 0

CS F621  Advanced Systems Programming
3 Credits
Offered As Demand Warrants
Multiprogramming and multiprocessor systems. File and program security. Scheduling optimization and system tuning, I/O processing, archiving and system recovery, and initialization. Study of current systems.
Prerequisites: CS F311 and CS F321.
Lecture + Lab + Other: 3 + 0 + 0

CS F625  Database Systems Design
3 Credits
Offered Fall
The design and analysis of database systems including data independence, relationships, and organization. Focus on data models, file organization and security, index organization, data integrity and reliability. Review of current database software packages. Design and implementation of a database application project.
Prerequisites: CS F311.
Lecture + Lab + Other: 3 + 0 + 0

CS F631  Programming Language Implementation
3 Credits
Offered Fall
Formal treatment of programming language translation and compiler design. Parsing context-free languages, translation specifications, machine independent code, NBF, scanners, symbol tables, parsers and recursive descent. Programming of compiler or interpreter segments as projects.
Prerequisites: CS F331.
Lecture + Lab + Other: 3 + 0 + 0

CS F641  Advanced Systems Architecture
3 Credits
Offered Spring
A study of advanced single processor systems. Detailed study of multiprocessor architectures, such as vector architectures, massively parallel processors and shared-memory multi-processors.
Prerequisites: CS F441 or permission of Computer Science graduate advisor.
Lecture + Lab + Other: 3 + 0 + 0
CS F642  Advanced Computer Networks
3 Credits
Offered Fall
A study of networks of interacting computers. The problems, rationales
and possible solutions for both distributed processing and distributed
databases will be examined. Major national and international protocols
will be presented.
Prerequisites: Graduate standing or permission of Computer Science
graduate advisor.
Lecture + Lab + Other: 3 + 0 + 0

CS F671  Advanced Software Engineering
3 Credits
Offered Spring
Advanced software development as an engineering discipline. Includes
investigation of current tools, standards, foundation and trends
in software engineering from component-ware, software system
composition, e-systems, software architecture and CASE tools.
Prerequisites: CS F471.
Lecture + Lab + Other: 3 + 0 + 0

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

CS F681  Topics in Computer Graphics
3 Credits
Offered Spring
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 F481 and MATH F314.
Lecture + Lab + Other: 3 + 0 + 0

CS F690  Graduate Seminar and Project
1-6 Credits
Offered Fall
First semester of two-semester seminar in which students will,
individually or in teams, work on and present the results of major
programming or literature survey projects in computer science or
software engineering. Written and oral reports will be required.
Prerequisites: 12 credits in graduate computer science or software
engineering courses; or permission of Computer Science or Software
Engineering graduate advisor.
Cross-listed with SWE F690.
Lecture + Lab + Other: 1-6 + 0 + 0

CS F691  Graduate Seminar and Project
3 Credits
Offered Spring
Second semester of a two-semester seminar in which students will,
individually or in teams, work on and present the results of major
programming or literature survey projects in computer science or
software engineering. Written and oral reports will be required.
Prerequisites: CS F690; 12 credits in graduate computer science or
software engineering courses; or permission of Computer Science or
Software Engineering graduate advisor.
Lecture + Lab + Other: 3 + 0 + 0

CS F692  Seminar
1-6 Credits
Lecture + Lab + Other: 1-6 + 0 + 0

CS F698  Non-Thesis Research/Project
1-9 Credits
Lecture + Lab + Other: 0 + 0 + 0

CS F699  Thesis
1-9 Credits
Lecture + Lab + Other: 0 + 0 + 0