Computer Engineering (CPR E)

Courses primarily for undergraduates:

(Cross-listed with INFAS). (1-0) Cr. 1.
Basic concepts of practical computer and Internet security: passwords, firewalls, antivirus software, malware, social networking, surfing the Internet, phishing, and wireless networks. This class is intended for students with little or no background in information technology or security. Basic knowledge of word processing required. Offered on a satisfactory-fail basis only.

CPR E 168. Professional Programs Orientation.
(Cross-listed with E E). Cr. R. F.S.
(1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

CPR E 185. Introduction to Computer Engineering and Problem Solving I.
(2-3) Cr. 3. Prereq: CPR E 168

CPR E 186. Introduction to Computer Engineering and Problem Solving II.
(0-2) Cr. 1. S. Prereq: CPR E 185
Project based examples from computer engineering. Group skills needed to work effectively in teams. Group problem solving. Computer based projects. Technical reports and presentations. Students will work on 2 or 3 self-directed team based projects that are representative of problems faced by computer engineers.

CPR E 261. Transfer Orientation.
(Cross-listed with E E). Cr. R.
Introduction to the College of Engineering and the engineering profession specifically for transfer students. Information concerning university and college policies, procedures, and resources. Offered on a satisfactory-fail basis only.

CPR E 281. Digital Logic.
(3-3) Cr. 4. F.S. Prereq: sophomore classification
Number systems and representation. Boolean algebra and logic minimization. Combinational and sequential logic design. Arithmetic circuits and finite state machines. Use of programmable logic devices. Introduction to computer-aided schematic capture systems, simulation tools, and hardware description languages. Design of simple digital systems.

(3-2) Cr. 4. F.S. Prereq: CPR E 281, COM S 207 or COM S 227 or E E 285
Embedded C programming. Interrupt handling. Memory mapped I/O in the context of an application. Elementary embedded design flow/methodology. Timers, scheduling, resource allocation, optimization, state machine based controllers, real-time constraints within the context of an application. Applications laboratory exercises with embedded devices.

CPR E 294. Program Discovery.
(Cross-listed with E E). Cr. R. Prereq: CPR E 166 or E E 166
The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Offered on a satisfactory-fail basis only.

CPR E 298. Cooperative Education.
Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.

(3-3) Cr. 4. F.S. Prereq: CPR E 381, CPR E 310
Operating system concepts, processes, threads, synchronization between threads, process and thread scheduling, deadlocks, memory management, file systems, I/O systems, security, Linux-based lab experiments.

(3-0) Cr. 3. F.S. Prereq: Credit or enrollment in CPR E 288, COM S 228
Propositional logic and methods of proof; set theory and its applications; mathematical induction and recurrence relations; functions and relations; and counting; trees and graphs; applications in computer engineering.

(3-0) Cr. 3. F.S.SS. Prereq: CPR E 310
Solving computer engineering problems using algorithms. Emphasis on problems related to the core focus areas in computer engineering. Real world examples of algorithms used in the computer engineering domain. Algorithm engineering. Prototyping of algorithms.

CPR E 329. Software Project Management.
(Cross-listed with S E). (3-0) Cr. 3. Prereq: COM S 309

CPR E 330. Integrated Electronics.
(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 201, credit or enrollment in E E 230, CPR E 281

(Cross-listed with INFAS). (0-2) Cr. 1. Repeatable. S.
Participation in cyber defense competition driven by scenario-based network design. Includes computer system setup, risk assessment and implementation of security systems, as well as defense of computer and network systems against trained attackers. Team based. Offered on a satisfactory-fail basis only.

(Cross-listed with S E). (3-0) Cr. 3. Prereq: S E 319

CPR E 370. Toying with Technology.
(Cross-listed with MAT E). (2-2) Cr. 3. F.S. Prereq: C I 201 or C I 202
A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGO and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

(3-2) Cr. 4. F.S. Prereq: CPR E 288
Introduction to computer organization, evaluating performance of computer systems, instruction set design. Assembly level programming: arithmetic operations, control flow instructions, procedure calls, stack management. Processor design. Datapath and control, scalar pipelines, introduction to memory and I/O systems.

(Cross-listed with S E). (3-2) Cr. 4. Prereq: CPR E 288
Contemporary programming techniques for event driven systems. Mobile platforms and operating systems. Location and motion sensors based on technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

CPR E 394. Program Exploration.
(Cross-listed with E E). Cr. R. Prereq: CPR E 294 or E E 294
Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Offered on a satisfactory-fail basis only.
CPR E 396. Summer Internship.
Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services
Summer professional work period.

CPR E 397. Engineering Internship.
Cr. R. Repeatable. F.S.S.S. Prereq: Permission of department and Engineering Career Services
One semester maximum per academic year professional work period.

CPR E 398. Cooperative Education.
Cr. R. F.S.S.S. Prereq: CPR E 298, permission of department and Engineering Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

(Cross-listed with COM S, S E). (3-0) Cr. 3. S. Prereq: COM S 330 or CPR E 310; COM S 311, STAT 330
A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms, and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

CPR E 416. Software Evolution and Maintenance.
(Cross-listed with S E). (3-0) Cr. 3. Prereq: COM S 309
Practical importance of software evolution and maintenance, systematic defect analysis and debugging techniques, tracing and understanding large software impact analysis, program migration and transformation, refactoring, tools for software evolution and maintenance, experimental studies and quantitative measurements of software evolution. Written reports and oral presentation.

(Cross-listed with E E). (3-2) Cr. 4. F. Prereq: E E 230 and E E 311

CPR E 419. Software Tools for Large Scale Data Analysis.
(Cross-listed with S E). (3-3) Cr. 4. Prereq: CPR E 308 or COM S 352, COM S 309
Software tools for managing and manipulating large volumes of data, external memory processing, large scale parallelism, and stream processing, data interchange formats. Weekly programming labs that involve the use of a parallel computing cluster.

(Cross-listed with COM S). (3-1) Cr. 3. S. Prereq: COM S 311, COM S 330, ENGL 250, SP CM 212
Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports.

CPR E 426. Introduction to Parallel Algorithms and Programming.
(Dual-listed with CPR E 526). (Cross-listed with COM S). (3-2) Cr. 4. F. Prereq: CPR E 308 or COM S 321, CPR E 315 or COM S 311
Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

(3-0) Cr. 3. S. Prereq: credit or enrollment in CPR E 489 or COM S 454
Introduction to and application of basic mechanisms for protecting information systems from accidental and intentional threats. Basic cryptography use and practice. Computer security issues including authentication, access control, and malicious code. Network security mechanisms such as intrusion detection, firewalls, IPSec, and related protocols. Ethics and legal issues in information security. Wireless security. Programming and system configuration assignments.

CPR E 435. Analog VLSI Circuit Design.
(Cross-listed with E E). (3-3) Cr. 4. S. Prereq: E E 324, E E 330, E E 332, and either E E 322 or STAT 330
Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies, operational amplifiers, references, integrated filters, and data converters.

CPR E 444. Introduction to Bioinformatics.
(Cross-listed with BC6, BSBIO, BIOL, COM S, GEN). (4-0) Cr. 4. F. Prereq: MATH 165 or STAT 401 or equivalent
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

CPR E 450. Distributed Systems and Middleware.
(Dual-listed with CPR E 550). (3-0) Cr. Prereq: CPR E 308 or COM S 352
Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications.

CPR E 454. Distributed Systems.
(Dual-listed with CPR E 554). (Cross-listed with COM S). (3-1) Cr. 3. S. Prereq: COM S 311, COM S 352
(3-1) Cr. 3. Theoretical and practical issues of design and implementation of distributed systems. The client server paradigm, inter-process communications, synchronization and concurrency control, naming, consistency and replication, fault tolerance, and distributed file systems. Graduate credit requires additional in-depth study of concepts. Programming projects and written reports.

(Dual-listed with CPR E 558). (3-0) Cr. Prereq: CPR E 308 or COM S 352

(Cross-listed with E E). (3-3) Cr. 4. S. Prereq: E E 330
Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (SOC) considerations. VLSI chip design project.

CPR E 466. Multidisciplinary Engineering Design.
(Cross-listed with A B E, AER E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3.
Repeatable. F.S. Prereq: Student must be within two semesters of graduation and permission of instructor.
Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

CPR E 467. Multidisciplinary Engineering Design II.
(Cross-listed with AER E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. Prereq: Student must be within two semesters of graduation or receive permission of instructor.
Build and test of a conceptual design. Conceptual design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

(3-3) Cr. 4. S. Prereq: CPR E 381 or COM S 321
Introduction to hardware architectures for computer graphics and their programming models. System-level view, including framebuffers, video output devices, displays, 2D and 3D graphics acceleration, and device interfacing. Architectural design of GPUs, from 2D and 3D sprite engines to 3D rendering pipelines to unified shader architecture. Computing models for graphics processors, GPGPU and GPU computing.

CPR E 483. Hardware Software Integration.
(3-3) Cr. 4. S. Prereq: CPR E 381
Embedded system design using hardware description language (HDL) and field programmable gate array (FPGA). HDL modeling concepts and styles are introduced; focus on synthesizability, optimality, reusability and portability in hardware design description. Introduction to complex hardware cores for data buffering, data input/output interfacing, data processing. System design with HDL cores and implementation in FPGA. Laboratory-oriented design projects.
(3-3) Cr. 4. Prereq: CPR E 381 or COM S 321
Embedded microprocessors, embedded memory and I/O devices, component interfaces, embedded software, program development, basic compiler techniques, platform-based FPGA technology, hardware synthesis, design methodology, real-time operating system concepts, performance analysis and optimizations.

CPR E 489. Computer Networking and Data Communications.
(3-2) Cr. 4. F.S. Prereq: CPR E 381 or E E 324
Modern computer networking and data communications concepts. TCP/IP, OSI protocols, client server programming, data link protocols, local area networks, and routing protocols.

CPR E 490. Independent Study.
Cr. arr. Repeatable. Prereq: Senior classification in computer engineering Investigation of an approved topic.

CPR E 490H. Independent Study: Honors.
Cr. arr. Repeatable. Prereq: Senior classification in computer engineering Investigation of an approved topic.

CPR E 491. Senior Design Project I and Professionalism.
(Cross-listed with E E). (2-3) Cr. 3. F.S. Prereq: E E 322 or CPR E 308, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, ENGL 314 Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

CPR E 492. Senior Design Project II.
(Cross-listed with E E). (1-3) Cr. 2. F.S. Prereq: CPR E 491 or E E 491 Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

CPR E 494. Portfolio Assessment.
(Cross-listed with E E). Cr. R. Prereq: CPR E 394 or E E 394, credit or enrollment in CPR E 491 or E E 491 Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

CPR E 498. Cooperative Education.
Cr. R. Repeatable. F.S.S.S. Prereq: CPR E 398, permission of department and Engineering Career Services Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:


(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 435, Credit or Registration for E E 501 Theory, design and applications of power management and regulation circuits (Linear and switching regulators, battery chargers, and reference circuits) including: Architectures, Performance metrics and characterization, Noise and stability analysis, Practical implementation and on-chip integration issues, design considerations for portable, wireless, and RF SoCs.

CPR E 505. CMOS and BiCMOS Data Conversion Circuits.
(Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered even-numbered years. Prereq: E E 501 Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

CPR E 506. Design of CMOS Phase-Locked Loops.
(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 435 or E E 501 or instructor approval Analysis and design of phase-locked loops implemented in modern CMOS processes including: architectures, performance metrics, and characterization; noise and stability analysis; and design issues of phase-frequency detectors, charge pumps, loop filters (passive and active), voltage controlled oscillators, and frequency dividers.

CPR E 507. VLSI Communication Circuits.
(Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered odd-numbered years. Prereq: E E 435 or E E 501 Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

CPR E 511. Design and Analysis of Algorithms.
(Cross-listed with COM S). (3-0) Cr. 3. F. Prereq: COM S 311 A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

(Cross-listed with COM S, MATH). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: CPR E 308 or MATH 481; experience in scientific programming; knowledge of FORTRAN or C Introduction to parallelization techniques and numerical methods for state-of-the-art high performance computers. A major component will be a final project in an area related to each student’s research interests.

(Dual-listed with CPR E 426). (Cross-listed with COM S). (3-2) Cr. 4. F. Prereq: CPR E 308 or COM S 321, CPR E 315 or COM S 311 Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

(3-0) Cr. 3. Prereq: CPR E 315 or COM S 311 The application of randomization and probabilistic methods in the design of computer algorithms, and their efficient implementation. Discrete random variables in modeling algorithm behavior, with applications to sorting, selection, graph algorithms, hashing, pattern matching, cryptography, distributed systems, and massive data set algorithms.

(Cross-listed with INFAS). (3-0) Cr. 3. Prereq: CPR E 381 or equivalent Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols. Network security issues, attack and mitigation techniques. Emphasis on laboratory experiments.

(Cross-listed with INFAS). (3-0) Cr. 3. Prereq: CPR E 489 or CPR E 530 or COM S 586 or MIS 535 Computer, software, and data security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

CPR E 532. Information Warfare.
(Cross-listed with INFAS). (3-0) Cr. 3. S. Prereq: CPR E 531 Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Study and use of attack tools. Ethics in information assurance. Emphasis on laboratory experiments.

CPR E 533. Cryptography.
(Cross-listed with INFAS, MATH). (3-0) Cr. 3. S. Prereq: MATH 301 or CPR E 310 or COM S 330 Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

CPR E 534. Legal and Ethical Issues in Information Assurance.
(Cross-listed with INFAS, POL S). (3-0) Cr. 3. S. Prereq: Graduate classification; CPR E 531 or INFAS 531 Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.
(Cross-listed with INFAS, MATH). (3-0) Cr. 3. S. S., offered even-numbered  
years. Prereq: E E 524 or MATH 317 or MATH 407 or COM S 330  
Basic principles of covert communication, steganalysis, and forensic analysis for  
digital images. Steganographic security and capacity, matrix embedding, blind  
attacks, image forensic detection and device identification techniques. Related  
material on coding theory, statistics, image processing, pattern recognition.  
(Cross-listed with INFAS). (3-0) Cr. 3. Prereq: CPR E 489 or CPR E 530  
Fundamentals of computer and network forensics, forensic duplication and  
analysis, network surveillance, intrusion detection and response, incident  
response, anonymity and pseudonymity, privacy-protection techniques, cyber law,  
computer security policies and guidelines, court testimony and report writing, and  
case studies. Emphasis on hands-on experiments.  
(3-0) Cr. 3. S. Prereq: Credit or enrollment in CPR E 489 or CPR E 530  
Introduction to the physical layer and special issues associated with the security  
of wireless networks. The basics of wireless communication systems (antennas  
and propagation, modulation, multiple access, channel modeling, specific security  
issues of the wireless link), jamming and countermeasures (spread spectrum  
technologies, channel coding, interleaving), authentication and confidentiality  
(basics of classic cryptography, common authentication and encryption  
algorithms). Detailed case studies on authentication, encryption and privacy flaws,  
and good practices based on the most common wireless technologies, including  
WiFi, GSM/3G, Bluetooth, and RFID. Individual or team-based class projects.  
(Cross-listed with INFAS). (2-3) Cr. 3. S. S. Prereq: COM S 321 or CPR E 381, COM  
S 352 or CPR E 308  
Techniques and tools for understanding the behavior of software/hardware  
systems based on reverse engineering. Flaw hypothesis, black, grey, and white  
box testing as well as other methods for testing the security of software systems.  
Discussion of counter-reverse engineering techniques.  
CPR E 539. Cyber Physical System Security for the Smart Grid.  
(3-0) Cr. 3. S.  
Introduction to cyber security, cyber physical system (CPS), and smart grid  
automation technologies; supervisor control and data acquisition (SCADA)  
systems; cyber risk modeling, vulnerability analysis, impact analysis, defense  
and mitigation techniques; cyber security of wide-area monitoring, protection,  
and control; security and privacy in advanced metering infrastructure (AMI),  
cyber security compliance and best practices, CPS security test-beds and attack- 
defense hands-on laboratory experiments.  
CPR E 541. High-Performance Communication Networks.  
(3-0) Cr. 3. Prereq: CPR E 489 or CPR E 530  
Selected topics from recent advances in high performance networks; next  
generation internet; asynchronous transfer mode; traffic management, quality of  
service; high speed switching.  
CPR E 542. Optical Communication Networks.  
(3-0) Cr. 3. S. Prereq: CPR E 489  
Optical components and interfaces; optical transmission and reception techniques;  
Wavelength division multiplexing; network architectures and protocol for first  
generation, single and multihop optical network; routing and wavelength  
assignment in second generation wavelength routing networks; traffic grooming,  
optical network control; survivability; access networks; metro networks.  
(3-0) Cr. 3. Prereq: Credit or enrollment in CPR E 489 or CPR E 530  
Introduction to the protocol architecture of the data link layer, network layer  
and transport layer for wireless networking. Operation and management of  
Medium Access Control in Wireless Local Area Networks (WLAN) and Wireless  
Metropolitan Area Networks (WMAN); recent developments in IEEE 802.11 &  
802.16 and Bluetooth; Mobile IP; Mobile TCP.  
CPR E 544. Introduction to Bioinformatics.  
(Cross-listed with BCB, COM S, GDBS), (4-0) Cr. 4. F. Prereq: MATH 165 or  
STAT 401 or equivalent  
Broad overview of bioinformatics with a significant problem-solving component,  
including hands-on practice using computational tools to solve a variety of  
biological problems. Topics include: database searching, sequence alignment,  
gene prediction, RNA and protein structure prediction, construction of  
phylogenetic trees, comparative, functional genomics, and systems biology.  
CPR E 545. Fault-Tolerant Systems.  
(3-0) Cr. 3. Prereq: CPR E 381  
Faits and their manifestations, errors, and failures; fault detection, location and  
reconfiguration techniques; time, space, and information (coding) redundancy  
management; design for testability; self-checking and fail-safe circuits; system-  
level fault diagnosis; Byzantine agreement; stable storage and RAID; clock  
synchronization; fault-tolerant networks; fault tolerance in real-time systems;  
reliable software design; checkpointing and rollback recovery; atomic actions;  
replica management protocols; and reliability evaluation techniques and tools.  
(3-0) Cr. 3. Prereq: CPR E 489 or CPR E 530  
Fundamental and well-known protocols for wireless ad hoc and sensor networks  
at various layers, including physical layer issues, MAC (medium access control)  
layer protocols, routing protocols for wireless ad hoc and sensor networks,  
data management in sensor networks, coverage and connectivity, localization  
and tracking, security and privacy issues. Introduction to TinyOS and the nesC  
language. Hands-on experiments with Crossbow Mote sensor devices.  
(3-0) Cr. 3.  
Analytical approach to resource allocation on communication networks (e.g. the  
Internet, multihop wireless networks, etc.). Network utility maximization and the  
internet congestion control algorithm. Layering as optimization decomposition: a  
cross-layer design approach in multihop wireless networks. Capacity of ad hoc  
wireless networks.  
(Cross-listed with COM S). (3-0) Cr. 3. Alt., S., offered even-numbered years.  
Prereq: COM S 311 and either COM S 228 or COM S 208  
Design and analysis of algorithms for applications in computational biology,  
pairwise and multiple sequence alignments, approximation algorithms, string  
algorithms including in-depth coverage of suffix trees, semi-numerical string  
algorithms, algorithms for selected problems in fragment assembly, phylogenetic  
trees and protein folding. No background in biology is assumed. Also useful as an  
advanced algorithms course in string processing.  
CPR E 550. Distributed Systems and Middleware.  
(Dual-listed with CPR E 450). (3-0) Cr. 3. Prereq: CPR E 308 or COM S 352  
Fundamentals of distributed computing, software agents, naming services,  
distributed transactions, security management, distributed object-based systems,  
web-based systems, middleware-based application design and development, case  
studies of middleware and internet applications.  
CPR E 554. Distributed Systems.  
(Dual-listed with CPR E 454). (Cross-listed with COM S). (3-1) Cr. 3. S. Prereq:  
COM S 311, COM S 352  
Design and analysis techniques scalable to large software, project-based  
learning of problem solving techniques, automation tools for high productivity and  
reliability of software, analysis-based measurement and estimation techniques for  
predictable software engineering.  
(Cross-listed with COM S, M E). (3-0) Cr. 3. F. S. Prereq: M E 421, programming  
experience in C  
Fundamentals of computer graphics technology. Data structures. Parametric curve  
and surface modeling. Solid model representations. Applications in engineering  
design, analysis, and manufacturing.  
(Dual-listed with CPR E 458). (3-0) Cr. 3. Prereq: CPR E 308 or COM S 352  
Fundamental concepts in real-time systems. Real time task scheduling paradigms.  
Resource management in uniprocessor, multiprocessor, and distributed real-time  
systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time  
channel, packet scheduling, and real-time LAN protocols. Case study of real-time  
operating systems. Laboratory experiments.  
(3-0) Cr. 3. Prereq: CPR E 465  
Physical design of VLSI systems. Partitioning algorithms. Placement and  
Physical design of FPGA’s and MCM’s. Performance-driven layout synthesis.
CPR E 567. Bioinformatics I (Fundamentals of Genome Informatics). (Cross-listed with BCB, COM S). (3-0) Cr. 3. F. Prereq: CPR E 281; CPR E 530; STAT 341; credit or enrollment in BIOL 315, STAT 430


CPR E 569. Bioinformatics III (Structural Genome Informatics). (Cross-listed with BBMB, BCB, COM S). (3-0) Cr. 3. F. Prereq: BCB 567, GEN 411, STAT 430


CPR E 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology). (Cross-listed with BCB, COM S, GDCB, STAT). (3-0) Cr. 3. S. Prereq: BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430


CPR E 575. Computational Perception. (Cross-listed with COM S, HCI). (3-0) Cr. 3. S. Prereq: Graduate standing or permission of instructor

This class covers statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. Participation in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

CPR E 581. Computer Systems Architecture. (Cross-listed with COM S). (3-0) Cr. 3. F. Prereq: CPR E 381

Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing. I/O devices and peripherals.

CPR E 582. Computer Systems Performance. (3-0) Cr. 3. Prereq: CPR E 381, CPR E 310 and STAT 330

Review of probability and stochastic processes concepts; Markovian processes; Markovian queue; renewal theory; semi-Markovian queue; queuing networks, applications to multiprocessor architectures, computer networks, and switching systems.

CPR E 583. Reconfigurable Computing Systems. (Cross-listed with COM S). (3-0) Cr. 3. Prereq: Background in computer architecture, design, and organization

Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurability.

CPR E 584. Models and Techniques in Embedded Systems. (3-0) Cr. 3.

Industry-standard tools and optimization strategies; practical embedded platforms and technology (reconfigurable platforms, multi-core platforms, low-power platforms); instruction augmentation, memory-mapped accelerator design, embedded software optimization. Students will be encouraged to compete as teams in an embedded system design competition.

CPR E 585. Developmental Robotics. (Cross-listed with HCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: knowledge of C/C++ programming language.

An introduction to the emerging interdisciplinary field of Developmental Robotics, which crosses the boundaries between robotics, artificial intelligence, developmental psychology, and philosophy. The main goal of this field is to create autonomous robots that are more intelligent, more adaptable, and more useful than the robots of today, which can only function in very limited domains and situations.

CPR E 596. Pervasive Computing. (3-0) Cr. 3. Prereq: CPR E 498 or CPR E 530

Fundamentals of pervasive computing, including location and context awareness, mobile and location services, ubiquitous data access, low power computing and energy management, middleware, security and privacy issues.

CPR E 588. Embedded Computer Systems. (3-0) Cr. 3. Prereq: CPR E 308


CPR E 590. Special Topics.

Cr. 1-6. Repeatable. Formulation and solution of theoretical or practical problems in computer engineering.

CPR E 592. Seminar in Computer Engineering.

Cr. 1-4. Repeatable. Prereq: Permission of instructor Projects or seminar in Computer Engineering.

CPR E 594. Selected Topics in Computer Engineering. (3-0) Cr. 3. Repeatable.

CPR E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:

CPR E 626. Parallel Algorithms for Scientific Applications. (Cross-listed with COM S). (3-0) Cr. 3. Prereq: CPR E 526

Algorithm design for high-performance computing. Parallel algorithms for multidimensional tree data structures, space-filling curves, random number generation, graph partitioning and load balancing. Applications to grid and particle-based methods and computational biology.

CPR E 632. Information Assurance Capstone Design. (Cross-listed with INFAS). (3-0) Cr. 3. Prereq: INFAS 531, INFAS 532, INFAS 534

Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attack each other’s secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report.

CPR E 681. Advanced Topics in Computer Architecture. (Cross-listed with COM S). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: CPR E 581. Repeatable with Instructor permission

Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

CPR E 697. Engineering Internship.

(Cross-listed with E E). Cr. R. Repeatable. One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

CPR E 699. Research.

Cr. arr. Repeatable.