Computer Science

1010 Introduction to Computers and the Internet (3)
Prerequisites: Same as for Math 1020 and Math 1030. Covers basic concepts and components of a PC, including microprocessor, disk, display, multimedia, printers, scanners, backup; survey of popular applications including e-mail, personal information managers, word processors, spreadsheets; brief discussion of computer languages; networking, terminology, methods for accessing information on remote computers; dialup access to computers including use of modems; overview of the Internet, popular browsers, World Wide Web, search engines, FTP, utilities, Hyper Text Markup Language, tools for Web page construction, security, privacy. Credit not granted for both Cmp Sc 1010 and Bus Ad 1800.

1015 Web Structures I (1)
Prerequisites: Cmp Sc 1010 and Math 1030 or equivalent. Introduction to Web page design and management using software such as GoLive. Topics include graphical user interfaces, page templates and dynamic Web page publishing.

1016 Web Structures II (1)
Prerequisites: Cmp Sc 1015(or equivalent) Introduction to Java and Java Script. This is a project oriented course using Java and software such as GoLive for Web page design and Internet programming.

1050 User Interface Design and Event-Driven Programming with Visual Basic (3)
Prerequisite: Cmp Sc 1250 or knowledge of some programming language and consent of the instructor. This course explores programming in Visual Basic for event-driven applications. Design and implementation of graphical user interfaces (GUI) are explored as primary examples. Additional topics may include DDE, OLE, and interactions with databases.

1220 Computers and Programming (3)
Prerequisite: Math 1800 or 1100, or a grade of at least B in Math 1030. An overview of a computer system is presented. Structured design techniques are considered and applied to the development of computer programs. Aspects of the FORTRAN language will be studied including basic data types, subroutines and functions, arrays, and files. Credit not granted for both Bus Ad 1804 and Cmp Sc 1220.

1250 Introduction to Computing (3)
Prerequisite: Math 1800 or 1100, or a grade of at least B in Math 1030. An overview of a computer system is presented. Structured design techniques are considered and applied to the development of computer programs. Aspects of a high level language such as Pascal or C will be studied, including elementary and advanced data types and subprograms. Various features of the UNIX operating system will also be discussed.

2010 An Introduction to Java and Internet Programming (3)
Prerequisite: Math 1030. Introduces the Java programming language and its use in Internet programming. This course will involve programming assignments in Java and their interface with browsers using applets. Students will also be exposed to the Java's windows toolkit -- the AWT. A brief introduction to object-oriented programming concepts will be provided. Other topics will include threads, virtual machines, byte code, and the Java security model.

2210 The C Programming Language (3)
Prerequisite: Cmp Sc 2250 or the equivalent. The C language is introduced together with the associated tools which make up the UNIX C programming environment. The course is project-oriented and a portion of the practical work will involve UNIX systems programming. This course is intended for students who have completed the equivalent of Cmp Sc 1250 and Cmp Sc 2250 but without the C language. It may not be taken for credit if the student has taken Cmp Sc 2250 with C.

2250 Programming and Data Structures (3)
Prerequisite: Cmp Sc 1250. A continuation of Cmp Sc 1250. Advanced programming techniques including recursion, divide-and-conquer, and backtracking will be considered. A discussion of dynamic data structures such as lists, binary trees, stacks, queues, and symbol tables will be presented. An introduction to modular programming, program specification and verification, and analysis of algorithms will be given.

2260 Object Oriented Programming with C++ (3)
Prerequisite: Cmp Sc 2250. Introduces object-oriented concepts, terminology, and notation. The C++ language is explored, including topics such as dynamic memory, exception handling, function and class templates, operator overloading, inheritance, polymorphism, and generic programming with the standard template library. Additional topics may include GUI libraries.

2700 Computer Systems: Architecture and Organization (3)
Prerequisite: Cmp Sc 2250. Introduces details of computer systems from architectural and organizational points of view. Topics discussed may include data representation, digital logic and basic circuits such as ALU, multiplexers, decoders, flip-flops, registers, RAM and ROM memory, memory hierarchies, I/O devices, pipelining, parallel and RISC architectures, etc.

2710 Computer Systems: Programming (3)
Prerequisite: Cmp Sc 2700. Continues introduction of computer systems, with assembly programming and its application. Topics covered may include addressing modes, stack manipulations and applications for reentrant and recursive modules, memory interfacing, I/O device interfacing, and serial and parallel communication.

2750 Advanced Programming with Unix (3)
Prerequisite: Cmp Sc 2250. Exploration of the Unix operating system, including its tools and utilities for program development, such as makefile, piping and redirection, shell scripts, regular expressions, and symbolic debuggers. In addition, this course explores advanced features of the C programming language, including various file processing, command-line and variable arguments, exception handling and generic interfacing.

3000 Discrete Structures (3)
Prerequisites: Math 1900 or 1100, and Cmp Sc 1250 or equivalent. Same as Math 3000. Treats fundamental ideas in discrete structures and serves as a foundation for subsequent course in both Mathematics and Computer Science. Provides an introduction to techniques of mathematical reasoning with examples derived from computer science. Topics include logic, set algebra, equivalence relations and partitions, functions, mathematical induction, elementary number theory, cardinality, recurrence relations, basic combinatorial methods, trees and graphs. Credit not granted for more than one of Cmp Sc 3000, Math 250, and Math 3000

3010 Web Programming Techniques (3)
Prerequisites: Cmp Sc 2750. A project-oriented course which provides a survey of current technologies including markup languages (XHTML, CSS, XML), scripting languages (Java Script), client/server computing CGI/PERL/PHP), applets, Web protocols, session tracking, and other topics as time permits.

3130 Design and Analysis of Algorithms (3)
Prerequisites: Cmp Sc 2250, Cmp Sc/Math 3000, Math 2450 and Math 1320. Addresses the design and mathematical analysis of fundamental algorithms in computer science. Algorithms studied may involve search, sorting, data compression, string manipulation, graph traversal and decomposition, and algebraic and numeric manipulation.

4020 Java and Internet Programming (3)
Prerequisites: Cmp Sc 3010 or consent of instructor. A project-oriented course which examines core Java features and selected Internet applications, such as networking, servlets, applets, AWT/SWING graphics, database connectivity, and XML.

4040 Electronic Commerce Protocols (3)
Prerequisites: Cmp Sc 2750 and Math 2450. Provides a technical introduction to electronic commerce over the Internet, examining topics such as electronic data interchange, digital currency, and electronic catalogs. The course discusses technical issues such as telecommunications infrastructure, data warehousing, software agents, and storage retrieval of multimedia information. Other topics may include cryptographic techniques as applicable to web-site development, management of data in a secure manner, authentication and confidentiality, different levels of security (transaction, network, and protocol), and digital signatures.

4050 User Interface Development (3)
Prerequisites: Cmp Sc 2750. Focuses on user interface design standards as a programming problem. It covers topics such as functional vs. aesthetic concerns, elegance and simplicity, interference between competing elements, visual variables, perceptual organization for visual structure, grid-based design of module and program, semiotics with images and representation.

4140 Theory of Computation (3)
Prerequisites: Cmp Sc 3130. Covers finite state machines and pushdown automata, and their relationship to regular and context-free languages. Also covers minimization of automata, Turing machines, and undecidability. Other topics may include Church's Thesis, uncomputability, computational complexity, propositional calculus and predicate calculus.

4250 Programming Languages (3)
Prerequisites: Cmp Sc 2260. A study of the principles of modern programming languages. The students perform a comparative study of syntax, semantics, and pragmatics of high-level programming languages. Also provides a discussion of list-processing, object-oriented, functional, procedural, or other programming paradigms.

4280 Program Translation Techniques (3)
Prerequisites: Cmp Sc 2700, Cmp Sc/Math 3000, Cmp Sc 4250, Math 2450. Looks at the theory of programming languages as well as the theory of program translation as a means for dealing with the conceptual gap introduced by the levels of abstraction. Program translation mechanisms are studied as a means to explore the tradeoff between language expressiveness, translation, and execution effectiveness. Particular attention is paid to compilers, with emphasis on constraints induced by syntax and semantics.

4300 Introduction to Artificial Intelligence (3)
Prerequisites: Cmp Sc 2260, Cmp Sc 2750 and Cmp Sc 3130. An overview of AI applications is presented. An AI programming language, such as Prolog or Lisp, is introduced. Fundamental AI problem solving techniques are applied to heuristic search and game playing. An introduction to knowledge representation and expert systems is given. Topics such as theorem proving, neural networks, and natural language processing may also be studied.

4410 Computer Graphics (3)
Prerequisites: Cmp Sc 2260, Cmp Sc 2750 and Cmp Sc 3130. The basic architecture of various types of graphics systems is presented. Also presents a detailed description of the basic algorithms for 2-dimensional and 3-dimensional graphics systems. Algorithms for shading, hidden line removal, and rendering in the 3-D systems will be examined. The course involves significant project work.

4440 Digital Image Processing (3)
Prerequisites: Cmp Sc 2260, Cmp Sc 2750 and Cmp Sc 3130. Focuses on low-level image processing data structures and algorithms for binary image processing, region and texture analysis, image filtering, edge detection, and contour following. Other topics include coding for storage, retrieval, transmission, and image restoration.

4500 Software Engineering (3)
Prerequisites: Cmp Sc 2260 and Cmp Sc 2750. Introduces software engineering as a discipline, discusses stages of software lifecycle, compares development models such as waterfall, prototyping and incremental/iterative, and compares structured and object-oriented methods. It also discusses software documentation, both internal and external verification/validation, quality assurance, testing methods, maintenance, project management and team structure, metrics, and available tools.

4520 Object-Oriented Analysis and Design (3)
Prerequisites: Cmp Sc 4500. Concentrates on modeling using a visual language such as UML, in the context of a generic object-oriented development process. Discusses the object world, analysis/design goals as the driving development force, different system views, use cases, static and dynamic models, diagrams, modeling with patterns, and principles of responsibility assignments. The course may be supplemented with a CASE tool.

4540 Software System Architectures (3)
Concerned with the design, modeling, and evaluation of complex software systems at the architectural level of abstraction. Covers basic principles of architectural system design, and may cover topics such as multi-tiered and packaged architectures, model-view and model-service separation, design supports for distributed and client-server applications, design patterns, package interfaces, notation, persistence, and GUI frameworks.

4560 Software Development Processes (3)
Prerequisites: Cmp Sc 4500 or Cmp Sc 4520. This course is an in-depth study of software development processes, in the context of an actual project. Discussion includes object-oriented processes such as Rational Unified Process, as well as process management issues such as scheduling, risk-assessment, various metrics, and the selection of appropriate development methodology and tools.

4610 Database Management Systems (3)
Prerequisites: Cmp Sc 2750 and Cmp Sc 3130. Presents the foundations, concepts and principles of database design. Various models of data representation are considered, including the hierarchical and relational models. Also considers some of the implementation issues for database systems.

4620 Information Retrieval (3)
Prerequisites: Cmp Sc 2750 and Cmp Sc 3130. Presents deterministic models of information retrieval systems, including conventional Boolean, fuzzy set theory, p-norm, and vector space models. Other topics include probabilistic models, text analysis and automatic indexing, automatic query formulation, system-user adaptation and learning mechanisms, evaluation of retrieval, review of new theories and future directions, and intelligent information retrieval.

4730 Computer Networks and Communications (3)
Prerequisite: Cmp Sc 2750 and Math 1320. Communication systems will be considered in the context of the ISO standard for systems interconnection. Various types of networks will be studied including wide area networks, local area networks, and fiber optic networks.

4740 Client-Server Architectures (3)
Prerequisites: Cmp Sc 2750 and Math 2450. Studies communications systems in the context of the ISO standard for systems interconnection. There is hands-on exposure to development of client-server applications.

4760 Operating Systems (3)
Prerequisites: Cmp Sc 2750, Cmp Sc 2700, Math 1320 and Math 2450. Studies the structure of a generic operating system, considering in detail the algorithms for interprocess communication, process scheduling, resource management, memory management, file systems, and device management. Topics in security may also be examined. Examples from pertinent operating systems are presented throughout, and use of the algorithms in modern operating systems is examined. Substantial practical work, using the UNIX operating system is required.

4770 Operating Systems for Telecommunications (3)
Prerequisites: Cmp Sc 4520 or MSIS 6806. The structure of a general operating system will be studied. The various components, including the interface with the underlying hardware, will be considered in detail. UNIX and Windows/NT will be considered as case studies throughout the course. The course will also emphasize hands on experience as a power user of at least one modern operating system.

4780 Systems Administration and Computer Security (3)
Prerequisites: Cmp Sc 2750. Identifies and studies major issues of relevance to systems and networks management. Covers a wide range of topics from a basic primer on networking topics from the systems perspective to advanced technical issues of user authentication, encryption, and mail privacy. Discusses the latest advances in network management tools and computer security protocols.

4880 Individual Studies (1-3)
Prerequisites: Cmp Sc 2750 and consent of instructor. Allows a student to pursue individual studies under the supervision of a faculty member. May include development of a software project. May be repeated for credit.

4890 Topics in Computer Science (3)
Prerequisite: Consent of instructor. A seminar on special topics in computer science to be determined by recent developments in the field and the interests of the instructor. May be repeated for credit with departmental consent.

5010 Advanced Java Programming (3)
Prerequisites: Cmp Sc 4020 or consent of instructor. Coverage will emphasize advanced Java topics and may include, J2EE, Beans/Enterprise Beans, RMI/RPC, JDBC, Servlets/JSP, development tools such as Ant, frameworks, such as Eclipse, and Java IDEs.

5130 Advanced Data Structures and Algorithms (3)
Prerequisites: An elementary course in analysis of algorithms or consent of the instructor. This course covers analysis of time and space complexity of iterative and recursive algorithms along with performance bounds, design of data structures for efficient performance, sorting algorithms, probabilistic algorithms, divide and conquer strategies, various algorithms on graphs, and NP completeness.

5320 Introduction to Evolutionary Computation (3)
Prerequisite: Cmp Sc 4300 or consent of instructor. This course introduces the concepts of nature-inspired problem solving population dynamics, Darwinian selection, and inheritance. It discusses problems applicable to evolutionary algorithms, overviews the existing models and instances, and analyzes specific instances such as genetic algorithms and genetic programming.

5340 Introduction to Machine Learning (3)
Prerequisite: Cmp Sc 4300 or consent of instructor. This course introduces both symbolic and sub-symbolic approaches to machine intelligence. Specific topics covered may include data mining, supervised learning such as decision trees, and approximate methods such as fuzzy reasoning.

5360 Expert Systems (3)
Prerequisites: Cmp Sc 4300 or consent of instructor. This course concentrates on issues related to building expert systems mimicking human-level expertise, including knowledge engineering processes leading to the design, construction, and evaluation of systems, relevant languages, tools, and shells, as well as representation, quality, and inference methods.

5380 Introduction to Neural Networks (3)
Prerequisites: Cmp Sc 4300 or consent of instructor. This course introduces the concepts of connectionism, along with algorithms for simulating neural networks, discussion of alternative networks architectures and training algorithms.

5400 Computer Vision (3)
Prerequisites: Graduate standing and consent of instructor. This course introduces computational models of visual perception and their implementation on computer systems. Topics include early visual processing, edge detection, segmentation, intrinsic images, image modeling, representation of visual knowledge, and image understanding.

5420 Visual Data Processing (3)
Prerequisites: Graduate standing and consent of instructor. This course introduces low-level concepts and techniques used in image processing, including methods for image capture, transformation, enhancement, restoration, and encoding.

5440 Pattern Recognition (3)
Prerequisites: Graduate standing and consent of instructor. This course provides an introduction to statistical decision theory, adaptive classifiers, and supervised and unsupervised learning. Different types of pattern recognition systems are introduced, including transducers, feature extractor, and decision units. Students are exposed to the application of the techniques to optical character recognition, speech processing, and remote sensing.

5500 Software Engineering (3)
Prerequisites: Graduate standing and consent of the instructor. This course introduces software engineering as a discipline, discusses stages of the software life cycle, compares development models such as waterfall, prototyping and incremental/iterative, covers requirements analysis, effort and cost

estimation, compares structured and object-oriented analysis and design methods. It also discusses verification/validation, quality assurance, software reliability, testing methods, maintenance, documentation, project management and team structure, metrics, and available tools. Credit not granted for both Cmp Sc 4500 and Cmp Sc 5500.

5520 Object Oriented Analysis and Design (3)
Prerequisites: Cmp Sc 4500, Cmp Sc 5500, or consent of the instructor. This course concentrates on modeling using a visual language such as UML, in the context of a generic object-oriented development process. It introduces the object world, analysis/design goals as the driving development force, different system views, use cases, static and dynamic models, diagrams, modeling and patterns, and principles of responsibility assignments. The course may be supplemented with a CASE tool. Topics are the same as Cmp Sc 4520 but material is covered at a greater depth and additional projects are required. Credit not granted for both Cmp Sc 4520 and Cmp Sc 5520.

5540 Software Systems Architectures (3)
Prerequisites: One of the following: Cmp Sc 4500, Cmp Sc 5500, Cmp Sc 4520, Cmp Sc 5520, or consent of the instructor. This course is concerned with the design, modeling, and evaluation of complex software systems at the architectural level of abstraction. It covers basic principles of architectural system design, and may cover topics such as multi-tiered and packaged architectures, model-view and model-service separation, design support for distributed and client-server applications, design patterns, package interfaces, notation, persistence and GUI frameworks. Topics are the same as Cmp Sc 4540 but material is covered at a greater depth and additional projects are required. Credit not granted for both Cmp Sc 4540 and Cmp Sc 5540).

5560 Software Development Processes (3)
Prerequisites: One of the following: Cmp Sc 4500, Cmp Sc 5500, Cmp Sc 4520, Cmp Sc 5520, or consent of the instructor. This course is an in-depth study of software development processes, in the context of an actual project. Discussion will include object-oriented processes such as the Rational Unified Process, as well as process management issues such as scheduling, risk-assessment, various metrics, and the selection of appropriate development methodology and tools. Topics are the same as Cmp Sc 4560 but material is covered at a greater depth and additional projects are required. Credit not granted for both Cmp Sc 4560 and Cmp Sc 5560.

5610 Advanced Databases (3)
Prerequisites: Graduate standing and consent of instructor. This course is an in-depth study of database techniques, including normalization theory, object-oriented databases, statistical databases, distributed databases, and failure recovery. The course will also involve substantial readings from the current literature.

5620 Intelligent Information Retrieval (3)
Prerequisites: Cmp Sc 4300 or consent of instructor. This course studies the use of AI techniques for the development of adaptive information retrieval systems. Techniques for analysis of information by statistical syntactical, and logical methods are also studied. Topics related to multimedia information are also discussed.

5640 Multimedia Information Systems (3)
Prerequisites: Cmp Sc 4410 or Cmp Sc 5400. This course studies the technical and human issues related to the design, construction, and use of computer programs that combine text, audio, video, graphics, animation, and graphical user interfaces. It also surveys applications and tools.

5700 Computer Systems (3)
Prerequisites: Background in computer organization or architecture or consent of instructor. This course focuses on parallel computing architectures, including RISC, pipelining, vector processing, SIMD, MIMD, and array processing. It introduces different memory and I/O subsystems, hardware description languages, and it demonstrates performance enhancement using different architectures studied.

5730 Client/Server Computing (3)
Prerequisite: Cmp Sc 4770 or MSIS 6836. The course will study communications systems in the context of ISO standards for systems interconnection. There will be hands on exposure to development of client-server applications.

5740 Parallel and Distributed Computing (3)
Prerequisites: Background in computer organization or architecture, or consent of instructor. This course introduces the fundamentals of parallel computation and algorithm design. It discusses general techniques for designing efficient parallel algorithms for fixed-connection parallel network architectures such as arrays, trees, and hypercubes.

5760 Advanced Operating Systems and Network Management (3)
Prerequisites: Cmp Sc 4760 or consent of instructor. This course provides a survey of contemporary operating systems principles, including overall design strategies for operating systems. The course also discusses communication and synchronization techniques for concurrent processes, and statistical analysis of job scheduling, process scheduling, I/O scheduling, and memory management.

5780 Systems Administration (3)
Prerequisite: Cmp Sc 4760 or 4770 and MSIS 6838. The course will identify and study major issues of relevance to systems and networks management. It covers a wide range of topics from a basic primer on networking topics from the systems perspective to advanced technical issues of user authentication, encryption, and mail privacy. The course will discuss the latest advances in network management tools and computer security protocols.

5870 Computer Science Seminar (1-3)
Prerequisites: Graduate standing and consent of instructor. This is a seminar on various topics. Substantial student reading and participation is expected. It may be taken more than once for credit with the consent of the department.

5880 Computer Science Independent Project (1-3)
Prerequisites: Graduate standing and consent of instructor. This course offers the student an opportunity to work on an adviser-supervised project, individually or in a group. A student may repeat the course for up to 6 credit hours total, but at most 6 hours can be accumulated for Cmp Sc 5880 and Cmp Sc 6900.

5890 Topics in Computer Science (1-3)
Prerequisites: Graduate standing and consent of instructor. This course offers various topics not offered on a regular basis. It may be taken more than once for credit with the consent of the department.

6320 Advances in Evolutionary Computation (3)
Prerequisites: Cmp Sc 5320 or consent of instructor. This course focuses on some advanced topics in Genetic and Evolutionary Computation, both theoretical and practical. Topics may include competent genetic algorithms, learning classifier systems, and Markov models. A substantial part of the course will be based on recent literature. Projects may involve literature research, developing specific applications or implementing a specific model.

6340 Genetic Programming (3)
Prerequisites: Cmp Sc 5320 or consent of instructor. This course provides an in-depth exploration of Genetic Programming, including advanced concepts such as scalability, evolution of modularity and regularity, and constrained evolution with CGP, STGP, or CFG-based GP. It may be reading, research, or application oriented.

6410 Topics in Computer Graphics (3)
Prerequisites: Cmp Sc 4410 or consent of instructor. This course covers various aspects of advanced graphics techniques, such as geometric modeling, rendering, shading, texturing, and computer animation. The course provides an in-depth study of recent advanced topics in computer graphics.

6420 Topics in Image Processing and Multimedia (3)
Prerequisites: Cmp Sc 5400, Cmp Sc 5420 or consent of instructor. This course covers new developments in digital image processing, computer vision, and multimedia. Topics to be covered may include image databases, object tracking, and large-scale data visualization.

6740 High Performance Computing (3)
Prerequisites: CMP SCI 5740, or Graduate standing and consent of instructor. Looks at the current state of the art in parallel and distributed computing, with emphasis on programming in such environments. Introduction to the state of the art in code optimization and grid computing environments.

6900 Thesis (1-6)
Prerequisites: Completion of at least 12 graduate credits and approval of research topic by thesis adviser. This course is designed for those students intending to present a thesis as part of their M.S. program. At most 6 hours can be accumulated for Cmp Sc 5880 and Cmp Sc 6900.

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