CS 1090 - Introduction to Programming Using MATLAB

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduction to programming with emphasis on structured programming techniques using MATLAB as the learning environment. Designed to teach mechanical and aerospace engineering students fundamentals of computer programming. Prer., high school algebra.

 CS 1100 - Introduction to Game Development

Units: 3 units

 Grading Basis Letter

Course Components Lecture Required

 Description: Introduces students to basic game development topics through game design and implementation activities. Students design, implement, and test computer games using drag-and-drop game creation tools. A small amount of programming is required. Approved for Compass Curriculum requirement: Explore-Physical and Natural World. Meets with GDD 1100.

CS 1120- Computational Thinking with Beginning Programming

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description**:** This course explores the ideas behind computational thinking: the thought processes involved in analyzing problems and formulating their solutions in precise, unambiguous ways. Topics include data collection, analysis, and representation; algorithms and procedures; simulation; and others. Most problem solutions in the course are implemented as computer programs. Prer., High school algebra or equivalent.

CS 1150 - Principles of Computer Science

Units: 3 units

 Grading Basis Letter

Course Components Lecture Required

Description: Introduction to programming with emphasis on computer science concepts. Develops methods for computer problem solving. Develops proficiency for programming in a modern programming language, and introduces the concepts of abstraction in problem solving. Includes basic concepts of computer systems and environments including debuggers, editors, and file systems. Prer., High school algebra and familiarity with computer concepts including file operations and text editing; previous programming experience is recommended. College of engineering students only.

CS 1450 - Data Structures and Algorithms

Units: 3 units

Grading Basis Letter

 Course Components Lecture Required

 Description: Concepts of data type, data abstraction, and data structure. Internal representations of fundamental data types. Linear data structures: stack, queue. Linked data structures and dynamic data types. Search table data abstraction, linear search in arrays and lists, binary search in arrays and trees. Binary trees, non-binary trees, binary search trees. Prer., CS 1150 or equivalent.

CS 2010 - Topics in Computer Science

CS 2030 - Topics in Computer Science

CS 2050 - Topics in Computer Science

CS 2070 - Topics in Computer Science

CS 2120 - Topics in Computer Science

Units: 1 - 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Content will vary to reflect the areas of current interest in computer science. As the courses continually change, students may take the course several times for elective credit. Prer., Consent of instructor.

 CS 2060 - Programming with C

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: A first course in the C programming language for those who are proficient in some other high level language. Prer., CS 1120 or CS 1150 or GDD 1200 or ECE 1021; College of Engineering students only.

 CS 2080 - Programming with UNIX

Units: 2 units

Grading Basis Letter

Course Components Lecture Required

Description: An introduction to the UNIX operating system with an emphasis on the development of C and command shell programs. Prer., CS 1450 or GDD 2200

CS 2100 - iPhone and iPad Application Development

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduces and gives students hands-on experience with tools such as Xcode and Interface Builder. Students will become familiar with Apple framework such as Foundation UIKit and will spend many hours with Apple's runtime language. Students will also become comfortable transferring innovative ideas to Objective C.

CS 2160 - Computer Organization and Assembly Language Programming

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Provides an introduction to the concepts of computer architecture, functional logic, design and computer arithmetic. It presents material on the mechanics of information transfer and control within a computer system. Also included are: symbolic programming techniques, implementing high level control structures, addressing modes and their relation to arrays, subprograms, parameters, linkage to high level languages and the assembly process. Prer., CS 1450 and C S 2060 Engineering majors only.

CS 2250 - Advanced Data Structures in C++

Units: 3 units

 Grading Basis Letter

 Course Components Lecture Required

 Description : An advanced study of data structures and object-oriented concepts designed to transition the students to C++. Students explore memory management concepts within C++ including pointers, arrays, constructors, destructors, templates, threads, and GUI development. Prer., GDD 2200. Engineering majors only.

CS 2300 - Computational Linear Algebra

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Covers mathematical as well as computational aspects of Linear Algebra. The class will apply/explore these concepts: Vectors, Matrices, 2D, 3D, and ND Transforms and Graphics, Systems of Linear Equations, Eigenvalues/Eigenvectors, Numerical Stability, and Linear Filters/Predictors. Req., A score of 20 or better on the Math ACT, or a score of 17 or better on the algebra diagnostic exam or successful completion of Math 090 AND programming: CS 1150 or GDD 1200 or Instructor permission.

CS 3010 - Web Programming

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: An introduction to the programming languages and technologies associated with the Web. Included are XHTML, cascading style sheets, Javascript, dynamic XHTML documents, applets, XML, Perl and its use in CGI programming, Java Servlets and web access to databases. Prer., CS 2060, CS 2080; Engineering majors only.

CS 3020 - Advanced Object Technology Using C#/.Net

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: C# class construction principles, delegates, threads, event handling, GUI components, observer pattern, standard collections, generic parameters, enumerators, custom components, UML representation, abstract classes, interfaces, object persistence, remoting, and refactoring. Prer., CS 1450; Engineering majors only.

CS 3030 - Selected Topics in Computer Science

Units: 1 - 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The content of these courses will vary from time to time and reflect the areas of current interest in Computer Science. As the courses continually change, students may take the course several times for technical elective credit. Prer., Instructor consent.

CS 3040 - Advanced Object Technology using Java

Units: 3 units

Grading Basis Letter

Course Components Laboratory Required Lecture Required

Description: Understand advanced object-oriented concepts and implement software in Java. Topics include swing, beans, class construction, exception handling, threads, graphics, printing, cloning, serialization, collections, event-handling models, model-view-controller and reflection. Apply good OO principles by implementing mid-sized projects in Java. Prer., CS 1450. Engineering majors only

CS 3050 - Social and Ethical Implications of Computing

Units: 1 units

Grading Basis Letter

Course Components Lecture Required

Description: This class will discuss selected topics in ethical, social, political, legal and economic aspects of the application of computers. Each student is expected to research one or more topics, actively participate in discussions, and give a presentation. Written papers may be required. Prer., CS 2080; Engineering majors only.

CS 3060 - Object-Oriented Programming Using C++

Units: 3 units

 Grading Basis Letter

Course Components Lecture Required

Description: The principal goals of this course are: 1) to learn the fundamentals of object-oriented programming, 2) to gain skill and proficiency in using the C++ programming language, 3) to exercise the C++ language in implementing a moderate sized software system designed with objects. Prer., CS 2060, CS 2080; Engineering majors only.

CS 3110 - Programming the Mobile Web

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Provides an introduction to web systems and technologies with focus on the support for mobile platforms. Topics include HTML5, CSS, JavaScript, AJAX, web servers, server side scripting/browser detection, content delivery, iOS, Android, and mobile web application development environments and processes. Req., CS 1450, CS 2080, or their equivalents.

CS 3160 - Concepts of Programming Languages

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Evolution of the central concepts of programming languages, describing syntax and semantics, data types, abstract data types, control structures, subprograms, concurrency and exception handling. Prer., CS 2060, CS 2160, and either CS 3020 or CS 3060; Engineering majors only.

CS 3300 - Software Engineering I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Software engineering methodologies. The software lifecycle. Emphasis on the design, development and implementation of a software system. A course project provides the student teams practical application of the software engineering techniques. Approved for Compass Curriculum requirement: Navigate. Prer., CS 2080 and either CS 3020 or CS 3060; Engineering majors only.

CS 3350 – Team-Based Game Production

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Students continue working on an existing game, starting from the end of pre-production and continuing to Alpha, a milestone that consists of delivery to internal company employees (team members) for testing.. Prer., GDD 2200 or CS 1450; PES 1110; Engineering majors only.

CS 3910 - System Administration and Security

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Covers the installation and configuration of mainstream operating systems, important network services, disaster recovery procedures, and techniques for ensuring the security of the system. Prer., CS 2080; Engineering majors only.

CS 4010 – CS 4090 Selected Topics in Computer Science

Units: 1 - 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The content of these courses will vary from time to time and reflect the areas of current interest in Computer Science. As the courses continually change, students may take the course several times for elective credit. Prer., Instructors consent.

CS 4100 - Compiler Design I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Underlying theory and design techniques for compilers. Lexical analysis, top-down and bottom-up parsing algorithms, runtime storage management, syntax directed translation schemes, intermediate code generation. Prer., CS 2160, CS 3160, CS 4700/5700; Engineering majors only. Meets with CS 5100.

CS 4200 - Computer Architecture I

Units: 3 units

 Grading Basis Letter

Course Components Lecture Required

Description: Course covers fundamentals of computer design, instruction set principles and examples, pipelining, advanced pipelining and instruction-level parallelism, memory-hierarchy design and survey of design issues in storage, interconnection network and multiprocessor systems. Prer., CS 2160; Engineering majors only. Meets with CS 5200.

CS 4220 - Computer Networks

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Course focuses on the basic network and protocol concepts and principles with practical hands-on exercises on network management, network programming, and network planning through the use of industry simulators. Topics include: Internet protocols and routing, local area networks, basic TCP/IP programming, congestion control, packet switching and routing, quality-of-service, and network management. Prer., CS 2060, MATH 2150; Engineering majors only.

 CS 4360 - Game Design and Development Capstone Project

Units: 1 units

 Grading Basis Letter

Course Components Lecture Required

Description: A Capstone Project course in which each individual student designs and develops a complete game on their own. Each student also develops the documentation associated with their game, including marketing materials and a user manual. Prer., CS 4780; Engineering majors only.

CS 4420 - Database Systems I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Course introduces general database concepts as well as database system technology. The course covers ER and R data models, R-algebra, SQL, data storage and indexing, query optimization, database design and security. Prer., CS 3300; Engineering majors only. Meets with CS 5420.

CS 4440 – Big Data

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Extensive experience in multiple paradigms for Big Data, focusing on: 1) Large-scale data analysis techniques: statistics basics, machine learning, classification; 2) parallel programming techniques: Nvidia GPUs/CUDA; 3) Cloud computing techniques: Map-Reduce, Hadoop, Pig, Hive. Prer., CS 3060, ECE 3610 or MATH 3810. Engineering majors only. Meets with CS 5440

CS 4500 - Operating Systems I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduces concepts, terminology, and algorithms of operating systems. Describes semaphores, processes, virtual mappings, interrupts, resource allocation and management, protection, synchronization, scheduling, queuing and communication as applied to operating system design and implementation. Prer., CS 2060 or ECE 1021, CS 2080, CS 4200/5200 or ECE 4480; Engineering majors only. Meets with CS 5500.

CS 4600 - Numerical Computing

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Algorithms for the solution of nonlinear equations, interpolation and approximation, differentiation, integration, systems of linear equations, ordinary differential equations and least squares. Prer., CS 1450, MATH 2350, MATH 3130; Engineering majors only. Meets with CS 5600.

CS 4700 - Computability, Automata and Formal Languages

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Finite automata and regular expressions, context-free grammars, context-free languages, and pushdown automata, Turning machines, undecidability, the Chomsky hierarchy of formal languages, computational complexity and intractable problems. Prer., MATH 2150, CS2300; Engineering majors only. Meets with CS 5700.

CS 4720 - Design and Analysis of Algorithms

Units: 3 units

 Grading Basis Letter

Course Components Lecture Required

Description: Design methodologies; divide-and-conquer, exhaustive search, dynamic programming. Time and space complexity measures, analysis of algorithms. Survey of important algorithms for searching, sorting, graph manipulation. Tractability: class P and NP, NP complete problems. Prer., MATH 2150; MATH 1300Engineering majors only. Meets with CS 5720.

CS 4780 - Advanced 3D Games and Digital Content Creation

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Populating virtual worlds with characters and objects. Concentrates on current technology and advanced topics using graphics and VR technology. Typical topics include graphics engines, landscape specializations, wrapping techniques, complex scenes, lighting, shadows, motion control, collisions, dynamics, image-based rendering, multiplayer games, etc., plus advanced features from Siggraph and others. Prer., CS 4800/5800 or instructor's consent. Engineering majors only. Meets with CS 5780.

CS 4800 - Computer Graphics

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Fundamental areas of modern raster computer graphics: hardware, software, data structures, mathematical modeling, user interface and manipulation of graphical objects. a subset of the two dimensional GKS is examined and implemented with emphasis placed upon segmented display files and instance modeling. Basic to all graphic programs written are the ergonomic requirements of the user. Required programs are in the areas of animation, paint systems, polygon filling and clipping, and curve generation. Prer., CS 1450 or GDD 2200, MATH 3130 or CS 2300; Engineering majors only. Meets with CS 5800.

CS 4820 - Functional and Logical Programming for Artificial Intelligence

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

 Description: Course focuses on functional programming using LISP and logical programming using Prolog. Programming projects are geared towards various aspects of artificial intelligence. Prer., CS 3160 or consent of instructor; Engineering majors only.

CS 4850 - Bioinformatics and Computational Biology

Units: 3 units

Grading Basis Letter

Course Components Laboratory Required Lecture Required

Description: Review of molecular and cell biology; bioinformatics databases; pairwise sequence alignment algorithms; Markov Chains, Hidden Markov Models; evolutionary models; Phylogenetic trees; gene recognition; protein structure prediction. Prer., MATH 3810, CS 4720, or instructor permission. Engineering majors only. Meets with CS 5850.

CS 4780- Artificial Neural Networks

Units: 3 units

Grading basis: Letter

Course Components: Lecture Required

Description: The course will cover neural network architectures and learning algorithms. Topics include biological motivation, perception, back-propagation, self-organizing maps, recurrent networks and deep learning. Prer., Math 2350 or equivalent; good programming skills.

CS 4860 - Machine Learning

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

 Description: Introduction to machine learning followed by a selection of machine learning topics such as regression, Bayesian learning, Hidden Markov Models, support vector machine, clustering and reinforcement learning. Math 2150, Math 3130 or CS 2300; CS 3160 or instructor permission.

CS 4870 - Introduction to Artificial Neural Networks

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The course will cover basic neural network architecture and learning algorithms. Topics include biological motivation, cross-listing, perceptron’s, back-propagation, self-organizing maps, recurrent networks and deep learning. Prer., MATH 2350 or equivalent; good programming skills. Meets with Cs5870.

CS 4890 - Computational Linguistics

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Approaches to syntactic processing of natural language: issues in semantic interpretation, pragmatics or the impact of context and world knowledge of natural language understanding and generation of natural language responses. Prer., MATH 2150, MATH 3130 or equivalent Math, CS 3160.

CS 4910 - Introduction to Computer Security

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Students will learn basic cryptography, user authentication, access control, malicious software, network attacks and protection, software security, and operating system security. Students will also perform hands-on security lab exercises. Prer., CS 3300, or instructor consent; Senior standing.

CS 4920 - Introduction to Applied Cryptography

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Basic security issues in computer communication, classical cryptographic algorithms, symmetric-key cryptography, public-key cryptography, authentication, and digital signatures. Prer., MATH 2150, MATH 3810, or instructor consent. Engineering majors only

CS 4930 - Privacy and Censorship

Units: 3 units

Grading: Basis Letter

Course Components: Lecture

Description: This class will cover two topics: privacy from the perspectives of organizations and individuals, and censorship techniques that censors use to monitor citizen’s Internet use and block unwanted network traffic. You will build your knowledge about privacy and censorship by learning about technology-related privacy concerns and mitigation. For example: the different techniques that third parties use to track website visits, privacy risks on smartphones; and the (in)famous ways how censors block Facebook, YouTube, Twitter, or other unwanted Internet access, using techniques such as DNS injection, content filtering, as well as some popular tools that can provide anonymity and censorship circumvention, like Tor. Pre-requisites: CS2080 and CS 4220 or CS5220. Meets with CS 5930.

CS4950 - Homeland Security

Units: 3 units

Grading: Basis Letter

Course Components: Lecture

Desciption: This course examines how homeland security safeguards the United States from domestic catastrophic destruction and investigates cyber security as a priority homeland security concern since a coordinated cyber attack against critical infrastructure could produce the worst catastrophe in the nation's history. Meets with CS 5950.

CS 5010 - Intensive Computer Science for Graduate Students

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Intended for prospective graduate students with extensive programming experience. Covers concepts in CS 1150 and CS 1450. Can substitute for these courses in satisfying entrance requirements for M.S. in Computer Science. Does not count towards M.S.or B.S. degrees. Not open to undergraduate. Prer., Knowledge of high-level programming language.

CS 5020 - Selected Topics in Computer Science

CS 5030 - Selected Topics in Computer Science

CS 5050 – 5090 Selected Topics in Computer Science

Units: 1 - 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Topics vary.

Prer: Graduate students only.

CS 5100 - Compiler Design

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Underlying theory and design techniques for compilers. Lexical analysis, top-down and bottom-up parsing algorithms, runtime storage management, syntax directed translation schemes, and intermediate code generation. Prer., CS 2160, CS 3160. Graduate students only. Meets with CS 4100.

CS 5200 - Computer Architecture I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Course covers fundamentals of computer design, instruction set principles and examples, pipelining, advanced pipelining and instruction-level parallelism, memory-hierarchy design and survey of design issues in storage, interconnection network and multiprocessor systems. Prer., CS 2160. Graduate students only. Meets with CS 4200.

CS 5220 - Computer Communication

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The subject of transmitting information between processors is described in detail. The student is expected to have maturity with hardware and/or real-time concepts. Communication systems, from simple to asynchronous point-to-point links, to those based on complex network architectures will be studied. Material will be oriented toward the computer scientist as a user, designer and evaluator of such systems. Terminology and concepts will be emphasized rather than detailed electronic or physical theory. Prer. CS 2060, CS 2080 and a Probability Course. Graduate students only.

CS 5250 - Multimedia Computing and Communications

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Design principles of multimedia authoring and communication systems. It covers the interface and characteristics of voice and video processing equipment, multimedia document architectures, media encoding/compression schemes, real-time scheduling of time critical multimedia documents, multimedia editors, multimedia communication standards and communication software. Prer., Graduate standing or instructor permission.

CS 5260 - Advanced Internet and Web Systems

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Advanced topics in Internet and WWW systems, TCP/IP network modules in kernel, content switching, web server technologies, web system management, load balancing, web security, and electronic commerce. Prer., C S 3010, C S 5220, instructor consent. Graduate students only.

CS 5310 - Software Requirements Analysis and Specification

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Techniques and tools for requirements analysis and requirements specification. Requirements languages and notations. Specification completeness and consistency. Team project in the analysis and specification of a major software system. Prer., CS 1450 or equivalent, knowledge of a modern programming language and discrete structures. Graduate students only.

CS 5320 - Software Design

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Covers a variety of methodologies and tools for design of sequential, parallel and distributed software systems. Design language; graphical design representations. Data abstraction, data dictionaries. Data flow design and diagrams. Object-oriented design. Documentation. Team project in the design of a major software system. Prer., Graduate students only.

CS 5330 - Formal Methods of Software Systems Engineering

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Elements of discrete mathematics. Formal mechanisms for specifying and verifying the correctness, reliability, and efficiency of software systems. State transition, regular expression, context free, and applicative models. Assertions, Hoare axioms, and weakest preconditions. State machine, algebraic, and operational specification techniques. Prer., Graduate students only.

CS 5340 - Software Maintenance

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Discussion and application of corrective, adaptive, perfective and preventive software maintenance techniques and tools. Related topics such as software systems analysis, reverse-engineering, re-engineering, regression testing and configuration management are examined. As a project, student teams maintain an existing software system. Prer., Graduate students only.

CS 5350 - Software Project Management

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Planning, scheduling, costing of projects. Measuring progress, predicting success, controlling failure. Management tools and their use. Effectiveness and efficiency of software engineering environments. Distributed software development. Quality control standards and practices. Prer., Knowledge of modern programming, NG language, data structures and algorithms, and discrete structures. Graduate students only.

CS 5360 - Software Product Assurance

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Principles, techniques and tools for producing quality software systems. The first half of this course focuses on software product assurance processes. The second half covers a variety of software testing techniques. Prer., Graduate students only.

~~CS 5370 - Human-Computer Interfaces~~

~~Units: 3 units~~

~~Grading Basis Letter~~

~~Course Components Lecture Required~~

 ~~Description: Techniques and tools for the analysis, design, implementation and testing of human-computer interfaces. Special topics such as human factors, rapid prototyping and usability testing will be studied. Term project. Prer., CS 3300 and CS 5310.~~

CS 5371 – Software Testing for Mobile Devices and Embedded Systems

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Theoretical and practical aspects of Software Testing for mobile devices and embedded systems; introduction to recent research in the area. Students will develop a research proposal in the subject area on a topic of their choice. Prer., CS 1450, CS 4500 or CS 3110. Graduate students only.

CS 5380 - Object-Oriented Software Development

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Principles of object-oriented problem-solving, object-oriented analysis and object-oriented design. Development of class hierarchies, use of polymorphism and inheritance, criteria for good design, semester project. Prer., CS 3300 or consent of instructor.

CS 5390 - Software Systems Engineering Project Laboratory

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Students participate in a project involving the development or maintenance of a software system intended for external distribution and use. Duties include requirements analysis, specification, design, implementation, testing, quality assurance, configuration management and documentation. Projects come from the university and from outside sources. Students are evaluated based on their project work and an oral presentation describing their work and critiquing their results. Prer., CS 5310, CS 5320, CS 5340, CS 5360.

CS 5420 - Database Systems I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

 Description: Course introduces general database concepts as well as database system technology. The course covers ER and R data models, R-algebra, SQL, data storage and indexing, query optimization, database design and security. Prer., CS 3300. Graduate students only. Meets with CS 4420.

CS 5430 - Database Systems II

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Course covers advanced database topics including transaction management, parallel and distributed databases, internet databases, decision support, data mining, object and object-relational database systems, spatial data management and other current research issues. Prer., CS 4420/CS 5420.

CS 5440 – Big Data

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Extensive experience in multiple paradigms for Big Data, focusing on: 1) Large-scale data analysis techniques: statistics basics, machine learning, classification; 2) parallel programming techniques: Nvidia GPUs/CUDA; 30 Cloud computing techniques: Map-Reduce, Hadoop, Pig, Hive. Prer., CS 3060, ECE 3610 or MATH 3810. Graduate students only. Meets with CS 4440.

CS 5450 - KDD (Knowledge Discovery in Databases) Applications in Bioinformatics and Neurosciences

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Both a theoretical and hands-on course that presents data mining concepts common to the art of KDD including discretization, rough set theory, fuzzy logic, and discrete finite automata trees. The application of these will be in terms of mining signals and data in bioinformatics and neurosciences. Prer., computer science familiarity. Graduate students only.

CS 5500 - Operating Systems I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduces concepts, terminology, and algorithms of operating systems. Describes semaphores, processes, virtual mappings, interrupts, resource allocation and management, protection, synchronization, scheduling, queuing and communication as applied to operating system design and implementation. Prer., CS 2060, CS 2080, and CS 4200/5200. Graduate students only. Meets with CS 4500.

CS 5510 - Distributed Systems

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Conveys insight into, and knowledge of, the principles and practice underlying the distributed systems, both Internet-based and otherwise. Describes major developments in inter-process communication, remote invocation, distributed file systems, replication and load balancing, distributed shared memory, and distributed multimedia systems. Prer., CS 4500/5500. Graduate students only.

CS 5530 - Mobile and Wireless Systems

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Considers aspects of mobile and wireless systems including the support for creating mobile applications, OS, programming, network protocols, security, and their interactions with web systems and cloud computing. Prer., CS 5220. Graduate students only.

CS 5540 – Datacenters and Cloud Computing

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Focus on recent research in cloud computing and datacenters, including automated cloud resource management, data center reliability, and secure and scalable data center design: Prer., CS 4500/5500. Graduate students only.

CS 5550 - Computer Systems Performance Evaluation

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Perspectives of performance evaluation, measurement techniques; hardware, software, and firmware tools, simulation techniques, analytical techniques; workload characterization, system selection; system tuning; performance tracking, performance prediction in the design phase and cost-benefit analysis. Prer., CS 4500/5500.

CS 5600 - Numerical Computing

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Algorithms for the solution of nonlinear equations, interpolation and approximation, differentiation, integration, systems of linear equations, ordinary differential equations and least squares. Prer., CS 1450, MATH 2350 and MATH 3130. Graduate students only. Meets with CS 4600.

CS 5670 - Discrete Simulation I

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Examines concepts and methods of discrete event simulation. Compares major modeling methods. Discusses statistical issues including random number generation, arrival processes, analysis of simulation output, verification and validation of models and simulation programs. Describes in detail the use of a major discrete event simulation language. Discusses simulation level of detail and simplifying assumptions. Prer., CS 2080 and either MATH 3810 or ECE 3610; Graduate students only.

CS 5700 - Computability, Automata, and Formal Languages

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Finite automata and regular expressions; context-freegrammars, context-free languages, and pushdown automata; Turing machines; undecidability; the Chomsky Hierarchy of Formal Languages; computational complexity, and intractable problems. Prer., MATH 2150, CS 2300. Graduate students only. Meets with CS 4700.

 CS 5710 - Evolutionary Computation

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduction to evolutionary computation with emphasis on genetic algorithms. Includes evolution strategies, evolutionary programming, schemata fitness functions and classifiers, current research topics, messy algorithms, and adaptive landscapes. Prer., Either ECE 3610 or MATH 3810, and CS 5720 or CS 5820; Graduate students only.

 CS 5720 - Design and Analysis of Algorithms

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Design methodologies: divide-and-conquer, exhaustive search, dynamic programming. Time and space complexity measures, analysis of algorithms. Survey of important algorithms for searching, sorting, and graph manipulation. Tractability: Class P and NP, NP-complete problems. Prer., CS 1450 and MATH 2150. Graduate students only. Meets with CS 4720.

CS 5750 - Computational Geometry

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Computational complexity of geometric problems within the framework of analysis of algorithms. Stress on geometric searching, intersection problems, particularly of rectangles, and fundamental algorithms. Practical applications of concepts developed can be found in computer graphics, analysis of algorithms, spatial data structures and VLSI system design. Prer., CS 4720/5720, CS 4800/5800 or instructor consent. Graduate students only.

CS 5770 - Computer Graphics Animation & Scientific Visualization Techniques

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Animation: basic principle, physically based modeling, algorithms for animation, constraint optimization, use of dynamics in animation, teleological modeling. Scientific visualization: overview, foundation techniques, and applications. Prer., CS 4800/5800. Graduate students only.

CS 5780 - Advanced 3D Games and Digital Content Creation

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Populating virtual worlds with characters and objects, this course will concentrate on current technology and advance topics using graphics and VR technology. Typical topics included are graphics engines, landscape specializations, wrapping techniques, complex scenes, lighting, shadows, motion control, collision, dynamics, image based rendering, multiplayer games, etc... plus advanced features from Siggraph and others. Prer., CS 4800/5800 or instructor consent. Graduate students only. Meets with CS 4780.

CS 5790 - Wearable Computing and Complex Systems

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Wearable computing with an emphasis on complex systems research is an important area of research. This course will cover concepts and related techniques, and state of the art issues. This course will provide an excellent basis for students who are interested in computer graphics and virtual reality research. Prer., CS 4800/5800 or instructor consent.

CS 5800 - Computer Graphics

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Fundamental areas of modern raster computer graphics; hardware, software, data structures, mathematical modeling, user interface and manipulation of graphical objects. A subset of the two dimensional GKS is examined and implemented with emphasis placed upon segmented display files and instance modeling. Basic to all graphic programs written are the ergonomic requirements of the user. Required programs are in the areas of animation, paint systems, polygon filling and clipping, and curve generation. Prer., CS 1450 or GDD 220,Math 3130 or CS 2300. College of Engineering students only. Meets with CS 4800.

CS 5810 - Topics in Computer Graphics

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Examines the mathematical and physical models used to produce realistic three dimensional images. Topics include perspective viewing, hidden surface removal, shading, fractals, and rag tracing. Prer., CS 4800/5800.

CS 5820 - Artificial Intelligence

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

 Description: Course covers the foundation of artificial intelligence: search techniques, first-order predicate calculus and knowledge representation. Also covers advanced topics such as speech and natural language processing and learning. Prer., CS 3160, CS 4820, or instructor consent. Graduate students only.

CS 5840 - Computer Vision

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Representation and manipulation of digital images, Fourier analysis of images, enhancement techniques in spatial and frequency domain, segmentation procedures, digital geometry, region and boundary representation, texture processing, pattern recognition and application to robotics. Prer., MATH 2350 or instructor consent. Graduate students only. Meets with MATH 5840.

CS 5850 - Bioinformatics and Computational Biology

Units: 3 units

Grading Basis Letter

Course Components Laboratory Required Lecture Required

Description: Review of molecular and cell biology; bioinformatics databases; pairwise sequence alignment algorithms; Markov Chains, Hidden Markov Models; evolutionary models; Phylogenetic trees; gene recognition; protein structure prediction. Prer., Either MATH 3810 or ECE 3610; CS 4720/5720; Graduate students only. Meets with CS 4850.

CS 5860 - Machine Learning

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

 Description: Introduction to machine learning followed by a selection of machine learning topics such as regression, Bayesian learning, Hidden Markov Models, support vector machine, clustering and reinforcement learning. Prer., Math 2150, Math 3130 or CS 2300; CS3160 or instructor consent. Graduate students only.

CS 5870 - Introduction to Artificial Neural Networks

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The course will cover basic neural network architecture and learning algorithms. Topics include biological motivation, cross-listing, perceptron’s, back-propagation, self-organizing maps, recurrent networks and deep learning. Prer., MATH 2350 or equivalent; good programming skills. Graduate students only.

CS 5880 - Information Retrieval

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Information retrieval focuses on algorithms and approaches to the search for information in documents, in databases, and on the Web. Topics include index construction and compression, probabilistic retrieval, language models, text classification, classification, clustering, web crawling, and web search. Prer., Graduate students only or instructor consent.

CS 5890 - Computational Linguistics

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Approaches to syntactic processing of natural language: issues in semantic interpretation, pragmatics or the impact of context and world knowledge of natural language understanding and generation of natural language responses. Prer., MATH 2150, Math 3130 or equivalent math, CS 3160 or instructor consent. Graduate students only.

CS 5910 - Fundamentals of Computer/Network Security

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Introduction to the study of computer and network security from the view of information warfare. Topics include information system threats, vulnerabilities and defensive mechanisms (cryptography, authentication digital signatures, PKI, etc.). Prer., CS 2080 and MATH 2150. Graduate students only.

CS 5920 - Applied Cryptography for Secure Communication

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Basic security issues in computer communication, classical cryptographic algorithms, symmetric-key cryptography, public-key cryptography, authentication, and digital signatures. Prer., MATH 2150, MATH 3810, CS 5220, or instructor consent. Graduate students only.

CS 5930 - Privacy and Censorship

Units: 3 units

Grading: Basis Letter

Course Components: Lecture

Description: This class will cover two topics: privacy from the perspectives of organizations and individuals, and censorship techniques that censors use to monitor citizen’s Internet use and block unwanted network traffic. You will build your knowledge about privacy and censorship by learning about technology-related privacy concerns and mitigation. For example: the different techniques that third parties use to track website visits, privacy risks on smartphones; and the (in)famous ways how censors block Facebook, YouTube, Twitter, or other unwanted Internet access, using techniques such as DNS injection, content filtering, as well as some popular tools that can provide anonymity and censorship circumvention, like Tor. Pre-requisites: CS2080 and CS 4220 or CS5220. Graduate Standing. Meets with CS 4930.

CS5950 - Homeland Security

Units: 3 units

Grading: Basis Letter

Course Components: Lecture

Desciption: This course examines how homeland security safeguards the United States from domestic catastrophic destruction and investigates cyber security as a priority homeland security concern since a coordinated cyber attack against critical infrastructure could produce the worst catastrophe in the nation's history. Meets with CS 5950.

CS6000 Computer Science Research

Units: 3 units

Grading Basis: Letter

Course Components: Lecture

Description:

CS 6010 - Technological Transfer, Patents and IP in Engineering

Units: 3 units

Grading Basis Letter

Course Components Lecture Required Seminar Required

Description: Technological transfer process including discovery through invention to commercialization. Forms of IP protection including copyrights and patents. Students will read/write patent applications. Prer., Instructor consent.

CS 6220 - Distributed Networks

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Deals with complex communications systems in depth. Packet switching networks, local area networks, satellite systems, the open systems interconnect (OSI) reference model, and the development of communications software. Prer., CS 5220. Graduate students only.

CS 6300 - Topics in Software Systems Engineering

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Advanced topics and current research issues in software engineering. Possible topics include software engineering environments, requirements, design, testing, software metrics, configuration management, maintenance, software cost analysis, and distributed software. Prer., CS 5310 or CS 5350.

CS 6380 - The Design and Modeling of Class Interfaces and Contracts

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Past and present work related to specifying the semantics of a class using assertions are examined. The BON method is presented. Prer., CS 5380.

CS 6430 - Data Mining

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: This course covers data warehousing, OLAP, association rules, cluster analysis, classification and prediction, complex data mining applications and trends in data mining. Prer., CS 4420/5420. Graduate students only.

CS 6770 - Virtual Reality and Computer-Human Interaction

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: The course will focus on the so-called ultimate form of interaction between human and machine, creating virtual or artificial world. The basic idea and various input devices will be discussed. Several advanced papers in this area will be covered. Some of these ideas will be implemented through a term project. Prer., CS 5800 or CS 5770 or instructor consent. Graduate students only.

CS 6820 - Seminar in Artificial Intelligence

Units: 3 units

Grading Basis Letter

Course Components Seminar Required

Description: Research seminar treating contemporary results in the theory and applications of artificial intelligence. Prer., CS 5820, or instructor consent.

CS 6870 - Advanced Studies in Artificial Neural Networks

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: A research seminar treating contemporary results in the theory and applications of artificial neural networks. Prer., CS 5870.

CS 6910 - Advanced System Security Design

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Advanced topics in network and system security, including firewall design, network intrusion detection, tracking and prevention, virus detection, programming language and OS support for security and wireless network security. Prer., CS 5910, CS 5920, or instructor consent.

CS 6920 - Advanced Topics in Network Security

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: Covers advanced topics in network security such as Kerberos, PGP, IPSec, VPNs, SSL, SET, Smart cards, Steganography, Watermarking and Biometric Encryption. Research papers may be discussed. Prer., CS 5920.

CS 6930 - Advanced Topics in Web Security and Privacy

Units: 3 units

Grading Basis Letter

Course Components Lecture Required

Description: This course will explore a series of important topics in web security and privacy. It is a combination of introductory lectures, homework, student presentations of research papers, and research projects. Prer., CS 5910 or instructor consent.

CS 7000 - Masters Thesis

Units: 1 - 6 units

Grading Basis Letter Grade with IP

Course Components Dissertation Required

Enrollment Information Consent Inst Cnsnt

Description: Masters Thesis

CS 7010 - Masters Project

Units: 1 - 3 units

Grading Basis Letter Grade with IP

Course Components Dissertation Required

Enrollment Information Consent Inst Cnsnt

Description: Masters Project

CS 7020 - Graduate Internship

Units: 1 - 3 units

Grading Basis Pass/Fail

Course Components Internship Required

Description: Educational readings and reporting associated with a computer science internship related to students' graduate studies. Must be enrolled in a CS graduate program and have faculty sponsor.

CS 7060 - Games and Media Integration Portfolio Development

Units: 1 - 6 units

Grading Basis Letter Grade with IP

Course Components Dissertation Required

Description: Completed works with interdisciplinary focus to be submitted to various animation or graphics festivals. Must be enrolled in Games and Media Integration (GMI) graduate program and have faculty sponsor. Prer., Permission of instructor.

CS 8000 - PhD Dissertation

Units: 1 - 15 units

Grading Basis Letter Grade with IP

Course Components Dissertation Required

Enrollment Information Consent Inst Cnsnt

 Description: Prer., Acceptance into program.

CS 9200 - Independent Study in Computer Science Undergraduate

Units: 1 - 3 units

Grading Basis Letter

Course Components Independent Study Required

Enrollment Information Consent Inst Cnsnt

Description: Independent Study in Computer Science Undergraduate

CS 9600 - Independent Study in Computer Science Graduate

Units: 1 - 3 units

Grading Basis Letter

Course Components Independent Study Required

Enrollment Information

Description: Independent and creative work in the Computer Science area for graduate students. Prer., Approval of program advisor.

CS 9990 - Candidate for Degree

Units: 0 units

Grading Basis Pass/Fail

Course Components Field Studies Required

Description: Candidate for Degree