Department of Computer Science and 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. 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
Spring. 3(1-3) P: (MTH 124 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 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 MTH 152H or LB 118) 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.

220 Programming in C
Fall, Spring. 3(2-2) P: (EGR 100 or ECE 101) and ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently)) R: Open to undergraduate students. Not open to students with credit in CSE 251.
Basics of programming in C. Data types, operators, control, functions, arrays, pointers, file processing, testing and debugging.

231 Introduction to Programming I
Fall, Spring. 4(3-2) P: (LB 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 (LB 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 LB 119 SA: CPS 260

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; application required. 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 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 College or in the Computer Science Disciplinary Teaching Minor. SA: CPS 320
Computer and processor architecture. Memory hierarchy and storage devices. Input-output and peripheral devices. Advanced architectures.

325 Introduction to Computer Security
Spring. 3(3-0) P: (STT 351 or ECE 280) and (CSE 410 or concurrently) 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 College or in the Computer Science Disciplinary Teaching Minor. SA: CPS 325
Introduction to computer security. Threats, types of attacks, countermeasures. Operating systems. Cryptography, authentication, and digital signatures.

330 Algorithms and Data Structures
Fall, Spring. 3(3-0) P: CSE 232 and CSE 260 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 College or in the Computer Science Disciplinary Teaching Minor. SA: CSE 330
Introduction to the theory and practice of computer science. Topics: elementary data structures, sorting algorithms, searching algorithms, graph algorithms, and the analysis of algorithms.
Computer Science and Engineering—CSE

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.

435 Software Engineering
Fall. 3(3-0) P: (CSE 331 and CSE 335) and completion of Tier I writing requirement 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: 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 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 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 students 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 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 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.

460 Computability and Formal Language Theory
Fall, Spring. 3(3-0) P: CSE 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: 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, recursive-ly 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. SA: CPS 472 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: 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. 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: 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. SA: CPS 472 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.

476 Mobile Application Development
Spring. 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. SA: CPS 472 Software development techniques for mobile devices such as smart phones and tablet computers.

477 Web Application Architecture and Development
Spring. 3(3-0) P: CSE 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 472 Fundamentals of World Wide Web (WWW) programming, including protocols, client-server interaction, markup languages, client- and server-side programming, databases, and remote procedure calls. Development of a WWW server and WWW sites with browser-based interfaces to remote databases. Students will incorporate scaling, throughput, and latency considerations in the development of widely-distributed systems.

480 Database Systems
Spring. 3(3-0) P: CSE 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 480 Storage of and access to 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
Spring. 3(3-0) P: CSE 331 RB: STT 351 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 484 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 to students in the College of Engineering or in 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 9 credits in all enrollments for this course. 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. Approval of department. SA: CPS 491 Topics selected to supplement and enrich existing courses and lead to the development of new courses.
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.

801 Introduction to Computational Science for Evolutionary Biologists Fall. (3-0) R. Requires a strong background in molecular biology, evolution, or ecology. R: Not open to students in the College of Engineering or in the Department of Computer Science and Engineering. Approval of department.
Introductory and intermediate programming and scripting for data analysis and modeling. Algorithmic considerations. Scientific controls, workflows, and reproducibility.

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

814 Formal Methods in Software Development Fall of odd years. 3(3-0) R: 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) R: MTH 420: R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 820

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

825 Computer and Network Security Spring. 3(3-0) R: CSE 410 and CSE 422 Threat assessments, secure software, intrusions and intrusion detection.

831 Design and Theory of Algorithms Fall, Spring. 3(3-0) R: CSE 232 and CSE 460: R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 831 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) R: CSE 232 and CSE 460: R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 835

836 Probabilistic Models and Algorithms in Computational Biology Spring. 3(3-0) R: CSE 331: R: Basic understanding of data structures; probabilities; programming experiences (no restriction to programming language)

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

847 Machine Learning Spring. 3(3-0) P: CSE 841: R: 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.

848 Evolutionary Computation Spring of even years. 3(3-0) R: CSE 440: R: Open to graduate students in the Department of Computer Science and 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) R: 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) 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.

880  Advanced Database Systems
     Fall. 3(3-0) 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.

885  Artificial Neural Networks

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) A student may earn a maximum of 9 credits in all enrollments for this course. 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) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to majors in the Department of Computer Science and Engineering. 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. R: Open to students in the Computer Science 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. RB: Open only to Computer Science majors. Approval of department. SA: EE 921
     Topics vary each semester.

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 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 36 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to graduate students in the Computer Science Major. Approval of department. SA: CPS 999
     Doctoral dissertation research.