Computer Science (CS) - Graduate Courses

Courses

CS 402/502 Cr.3
Web Application Development
This course will give a detailed description of the core concepts and general principles of web application development. The course will cover various protocols, programming languages, scripting languages, data storage and security, layered software architectures, and graphical interface design as they relate to web development. Students will apply these techniques to the development of medium scale web application. Prerequisite: CS 340. Offered Fall - Odd Numbered Years.

CS 410/510 Cr.3
Free and Open Source Software Development
This course examines all aspects of the Free and Open Source Software movement. The course surveys the various definitions of open source licenses and examples of major free and open source development projects (e.g. the GNU Project, Apache Foundation, Linux). The course also examines the development tools that support developer communities as well as how web-based applications have created the possibility of international development teams. Students will select and contribute to the software development of an existing open source project. Prerequisite: CS 340. Offered Fall - Odd Numbered Years.

CS 418/518 Cr.3
Mobile Application Development
An introduction to the concepts and techniques of application development for mobile devices. The course will examine the design constraints of mobile devices, how mobile applications can leverage external data resources, integration of sensor data and the development environments of the chosen platform (e.g. iOS, Android and others). Repeatable for credit with different topic - maximum six. Offered Occasionally.

CS 419/519 Cr.1-3
Topics in Computer Science
A special topics course in computer science which will function as a forum for new ideas and testing ground for new courses. Repeatable for credit - maximum six. Consent of instructor. Offered Fall, Spring, Summer.

CS 421/521 Cr.3
Programming Language Concepts
A comparative study of the concepts underlying the design of contemporary high-level programming languages, including imperative, functional, logic and object-oriented paradigms; formal representation of syntax and semantics; control structures; data and procedural abstraction; scope and extent; parallelism and exception handling. This course cannot be taken both at the undergraduate level and at the graduate level. Prerequisite: CS 340; CS 225 or MTH 225. Offered Fall, Spring.

CS 431/531 Cr.3
Introduction to Robotics
This course is a hands-on introduction to the algorithms and techniques required to write robot control software. Topics include the components of mobile robots and robot manipulators, manipulator kinematics, robot task planning, sensing, sensor fusion, visual servoing and robot control concepts. Offered Spring - Odd Numbered Years.

CS 441/541 Cr.3
Operating System Concepts
The study of the structures and algorithms of operating systems. Operating systems are viewed as managers and controllers of resources such as processors, memory, input and output devices and data. Topics include multiprogramming systems, CPU scheduling, memory management and device management. Prerequisite: CS 340; CS 370. Offered Fall, Spring.

CS 442/542 Cr.3
Structures of Compilers
An extensive study of all phases of the compilation of high level programming languages. Topics include: scanning, parsing (LL and LR), semantics analysis, symbol table organization and manipulation, internal code generation, storage allocation, optimization and object code generation. Students are required to complete a compiler for a small high-level language. Prerequisite: CS 270; CS 340. Offered Spring.

CS 443/543 Cr.3
Topics in Operating Systems
An intermediate course in operating systems extending topics introduced in CS 441. Operating systems concepts are studied in-depth. Typically students will study and modify an existing system. Prerequisite: CS 441. Offered Fall - Even Numbered Years.

CS 446/546 Cr.3
Object-Oriented Software Development
Introduction to the concepts and principles of object-orientation (OO). Topics include detailed discussion on analysis and design of OO software systems, notations for OO analysis and design, and comparison of OO programming languages. Advanced topics on object-orientation such as OO testing and Software reuse will be briefly discussed. Prerequisite: CS 340. This course cannot be taken for credit both at the undergraduate level and at the graduate level. Offered Spring.

CS 449/549 Cr.3
Advances in Software Engineering
Introduces advanced topics in Software Engineering. Topics include prototyping models, risk analysis, component-oriented software development, software architectures, software reuse, software metrics and quality analysis. Prerequisite: CS 741. Offered Fall - Even Numbered Years.

CS 451/551 Cr.3
User Interface Design
This course focuses on the design and implementation of user interfaces. The topics include characteristics of user interfaces, user profiles, user interface design principles, methods and tools for user interface development, evolution of user interfaces, evaluation of user interfaces, and case studies. Prerequisite: CS 340. Offered Fall - Odd Numbered Years.

CS 452/552 Cr.3
Artificial Intelligence and Pattern Recognition
An introduction to the fundamental principles of artificial intelligence. Topics include the biological basis for intelligence, classification of object descriptions and pattern recognition, search strategies and game trees, natural language processing, automatic theorem proving, programming for artificial intelligence and knowledge-based systems. Projects include writing a substantial artificial intelligence application program. Prerequisite: CS 340. Offered Fall - Odd Numbered Years.
CS 453/553 Cr.3

Introduction to Theory of Computation
An introduction to the theoretical aspects of computation. The capabilities and limits of several computation models are considered including: partial recursive functions, Turing machines, finite state automata and formal languages. The implications of Church’s thesis and unsolvable problems such as the halting problem are discussed. Prerequisite: CS 340. Offered Spring - Even Numbered Years.

CS 454/554 Cr.3

Digital Image Processing
This course introduces the fundamentals of digital image processing techniques with an emphasis on the design and implementation of image processing algorithms. Topics include: color models, point-processing techniques, convolution, fourier domain processing, the discrete cosine transform, image compression methodologies, image restoration and enhancement, sampling and image display. Prerequisite: CS 340. This course cannot be taken both at the undergraduate level and at the graduate level. Offered Fall - Even Numbered Years.

CS 455/555 Cr.3

Fundamentals of Information Security
This course presents the fundamental concepts of information security. Basic policies, techniques and tools for maintaining the security of host computer, information networks and computer software are presented. Elementary cryptography is explored with special attention to applications in data encryption, hashing and digital signatures. Fundamental security management procedures are also introduced, as are the legal and ethical issues associated with computer security. Students will be expected to apply the knowledge gained to construct security policies and practice security in the form of access privileges, firewalls, vulnerability scanners and intrusion detection tools. Prerequisite: CS 220. This course cannot be taken both at the undergraduate level and at the graduate level. Offered Fall - Odd Numbered Years.

CS 456/556 Cr.3

Secure Software Development
Traditionally, software engineering has viewed flaws as the inconsistency of software behavior with its functional requirements. Software security problems, however, can occur in software that contains no such flaws but is nonetheless susceptible to external attack. This course examines known reasons for software security vulnerabilities with an emphasis on best practices for their detection and mitigation, along with general principles for engineering software in ways that enhance security. Prerequisite: CS 340. Offered Spring - Even Numbered Years.

CS 464/564 Cr.3

Advanced Database Management Systems
Advanced topics in database management systems. Topics include the relational data model, relational calculus, embedded SQL programming, database application programming, indexing, system software and storage structures for databases, concurrency control, crash recovery, database administration, parallel and distributed databases, object-oriented databases. Prerequisite: CS 364. This course cannot be taken for credit both at the undergraduate level and at the graduate level. Offered Spring - Odd Numbered Years.

CS 470/570 Cr.3

Parallel and Distributed Computing
A study of architectures, control software, and applications for parallel and distributed systems. A survey of parallel and distributed architectures including data flow machines, vector processors, shared memory multiprocessors, and message based multiprocessors. Software topics include process communication and synchronization, global state maintenance, negotiation, scheduling, data parallelism, control parallelism, and languages for parallel and distributed computing. Prerequisite: CS 370. Offered Occasionally.

CS 471/571 Cr.3

Data Communications
An introduction to data communications, including the electrical properties and software protocols. In addition to presentations of the concepts and techniques used for data communications, several currently used standards and communications networks will be examined. Prerequisite: CS 270; CS 340. Offered Spring - Even Numbered Years.

CS 472/572 Cr.3

Internet of Things
This course explores the possibilities which are created when everyday things become connected to the internet and how this can create new ways for humans to interact with computation and for computation to enable human activities. This course involves building small, sensor equipped hardware devices and cloud based software systems using various technologies. Prerequisite: CS 340, CS 372. Offered Annually.

CS 475/575 Cr.3

Computer Graphics and Modeling
An introduction to computer graphics in modern computing environments. Topics include geometric transformations, fundamental drawing algorithms, scalable vector graphics (SVG), OpenGL, WebGL, surface shaders, scene graphics, photorealistic rendering, surface mesh data structures, animation and modeling and GPGPU computing. Prerequisite: CS 340; MTH 207. Offered Fall - Odd Numbered Years.

CS 476/576 Cr.3

Data Visualization
An introduction to visualizing various forms of data (abstract and concrete) using computer graphics. The course will consider both scientific visualization where the data itself determines the spatial representation and information visualization where appropriate spatial representations are imposed on the data. Prerequisite: CS 575. Offered Spring - Odd Numbered Years.

CS 741 Cr.3

Software Engineering Principles
An advanced course in Software Engineering that provides a broader outlook of software development activities, introduces software qualities, introduces various life cycle models and software development processes that achieve the qualities, introduces principles of testing and maintenance activities, and guides the selection of appropriate life cycle model and software development processes for any given application. Prerequisite: CS 341. Offered Fall.

CS 742 Cr.3

Formal Methods in Software Development
Introduces various formal notations that are used in software development, the mathematical preliminaries that are required to understand and to use the formal notations, provides hands-on experience with one or two formal notations along with some case studies. Prerequisite: CS 340. Offered Spring.

CS 743 Cr.3

Software Verification and Validation
This course explains the need for verification and validation, discusses the methods (formal, informal and diagrammatic) and techniques (prototyping and theoretical proof techniques) that implement verification and validation, and provides hands-on experience to apply these methods and techniques to some simple case studies. Automation of verification and validation methods will also be briefly discussed. Prerequisite: CS 741 or concurrent enrollment. Offered Fall.
CS 744 Cr.3
Management Issues in Software Engineering
This course addresses management issues that are involved in software projects. Some of these issues are group working, allocation of teams and division of labor, feasibility analysis, marketing strategies and project deadlines. Other topics include in-house software development versus outsourcing, customer interaction, standards and organizational impacts on software development. Offered Spring.

CS 750 Cr.1-3
Topics in Software Engineering
This is a topics course in Software Engineering. New topics will be introduced based on the evolution of Software Engineering research. Some such topics are real-time systems, embedded systems, software for safety-critical applications, software architectures, component-oriented programming, CORBA, COM/DCOM, and CASE (Computer-Aided Software Engineering). Topics may vary each semester. Repeatable for credit - maximum six. Prerequisite: CS 741. Consent of instructor. Offered Occasionally.

CS 751 Cr.1-3
Seminar in Software Engineering
This course is meant for those who want to specialize in one or more areas in Software Engineering such as software reuse, software architectures, software testing, software verification, etc. The workload for the course will include a number of presentations in the class and one or more written reports. Topics of specialization may vary for each semester. Repeatable for credit - maximum six. Prerequisite: CS 741. Consent of instructor. Offered Occasionally.

CS 752 Cr.1-3
Independent Study
This course is meant for those who want to acquire an in-depth knowledge on any Software Engineering topic. Typically, the student may be required to focus on one particular topic and conduct some research on this topic, or to do some software development activities such as analysis, design, implementation or testing. If registered for more than once, a different topic must be chosen each time. Each student is required to submit a report at the end of the term. Repeatable for credit - maximum six. Prerequisite: CS 741. Consent of instructor. Offered Fall, Spring, Summer.

CS 795 Cr.1
Software Development Internship
An academically relevant field experience in government, industry, business, or community agencies. Students must have their internships approved and be advised by the computer science department. Determination of relevancy shall be made by the Career Services Office with the advice and consent of the computer science department. The experience will be supervised closely by the intern's on-site supervisor, by the Career Services Staff, and by the student's faculty internship adviser. Students should contact the Career Services Office. Internship does not count for credit towards the MSE program. Repeatable for credit - maximum two. Prerequisite: Master of Software Engineering graduate student status; nine MSE credits earned; 3.5 or higher GPA. Student must be on their internship work site during the semester for which they are registered for academic credit. Consent of instructor. Pass/Fail grading. Offered Fall, Spring, Summer.

CS 798 Cr.1-6
Software Development Project
A major project that requires a detailed analysis of the problem domain, detailed design, implementation and demonstration. The project will be guided by a graduate CS faculty member. Submission of a written project report is required, followed by an oral examination by the Project Evaluation Committee in the CS department. Repeatable for credit - maximum 12. Maximum of six credits per semester. Prerequisite: project proposal must be approved by the Project Evaluation Committee in the CS department. Pass/Fail grading. Offered Fall, Spring, Summer.