COMPUTER SCIENCE AND ENGINEERING  CSE

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.


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.

102 Algorithmic Thinking and Programming
Fall, Spring. 3(2-2) P: (MTH 103 or MTH 103B or MTH 116 or MTH 124 or MTH 152H or LB 118) or designated score on Mathematics Placement Test Not open to students with credit in CSE 231.

Fundamentals of computing, algorithms and programming, using a high-level language such as Python.

201 Fundamentals of Information Technology
Fall, Spring. 3(3-0) P: (CSE 102 or CSE 220 or CSE 231) and (MTH 103 or MTH 103B or MTH 116 or MTH 124 or MTH 132 or MTH 152H or LB 118) or designated score on Mathematics Placement Test Not open to students with credit in CSE 231.

Fundamentals of applied computing and computational thinking.

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 all undergraduates. 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 or CMSE 202) 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.

260 Discrete Structures in Computer Science
Fall, Spring. 4(5-0) 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. SA: CPS 291

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

300 Social, Ethical, and Professional Issues in Computer Science
Fall, Spring. 1(1-0) R: Open to undergraduates.

Professional responsibilities and informed judgments in computing practice based on legal and ethical principles. Local and global impacts of computing solutions on individuals, organizations, and society.

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 Major or in the Data Science Major.


331 Algorithms and Data Structures
Fall, Spring. 3(3-0) P: (CSE 232) and (CSE 260 or CMSE 202) 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 Data Science Major and open to juniors or seniors in the College of Engineering.

Design, analysis, and application of fundamental algorithms and data structures in computer science.

335 Object-oriented Software Design
Fall, Spring. 4(4-0) 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 Major or in the Computer Science Disciplinary Teaching Minor.


402 Biometrics and Pattern Recognition
Spring. 3(3-0) P: (CSE 331) and (STT 351 or STT 430 or STT 441) and MTH 314 and (MTH 234 or MTH 254H or LB 220) R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major.

Automated techniques used for feature extraction and pattern matching focusing on face, fingerprint and iris recognition.

404 Introduction to Machine Learning
Spring. 3(3-0) Interdepartmental with Computational Mathematics, Science, and Engineering and Statistics and Probability. Administered by Computer Science and Engineering. P: (CSE 331) and (STT 351 or STT 380 or STT 430 or STT 441) and MTH 314 R: Open to seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major.

Core principles and techniques for machine learning including algorithms, model design, and programming.

410 Operating Systems
Spring. 3(3-0) P: (CSE 232 and CSE 260) and CSE 325 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

Theory and application of modern computer operating systems.
415 Introduction to Parallel Computing—Spring, 3(3-0) P: (CSE 320 or ECE 331) and (MTH 314 or ECE 280) and CSE 331 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. Not open to students with credit in CMSE 401.

420 Computer Architecture Spring of odd years, 3(3-0) P: (CSE 232 and CSE 260) and CSE 325 R: Open to juniors or seniors in the College of Engineering 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

422 Computer Networks Fall, Spring, 3(3-0) P: (STT 351 or ECE 280 or STT 430 or STT 441) and CSE 325 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major. SA: CPS 422

425 Introduction to Computer Security Spring, 3(3-0) P: (CSE 442 or concurrently) or (ECE 442 or concurrently) R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

429 Interdisciplinary Topics in CyberSecurity Spring, 3(3-0) Interdepartmental with Criminal Justice. Administered by Computer Science and Engineering. P: CSE 102 or CSE 231 R: Open to juniors or seniors or graduate students.

431 Algorithm Engineering Fall, Spring, 3(3-0) P: CSE 331 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

433 Autonomous Vehicles Spring, 3(3-2) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. P: ECE 331 or CSE 331 RB: Prerequisite or concurrent. Python R: Open to juniors or seniors in the College of Engineering.

434 Software Engineering Spring, 3(3-0) P: (CSE 331 and CSE 335) and completion of Tier I writing requirement R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

440 Introduction to Artificial Intelligence Spring, 3(3-0) P: (CSE 331) and (MTH 314 or ECE 280) R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. SA: CPS 440

444 Information Technology Project Management Spring, 3(3-0) Interdepartmental with Information Technology Management and Media and Information. Administered by Information Technology Management. P: ITM 311 R: Open to students in the Information Technology Minor.

450 Translation of Programming Languages Spring, 3(3-0) P: CSE 331 and (CSE 320 or ECE 331) R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major. SA: CPS 450

460 Computability and Formal Language Theory Spring, 3(3-0) P: CSE 331 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. SA: CSE 360

471 Media Processing and Multimedia Computing Spring, 3(3-0) P: CSE 320 or CSE 331 or CSE 335 and (MTH 314 or ECE 280) R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

472 Computer Graphics Spring, 3(3-0) P: (CSE 331 or CSE 335) and (MTH 314 or ECE 280) R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major. SA: CPS 472

477 Web Application Architecture and Development Spring, 3(3-0) P: CSE 320 or CSE 331 or CSE 335 R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. SA: CPS 477

480 Database Systems Spring, 3(3-0) P: CSE 331 or CSE 335 R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. SA: CPS 480

482 Big Data Analysis Spring, 3(3-0) P: (CSE 331) and (STT 351 or STT 380 or STT 430) and STT 441 and MTH 314 and (MTH 234 or MTH 254H or LB 220) R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Data Science Major. SA: CPS 482

490 Principles and technologies for database systems, algorithms, languages, and applications.
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 Computer Engineering Major or in the Computer Science 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 Computer Engineering Major or in the Computer Science 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.

492 Selected Topics in Data Science
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. Interdepartmental with Computational Mathematics, Science, and Engineering and Statistics and Probability. Administered by Computational Mathematics, Science, and Engineering. R: Approval of department. SA: CPS 492

Topics selected to supplement and enrich existing courses in Data Science.

495 Experiential Learning in Data Science (W)
Fall, Spring. 4(2-4) Interdepartmental with Computational Mathematics, Science, and Engineering and Statistics and Probability. Administered by Computational Mathematics, Science, and Engineering. R: Probability, some linear algebra, and some geometry. Some programming background such as familiarity with Python and scripting/command line usage in various operating systems. R: Open to graduate students in the Business Analytics Major. Introduction to data retrieval, processing, analysis, and visualization.

SA: CPS 495

499 Undergraduate Research
Fall, Spring, Summer. 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 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. Approval of department. Independent undergraduate research in contemporary areas of computer science.

SA: CPS 499

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

SA: CPS 801A

801A Introduction to Big Data Analysis
Spring, 3(3-0) R: Probability, some linear algebra, and some geometry. Some programming background such as familiarity with Python and scripting/command line usage in various operating systems. R: Open to graduate students in the Business Analytics Major. Introduction to data retrieval, processing, analysis, and visualization.

SA: CPS 801A

802 Pattern Recognition and Analysis
Spring, 3(3-0) R: (CSE 331 and MTH 314) or CSE 331 and MTH 314 and CSE 420. 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.

SA: CPS 802

803 Computer Vision

SA: CPS 803

812 Distributed Systems
Spring, 3(3-0) R: CSE 410. R: Open to students in the Electrical Engineering Major or in the Computer Science Major. SA: CPS 812

Principles, paradigms, techniques used in distributed systems. Assurance techniques for distributed systems. Fault-tolerance and security issues in distributed systems. Research issues in the design and implementation of distributed systems.
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.

836 Probabilistic Models and Algorithms in Computational Biology
Spring. 3(3-0) P: CSE 331 RB: Basic understanding of data structures; probabilities; programming experiences (no restriction to programming language)
Canonical probabilistic models and algorithms used in important bioinformatics tools.

841 Artificial Intelligence
Spring. 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.

843 Language and Interaction
Spring of even years. 3(3-0) RB: Programming skills. Basic probability and statistical knowledge. Artificial intelligence.
Introduction to foundations and the state-of-the-art technology enabling natural language communication with artificial agents. Speech recognition, acoustic modeling and language modeling, dialogue and discourse modeling, psycholinguistic studies on situated human language processing, and their applications in situated human robot dialogue.

845 Multi-disciplinary Research Methods for the Study of Evolution
Spring. 3(3-0) Interdepartmental with Integrative Biology and Microbiology and Molecular Genetics. Administered by Computer Science and Engineering.
Techniques for engaging in multi-disciplinary research collaborations, including biology, computer science, and engineering. Students engage in group projects to answer fundamental questions about the dynamics of actively evolving systems including both natural and computational. Multi-disciplinary teams will learn to overcome discipline-specific language and conceptual issues. Experimental design, statistical analysis, data visualization, and paper and grant writing for multi-disciplinary audiences.

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
Spring 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

867 Nature and Practice of Cognitive Science
Spring. 3(3-0) Interdepartmental with Integrative Biology and Linguistics and Philosophy and Psychology. Administered by Psychology. RB: Undergraduate course work in behavioral biology, cognitive psychology, philosophy, linguistics, or artificial intelligence. SA: ZOL 867
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
Spring. 3(3-0) RB: CSE 472
Advanced aspects of digital image generation, geometric modeling, computer animation and rendering methods.

881 Data Mining
Spring. 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
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. SA: EE 885

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.

898 Master's Project
Spring. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to students in the Department of Computer Science and Engineering. Approval of department.
In depth student project where the student performs original research, research replication, or survey and reporting on a topic such as system design and development, or system conversion or installation.

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 892 and CSE 893 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.

914  Formal Methods in Software Development
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P: CSE 814 RB: Undergraduate courses in software engineering and in logic. R: Open to graduate students 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.

941  Selected Topics in Artificial Intelligence
Spring. 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 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.