COMPUTER SCIENCE CSE AND ENGINEERING

**Department of Computer Science and Engineering
College of Engineering**

100   Computer Science as a Profession
Fall, Spring. 1(1-0) RB: High school algebra; ability to use a computer for browsing, email, and report preparation.

The computing and programming profession. Professionalism and ethics. Industry practice. Experiments with programming.

101   Computing Concepts and Competencies
Fall, Spring, Summer. 3(2-2) SA: CPS 100, CPS 130

Core concepts in computing including information storage, retrieval, management, and representation. Applications from specific disciplines. Applying core concepts to design and implement solutions to various focal problems, using hardware, multimedia software, communication and networks.

131   Technical Computing and Problem Solving
Fall, Spring. 3(1-3) P: (MTH 124 or concurrently) or (MTH 132 or concurrently) or (LBS 118 or concurrently) SA: CPS 131

Use of computing systems for technical problem solving in engineering and science.

201   Fundamentals of Information Technology
Fall, Spring. 3(3-0) P: (CSE 101 or CSE 131) and (MTH 103 or MTH 116 or MTH 124 or MTH 132 or LBS 117) RB: high school algebra; literacy in web and computer tools, such as editor and browser. SA: CSE 240

Digital representation of objects such as numbers, signals, and 3-dimensional shapes. Algorithms that operate on digital objects. Computer communications and the Internet. Computer security and web services.

231   Introduction to Programming I
Fall, Spring, Summer. 4(3-2) P: (LBS 118 or concurrently) or (MTH 124 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) SA: CSE 230

Introduction to programming using Python. Design, implementation and testing of programs to solve problems such as those in engineering, mathematics and science. Programming fundamentals, functions, objects, and use of libraries of functions.

232   Introduction to Programming II
Fall, Spring. 4(3-2) P: CSE 231 and (LBS 118 or MTH 124 or MTH 132 or MTH 152H) SA: CSE 330

Continuation of object-centered design and implementation in C++. Building programs from modules. Data abstraction and classes to implement abstract data types. Static and dynamic memory allocation. Data structure implementation and algorithm efficiency. Lists, tables, stacks, and queues. Templates and generic programming.

251   Programming in C
Fall, Spring. 1(0-2) P: CSE 231 or CSE 131 or EGR 102 RB: Students are expected to have experience in programming in some language other than C R: Open to undergraduate students or graduate students.

Programming in the C language. Data and control. Compiling and linking.

260   Discrete Structures in Computer Science
Fall, Spring. 4(4-0) P: MTH 133 or MTH 126 or MTH 153H or LBS 119 SA: CPS 260

Propositional and first order logic. Equivalence and methods of proof. Basics of counting. Set operations, relations, functions. Grammars and finite state automata. Discrete probability. Applications to computer science and engineering.

290   Independent Study in Computer Science
Fall, Spring. 1 credit. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department; application required. SA: CPS 290

Supervised individual study in an area of computer science.

291   Selected Topics in Computer Science
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department. SA: CPS 291

Topics selected to supplement and enrich existing courses and lead to the development of new courses.

320   Computer Organization and Architecture
Fall, Spring. 3(3-0) P: CSE 232 and CSE 260 R: Open to undergraduate students in the Department of Computer Science and Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science major. SA: CPS 320 Not open to students with credit in ECE 331.

Boolean algebra and digital logic. Combinational and sequential circuits. Representations of data and instructions. Architecture and major components of computer systems. Assembly language programming and interfacing to high level languages. Assembler and linker processing.

331   Algorithms and Data Structures
Fall, Spring. 3(3-0) P: CSE 232 and CSE 260 R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering majors or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor.

Linear data structures, trees, graphs and algorithms which operate on them. Fundamental algorithms for searching, sorting, string matching, graph problems. Design and analysis of algorithms.

335   Object-oriented Software Design
Fall, Spring. 3(3-0) P: CSE 232 and CSE 260 R: Open only to students in Computer Science or Computer Engineering or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor. SA: CSE 370

Development of large software products, libraries, and product families. Object-oriented programming using inheritance and polymorphism. Design methods. Specification and the use of contracts to design reliable software. Configuration management and life-cycle issues.

410   Operating Systems
Fall, Spring. 3(3-0) P: (CSE 232 and CSE 260) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CPS 410

Principles and evolution of operating systems. Process and processor management. Concurrent processes and threads. Primary and secondary storage management. Case studies of modern operating systems.

420   Computer Architecture
Fall, Spring. 3(3-0) P: (CSE 232 and CSE 260) and (CSE 320 or ECE 331) R: Open to students in the Department of Computer Science and Engineering or in the Computer Engineering major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science major or in the Computer Science Disciplinary Teaching Minor. SA: CPS 420

Organization and architecture of computer systems. Arithmetic Logic Unit and control unit implementations. Hardwired and microprogrammed control. Pipelined processors; data and branch hazards. Memory hierarchy and storage devices. Input-output and peripheral devices. Advanced architectures.

422   Computer Networks
Fall, Spring. 3(3-0) P: (STT 351 or ECE 280) and (CSE 320 or ECE 331) and (CSE 410 or concurrently) R: Open only to students in the Department of Computer Science or the Computer Engineering or LBS Computer Science major or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CPS 422

Computer network architectures and models. Physical media and signaling. Data link protocols. Medium access control. Routing and IP. Transport services including TCP/UDP. Network applications. Local-area and wide-area networks.

425   Introduction to Computer Security
Spring. 3(3-0) P: CSE 422 R: Open to students in Computer Engineering major or in Computer Science major.

Theory and practice of security engineering. Security protocols. Cryptography and cryptanalysis. Smartcards. Network security and intrusion detection. Common system attacks.

429   Interdisciplinary Topics in CyberSecurity
Fall. 3(3-0) Interdepartmental with Criminal Justice. Administered by Computer Science and Engineering. P: CSE 101 or CSE 131 or CSE 231 R: Open to juniors or seniors or graduate students.

Technical, legal, criminal, medical business, and communication aspects of CyberSecurity.

Computer Science and Engineering—CSE

435 Software Engineering
Fall. 3(3-0) P: CSE 320 and CSE 331 and CSE 335 R: Open only to students in the Department of Computer Science or the Computer Engineering or LBS Computer Science major or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CSE 470

Software lifecycle including specification, design, coding, testing, and verification of a software product. Stepwise refinement and traceability. Software maintenance and documentation.

440 Introduction to Artificial Intelligence
Fall. 3(3-0) P: CSE 331 or CSE 335 R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CPS 440

Fundamental issues in intelligent systems. Knowledge representation and mechanisms of reasoning. Search and constraint satisfaction. Agents. Application areas of AI and current topics.

444 Information Technology Project Management
Spring. 3(3-0) Interdepartmental with Information Technology Management and Telecommunication. Administered by Information Technology Management. P: ITM 311 R: Open to seniors in the Information Technology Specialization.

Practical training and experiences in design, testing, and launch of new information technologies and systems.

450 Translation of Programming Languages
Spring. 3(3-0) P: (CSE 331 or CSE 335) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CPS 450

Theory and practice of programming language translation. Languages, grammars and parsing. Lexical, syntactic and semantic analysis. Compile-time error handling. Code optimization and code generation.

452 Organization of Programming Languages
Fall. 3(3-0) P: (CSE 331 or CSE 335) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering major or the LBS Computer Science coordinate major or the LBS Computer Science field of concentration or the Computer Science disciplinary teaching minor. SA: CPS 452

Organization of programming languages. Type systems. Alternative execution models. Comparison of language features: functional, imperative, logical and object-oriented.

460 Computability and Formal Language Theory
Fall, Spring. 3(3-0) P: CSE 331 R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering major or LBS Computer Science field of concentration or the Computer Science disciplinary teaching minor. SA: CSE 360

Formal models of computation such as finite state automata, pushdown automata and Turing machines. Formal definitions of languages, problems, and language classes including recursive, recursively enumerable, regular, and context free languages. The relationships among various models of computation, language classes, and problems. Church's thesis and the limits of computability. Proofs of program properties including correctness.

471 Media Processing and Multimedia Computing
Fall. 3(3-0) P: CSE 320 or CSE 331 or CSE 335 R: Open to students in the Department of Computer Science and Engineering or in the Computer Engineering major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science major or in the Computer Science Disciplinary Teaching Minor.

Basic operations for processing images, video, and audio. Devices for input and output. Data formats and compression. Tools for processing images and sound. Multimedia authoring tools. Applications.

472 Computer Graphics
Spring. 3(3-0) P: (MTH 234 or LB 220) and (CSE 331 or CSE 335) R: Open to juniors or seniors or graduate students in the Department of Computer Science and Engineering and open to juniors or seniors in the Computer Engineering major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science major. SA: CPS 472

Graphics systems. Two- and three-dimensional imaging geometry and transformations. Curve and surface design. Rendering, shading, color, and animation. Graphics programming.

473 Fundamentals of 3D Game Development
Fall. 3(3-0) P: MTH 234 and (CSE 320 or CSE 331 or CSE 335) R: Open to juniors or seniors or graduate students in the Department of Computer Science and Engineering or in the Computer Engineering major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science major.

Fundamental algorithms and techniques for 3D computer game development including geometric transformations, procedural and keyframe animation, models and scene graphs, skeletal animation and skinned characters, illuminations and shading, collision detection, and level of detail.

475 Introduction to Computational Linguistics
Fall. 3(3-0) Interdepartmental with Linguistics. Administered by Linguistics. P: CSE 232 and LIN 401

Computer science of linguistic theories and their application in natural language processing systems. Stochastic and categorical automata for morphological analysis. Rule systems for grammars. Parsing algorithms for syntactic and semantic analysis, with implications for cognitive models of human sentence processing. Probabilistic models of linguistic events.

480 Database Systems
Spring. 3(3-0) P: CSE 331 and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary teaching minor. SA: CPS 480

Storage of and access to physical databases including indexing, hashing, and range accesses. Relational data models, database design principles, query languages, query optimization, transaction processing and recovery techniques. Object-oriented and distributed databases.

484 Information Retrieval
Fall. 3(3-0) P: CSE 331 RB: STT 351 R: Open only to students in Computer Science or Computer Engineering or Lyman Briggs Computer Science major.

Retrieval models including Boolean, vector space, and probabilistic models. Architecture of information retrieval systems. Text clustering, categorization and filtering. Recommendation systems. Natural language processing for text retrieval. Information extraction, question answering. Multimedia retrieval. Digital libraries.

490 Independent Study in Computer Science
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to students in the Department of Computer Science or the Computer Engineering major. Approval of department; application required. SA: CPS 490

Supervised individual study in an area of computer science.

491 Selected Topics in Computer Science
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to students in the Department of Computer Science or the Computer Engineering major. Approval of department. SA: CPS 491

Topics selected to supplement and enrich existing courses and lead to the development of new courses.

498 Collaborative Design (W)
Fall, Spring. 4(2-4) P: ((CSE 335 and CSE 410) and completion of Tier I writing requirement) and (CSE 420 or CSE 422 or CSE 435 or CSE 440 or CSE 450 or CSE 452 or CSE 460 or CSE 471 or CSE 472 or CSE 480) R: Open only to students in the Department of Computer Science and Engineering. SA: CSE 449, CSE 478, CSE 479

Development of a comprehensive software and/or hardware solution to a problem in a team setting with emphasis on working with a client. Participation in a design cycle including specification, design, implementation, testing, maintenance, and documentation. Issues of professionalism, ethics, and communication.

802 Pattern Recognition and Analysis
Spring. 3(3-0) RB: (CSE 331 and MTH 314 and STT 441) or CSE 331 and MTH 314 and STT 441 R: Open to graduate students in the Department of Computer Science and Engineering or in the Department of Electrical and Computer Engineering.

Algorithms for classifying and understanding data. Statistical and syntactic methods, supervised and unsupervised machine learning. Cluster analysis and ordination. Exploratory data analysis. Methodology for design of classifiers.

803 Computer Vision
Fall. 3(3-0) RB: CSE 331 and MTH 314 and STT 351 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 803

Visual information processing problems. Human and machine vision systems. Image formation and transforms. Encoding, enhancement, edge detection, segmentation. 2D and 3D object description and recognition. Scene analysis. Applications.

809 Algorithms and Hardware Implementation
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. SA: EE 809

Arithmetic, signal processing, and image processing algorithms. Array structures: systolic architecture, data flow structure, neural network architecture. Performance analysis.

812 Advanced Operating Systems
Spring. 3(3-0) RB: CSE 410 and CSE 420 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 812

Parallel and distributed operating systems. Load sharing, scheduling, reliability, recovery, memory management. Distributed file systems, distributed agreement, and object-oriented operating systems.

813 Advanced VLSI Design
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. P: ECE 410 SA: EE 813

Advanced topics in digital integrated circuit design. Design specifications: functionality, performance, reliability, manufacturability, testability, cost. Standard cells. Design-rule checking. Circuit extraction, simulation, verification. Team-based design.

814 Formal Methods in Software Development
Fall of odd years. 3(3-0) RB: MTH 472 R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 814

Formal specification languages, integrating verification with development. Design and the implementation of term project.

820 Advanced Computer Architecture
Fall, Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Computer Science and Engineering. RB: CSE 410 and CSE 420 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 820

Instruction set architecture. Pipelining, vector processors, cache memory, high bandwidth memory design, virtual memory, input and output. Benchmarking techniques. New developments related to single CPU systems.

824 Advanced Computer Networks and Communications
Fall. 3(3-0) RB: CSE 422 R: Open only to graduate students in the Department of Computer Science and Engineering. SA: CPS 824

Advanced topics in emerging computer networking technologies, including high-speed wide area networks and local area networks, wireless and mobile computing networks, optical networks, and multimedia networking.

825 Computer and Network Security
Spring. 3(3-0) RB: CSE 410 and CSE 422

Threat assessments, secure software, intrusions and intrusion detection.

830 Design and Theory of Algorithms
Fall, Spring. 3(3-0) RB: CSE 232 and CSE 460 R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 830

Analysis of algorithms. Algorithm design techniques. Efficient algorithms for classical problems. Intractable problems and techniques to handle them.

835 Algorithmic Graph Theory
Spring. 3(3-0) RB: (CSE 232 and CSE 460) and (MTH 309 or MTH 314) R: Open to students in the Department of Computer Science and Engineering or approval of department. SA: CPS 835

Classical concepts in Graph Theory. Algorithmic aspects of graphs such as finding paths, network flow, spanning trees and matching.

841 Artificial Intelligence
Fall. 3(3-0) RB: CSE 440 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 841

Types of intelligence, knowledge representation, cognitive models. Goal-based systems, heuristic search and games, expert systems. Language understanding, robotics and computer vision, theorem proving and deductive systems, and learning.

842 Natural Language Processing
Spring of odd years. 3(3-0) RB: Programming skills, basic probability and statistics knowledge.

Models and algorithms for natural language processing including syntax, semantics, pragmatics, and discourse. Knowledge-based and statistical approaches to a variety of language related applications.

847 Machine Learning
Spring. 3(3-0) P: CSE 841 RB: Algorithms, programming in C or equivalent, probability and statistics, artificial intelligence. R: Open only to students in the Department of Computer Science and Engineering or approval of department.

Computational study of learning and data mining. Strengths and limitations of various learning paradigms, including supervised learning, learning from scalar reward, unsupervised learning, and learning with domain knowledge.

848 Evolutionary Computation
Fall of even years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Computer Science and Engineering. RB: CSE 841 and CSE 440 R: Open to graduate students in the Department of Computer Science and Engineering and open to graduate students in the Department of Electrical and Computer Engineering or approval of department.

Investigation of evolutionary computation from a historical, theoretical and application viewpoint. Readings from the present literature, experiments with provided software on the application of evolutionary computation principles.

860 Foundations of Computing
Spring of even years. 3(3-0) RB: CSE 460 R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 860

Models of computation: partial recursive functions, Turing machines, alternative models of computing. Basic theory and limitations of computability. Undecidability. Resource-bounded computational complexity, non-determinism, NP-completeness.

867 Nature and Practice of Cognitive Science
Spring. 3(3-0) Interdepartmental with Linguistics and Philosophy and Psychology and Zoology. Administered by Zoology. RB: Undergraduate course work in behavioral biology, cognitive psychology, philosophy, linguistics, or artificial intelligence.

Survey of how different disciplines explore the cognitive processes underlying intelligent behavior.

870 Advanced Software Engineering
Spring. 3(3-0) RB: (CSE 470) or undergraduate software engineering course R: Open only to students in the Department of Computer Science and Engineering.

Methods and techniques supporting later lifecycle activities, including software testing and maintenance, reuse, and reverse engineering. Domain-specific software engineering methods. Human-computer interfaces, distributed systems, and visualization techniques.

872 Advanced Computer Graphics
Fall. 3(3-0) RB: CSE 472

Advanced aspects of digital image generation, geometric modeling, computer animation and rendering methods.

875 Advanced Studies in Computational Linguistics
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Interdepartmental with Linguistics. Administered by Linguistics. P: (LIN 475)

Cutting-edge research in computational linguistics. Expressive formalisms such as tree-adjoining, type-logical and multi-component string grammars, and their associated parsing and learning problems. Robustness for spoken language understanding. Mathematical theories of language learnability. Logic and probability of finite state techniques.

880 Advanced Database Systems
Fall. 3(3-0) RB: CSE 480 R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 880

Distributed and object-oriented databases and knowledgebase systems. Design theory, query optimization, and transaction processing.

881 Data Mining
Fall. 3(3-0) RB: Programming skills in C, C++, Java and Matlab. Basic knowledge in calculus, probability and statistics.

Techniques and algorithms for knowledge discovery in databases, from data preprocessing and transformation to model validation and post-processing. Core concepts include association analysis, sequential pattern discovery, anomaly detection, predictive modeling, and cluster analysis. Application of data mining to various application domains.

Computer Science and Engineering—CSE

885   Artificial Neural Networks
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. SA: EE 885

Overview of neuro-engineering technology. Basic neural network architectures. Feedforward and feedback networks. Temporal modeling. Supervised and unsupervised learning. Implementation. Basic applications to pattern recognition.

890   Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Computer Science or Electrical Engineering majors. Approval of department. SA: CPS 890

Independent study of some topic, system, or language not covered in a regular course.

891   Selected Topics
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 891

Selected topics in computer science of current interest and importance but not covered in a regular course.

899   Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to Computer Science majors. Approval of department. SA: CPS 899

Master's thesis research.

902   Selected Topics in Recognition by Machine
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: CSE 802 and CSE 803 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 902

Advanced topics in pattern recognition and computer vision such as Markov random fields, modeling and recognition of three dimensional objects, and integration of visual modules.

910   Selected Topics in Computer Networks and Distributed Systems
Spring of even years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: CSE 422 and CSE 812 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 910

Advanced topics and developments in high-bandwidth computer networks, protocol engineering, and distributed computer systems.

912   Advanced Topics in Distributed Computing Systems
Spring of odd years. 3(3-0) RB: CSE 410 and CSE 812

Advanced topics and developments in Internet computing, distributed algorithm and operating systems, distributed middleware, high-performance distributed computing, peer-to-peer computing, security and fault tolerance of distributed systems, mobile computing, ubiquitous and pervasive computing, and distributed-data management.

914   Formal Methods in Software Development
Fall. 3(3-0) P: CSE 814 RB: Undergraduate courses in software engineering and in logic. R: Open only to students in the Department of Computer Science and Engineering. SA: CPS 914

Current research in selected areas of software engineering such as: approaches for the incorporation of formal methods in software development; current projects using formal methods in software engineering; object-oriented analysis and development techniques; and approaches for the incorporation of user-interface analysis and design in software development.

920   Selected Topics in High Performance Computer Systems
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. Interdepartmental with Electrical and Computer Engineering. Administered by Computer Science and Engineering. P: CSE 822 R: Open only to students in the Computer Science and Engineering major or approval of department. SA: CPS 920

Design of high performance computer systems. Seminar format.

921   Advanced Topics in Digital Circuits and Systems
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. SA: EE 921

Topics vary each semester.

921B   Embedded Architectures
Fall of odd years, Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. RB: ECE 809 and ECE 813 SA: EE 921B

Embedded computers and architectures for real-time computation and/or robust control. ASICs. Bit-slice architectures. Systolic arrays. Neural networks. Genetic algorithms. Implementation technologies and design issues.

941   Selected Topics in Artificial Intelligence
Fall. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: CSE 841 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 941

Topic such as second generation expert systems, human factors, natural language processing, speech understanding, neural networks, genetic algorithms and opportunistic planning.

960   Selected Topics in Algorithms and Complexity
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: CSE 830 and CSE 860 R: Open only to graduate students in the Department of Computer Science and Engineering. Approval of department. SA: CPS 960

Current research in the general theory of algorithms and computational complexity.

980   Selected Topics in Database Systems
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: CSE 880 R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 980

Recent developments in areas such as distributed and parallel database systems, object oriented database systems, knowledgebase and expert database systems.

999   Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Computer Science majors. Approval of department. SA: CPS 999

Doctoral dissertation research.