Course Descriptions - Computer Science and Software Engineering

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For current information on course offerings, see the department's web site: www.cs.rose-hulman.edu.

CSSE 120 Introduction to Software Development  3R-3L-4C F, W, S

An introduction to procedural and object-oriented programming with an emphasis on problem solving. Students will solve problems by developing software in both an interpreted language (Python) and a compiled language (C). Problems may include visualizing scientific or commercial data, interfacing with external hardware such as robots, or solving numeric problems from a variety of engineering disciplines. Procedural programming concepts covered include data types, variables, control structures, arrays, and data I/O. Object-oriented programming concepts covered include object creation and use, object interaction, and the design of simple classes. Software engineering concepts covered include testing, incremental development, understanding requirements, and teamwork.

CSSE 220 Object-Oriented Software Development  3R-3L-4C F,W,S Prerequisite: CSSE 120

Object-oriented programming concepts, including the use of inheritance, interfaces, polymorphism, abstract data types, and encapsulation to enable software reuse and assist in software maintenance. Recursion, GUIs and event handling. Use of common object-based data structures, including stacks, queues, lists, trees, sets, maps, and hash tables. Space/time efficiency analysis. Testing. Introduction to UML.

CSSE 221 Fundamentals of Software Development Honors 3R-3L-4C F Prerequisite: A score of 4 or 5 on the APCS A exam or permission of instructor

This course is intended for students who have sufficient programming experience to warrant placement in an accelerated course covering the topics from CSSE 120 and CSSE 220. This course will satisfy the prerequisite requirements for courses that have CSSE 220 as a prerequisite.

CSSE 230 Data Structures and Algorithm Analysis 3R-3L-4C W,S Prerequisites: CSSE 220 or CSSE 221 or a score of 4 or 5 on the APCS AB exam

This course reinforces and extends students' understanding of current practices of producing object-oriented software. Students extend their use of a disciplined design process to include formal analysis of space/time efficiency and formal proofs of correctness. Students gain a deeper understanding of concepts from CSSE 220, including implementations of abstract data types by linear and non-linear data structures. This course introduces the use of randomized algorithms. Students design and implement software individually, in small groups, and in a challenging multi-week team project.

CSSE 232 Computer Architecture I 3R-3L-4C F, W Prerequisites: CSSE 120 and ECE 130

Computer instruction set architecture and implementation. Specific topics include historical perspectives, performance evaluation, computer organization, instruction formats, addressing modes, computer arithmetic, ALU design, floating-point representation, single-cycle and multi-cycle data paths, and processor control. Assembly language programming is used as a means of exploring instruction set architectures. The final project involves the complete design and implementation of a miniscule instruction set processor.

CSSE 241 Computing in a Global Society 2R-6L-4C Arr Prerequisite: CSSE 220 or CSSE 221

The ability to work with colleagues from other cultures and to work on international projects are key assets in today's job market. The centerpiece of this course is a real-world computing project that students develop in cooperation with peers from an institution of higher education in a foreign country. Exposes students to the procedures and complexities of working on projects that span many time-zones and cultures. Additionally, students examine the use and impact of computing in a global community. International travel is required; students will be expected to incur additional expenses.
(will vary depending on the project, institution, and country). May be repeated once (for free elective credit only) if the country involved is different.

CSSE 304 Programming Language Concepts 4R-0L-4C Prerequisite: CSSE230 and MA275
Syntax and semantics of programming languages. Grammars, parsing, data types, control flow, parameter passing, run-time storage management, binding times, functional programming and procedural abstraction, syntactic extensions, continuations, language design and evaluation. Students will explore several language features by writing an interpreter that implements them.

CSSE 325 Fractals and Chaotic Dynamical Systems 4R-0L-4C Prerequisites: CSSE 220 or CSSE 221, and MA 222

CSSE 332 Operating Systems 3R-3L-4C Prerequisites: CSSE 220 or CSSE 221, and CSSE 232
Students learn fundamental concepts of modern operating systems by studying how and why operating systems have evolved. Topics include CPU scheduling, process synchronization, memory management, file systems, I/O systems, privacy and security, and performance evaluation. Students implement parts of an operating system as a means of exploring the details of some of these topics.

CSSE 333 Database Systems 3R-3L-4C W Prerequisite: MA 275 and CSSE 230 (or concurrent enrollment in CSSE 230)
Relational database systems, with emphasis on entity relationship diagrams for data modeling. Properties and roles of transactions. SQL for data definition and data manipulation. Use of contemporary APIs for access to the database. Enterprise examples provided from several application domains. The influence of design on the use of indexes, views, sequences, joins, and triggers. Physical level data structures: B+ trees and RAID. Survey of object databases.

CSSE 351 Computer Graphics 4R-0L-4C Prerequisites: CSSE 220 or CSSE 221, and MA 221
Computer graphics algorithms, hardware and software. Line generators, affine transformations, line and polygon clipping, interactive techniques, perspective projection, solid modeling, hidden surface algorithms, lighting models, shading, and graphics standards. Programming assignments and a final project are required.

CSSE 371 Software Requirements and Specification 4R-0L-4C F Prerequisite: CSSE 230, CSSE372 or concurrent enrollment in CSSE372, and Junior standing
Basic concepts and principles of software requirements engineering, its tools and techniques, and methods for modeling software systems. Topics include requirements elicitation, prototyping, functional and non-functional requirements, object-oriented techniques, and requirements tracking.

CSSE 372 Software Project Management 4R-0L-4C W Prerequisite: CSSE230, CSSE 371 or concurrent enrollment in CSSE371, and Junior standing.
Major issues and techniques of project management. Project evaluation and selection, scope management, team building, stakeholder management, risk assessment, scheduling, quality, rework, negotiation, and conflict management. Professional issues including career planning, lifelong learning, software engineering ethics, and the licensing and certification of software professionals.

CSSE 373 Formal Methods in Specification and Design 4R-0L-4C F Prerequisite: CSSE230 and MA275
Introduction to the use of mathematical models of software systems for their specification and validation. Topics include finite state machine models, models of concurrent systems, verification of models, and limitations of these techniques.

CSSE 374 Software Architecture and Design 4R-0L-4C W Prerequisite: CSSE 371
Introduction to the architecture and design of complete software systems, building on components and patterns. Topics include architectural principles and alternatives, design documentation, and relationships between levels of abstraction.

CSSE 375 Software Construction and Evolution 4R-0L-4C F Prerequisite: CSSE 371
Issues, methods and techniques associated with constructing software. Topics include
detailed design methods and notations, implementation tools, coding standards and styles, peer review techniques, and maintenance issues.

**CSSE 376 Software Quality Assurance 4R-0L-4C S Prerequisite: CSSE 230**
Theory and practice of determining whether a product conforms to its specification and intended use. Topics include software quality assurance methods, test plans and strategies, unit level and system level testing, software reliability, peer review methods, and configuration control responsibilities in quality assurance.

**CSSE 377 Software Architecture and Design II 4R-0L-4C S Pre: CSSE 374 or consent of instructor**
This is a second course in the architecture and design of complete software systems, building on components and patterns. Topics include architectural principles and alternatives, design documentation, relationships between levels of abstraction, theory and practice of human interface design, creating systems which can evolve, choosing software sources and strategies, prototyping and documenting designs, and employing patterns for reuse. How to design systems which a team of developers can implement, and which will be successful in the real world.

**CSSE 404 Compiler Construction 4R-0L-4C S Prerequisites: CSSE 232, CSSE 304, and CSSE/MA474**
Theory and practice of programming language translation. Lexical analysis, syntax analysis, parser generators, abstract syntax, symbol tables, semantic analysis, intermediate languages, code generation, code optimization, run-time storage management, error handling. Students will construct a complete compiler for a small language.

**CSSE 413 Artificial Intelligence 4R-0L-4C Prerequisite: CSSE 230**
Students investigate how to model and implement intelligent behavior using computers. Topics are chosen from how machines can: solve problems; reason and use knowledge; learn from experience; and perceive and act. Students explore these topics by implementing many of the ideas in software. Readings are drawn both from a textbook and from technical papers in recent conferences and journals.

**CSSE 432 Computer Networks 4R-0L-4C Prerequisite: CSSE 220 or CSSE 221**
Organization, design, and implementation of computer networks, especially the Internet. Network protocols, protocol layering, flow control, congestion control, error control, packet organization, routing, gateways, connection establishment and maintenance, machine and domain naming, security. Each of the top four layers of the Internet protocol stack: application (FTP, HTTP, SMTP), transport (TCP, UDP), network (IP), link (Ethernet).

**CSSE 433 Advanced Database Systems 4R-0L-4C Prerequisite: CSSE 333**
Topics selected from object-oriented databases, object-relational databases, query processing, transactions, transaction logging, concurrency control, database recovery, parallel and distributed databases, security and integrity, data mining and data warehousing.

**CSSE 442 Computer Security 4R-0L-4C W Prerequisites: CSSE 332 and MA 275**
This course introduces ethical, theoretical, and practical issues of information security in computing systems. Implications of relevant professional codes of ethics are a recurring theme of the course. Foundational topics include access control matrices and standard system models, as well as policies for security, confidentiality, and integrity. Implementation issues include key management, cipher techniques, authentication, principles of secure design, representation of identity, access control mechanisms, information flow, life cycle issues, and formal evaluation and certification techniques. Additional topics include malicious logic, vulnerability analysis, and auditing. Computer network attack techniques are discussed and explored in a closed environment to motivate and inform discussion and exploration of computer network defense techniques.

**CSSE 451 Advanced Computer Graphics 4R-0L-4C Prerequisite: CSSE 351**
Advanced topics in computer graphics. Topics will be drawn from current graphics research and will vary, but generally will include ray tracing, radiosity, physically-based modeling, animation, and stereoscopic viewing. Programming assignments and a research project are required.

**CSSE 453 Topics in Artificial Intelligence 4R-0L-4C Prerequisite: CSSE 413**
Advanced topics in artificial intelligence. Topics will vary. Past topics have included machine game playing and machine learning. May be repeated for credit if topic is different.

**CSSE 461 Computer Vision 4R-0L-4C Prerequisites: CSSE 220 or CSSE 221, and MA 221 (MA 371 or MA 373 recommended)**
An introduction to 3D computer vision techniques. Both theory and practical applications will be covered. Major topics include image features, camera calibration, stereopsis, motion, shape from x, and recognition.

**CSSE 463 Image Recognition 4R-0L-4C Prerequisites: Junior standing, MA221 and programming experience**
Introduces statistical pattern recognition of visual data; low-level visual feature extraction (color, shape, edges); clustering and classification techniques. Applies knowledge to various application domains through exercises, large programming projects in Matlab, and an independent research project. Familiarity with probability distributions will be helpful, but not required.

**CSSE 473 Design and Analysis of Algorithms 4R-0L-4C Prerequisites: CSSE 230 and MA 375**
Students study techniques for designing algorithms and for analyzing the time and space efficiency of algorithms. The algorithm design techniques include divide-and-conquer, greedy algorithms, dynamic programming, randomized algorithms and parallel algorithms. The algorithm analysis includes computational models, best/average/worst case analysis, and computational complexity (including lower bounds and NP-completeness). Same as MA 473.

**CSSE 474 Theory of Computation 4R-0L-4C Prerequisites: CSSE 230 and MA 375**
Students study mathematical models by which to answer three questions: What is a computer? What limits exist on what problems computers can solve? What does it mean for a problem to be hard? Topics include models of computation (including Turing machines), undecidability (including the Halting Problem) and computational complexity (including NP-completeness). Same as MA 474.

**CSSE 479 Cryptography 4R-0L-4C Prerequisites: CSSE 220 or CSSE 221, and MA 275**
Introduction to basic ideas of modern cryptography with emphasis on mathematical background and practical implementation. Topics include: the history of cryptography and cryptanalysis, public and private key cryptography, digital signatures, and limitations of modern cryptography. Touches upon some of the societal issues of cryptography. Same as MA 479.

**CSSE 481 Web-Based Information Systems 4R-0L-4C Prerequisite: CSSE 230**
In this course, students learn about several aspects of research: thinking creatively about interesting research problems, researching existing work in a chosen area, and keeping current in a field. Students are exposed to the process of research by writing a pre-proposal for a project that advances the web. Projects either develop new web-technologies or applications or investigate a topic of importance. Based on feedback received, groups of students write a research proposal which goes through a formal peer review process. Approved projects are pursued for the remainder of the quarter. Students present current research as well as give a final presentation of their group project. Selected web-technologies are introduced; in the past, these have included CGI programming and XML technologies.

**CSSE 490 Special Topics in Computer Science 4C Arr Prerequisite: Permission of instructor**
Selected topics of current interest. May be repeated for credit if topic is different.

**CSSE 491 Directed Independent Studies 1-4C Arr Prerequisite: Permission of instructor and department head**
Independent study of an advanced subject not included in regularly offered courses. May be repeated for credit if topic or level is different.

**CSSE 492 Undergraduate Research in Computer Science 1-4C Arr Prerequisite: Permission of instructor and department head**
**CSSE 493 Undergraduate Research in Software Engineering 1-4C Arr Prerequisite: Permission of instructor and department head**
Research under direction of a faculty member. Presentation of preliminary and final results to departmental seminar. Presentation of work at professional meetings or by publication in professional journals is strongly encouraged. May be repeated for credit if topic or level is different.

**CSSE 494 Senior Thesis I 4C Arr Prerequisite: RH 330 and Permission of instructor and department head**
**CSSE 495 Senior Thesis II 4C Arr Prerequisite: CSSE 494**
**CSSE 496 Senior Thesis III 4C Arr Prerequisite: CSSE 495**
Individual study and research of a topic in computer science or software engineering. Topic is expected to be at an advanced level. Research paper and presentation to department seminar are required.
CSSE 497 Senior Project I 4C F Prerequisite: RH 330 and CSSE 372
CSSE 498 Senior Project II 4C W Prerequisite: CSSE 497
CSSE 499 Senior Project III 4C S Prerequisite: CSSE 498

Group software engineering project requiring completion of a software system for an approved client. Tasks include project planning, risk analysis, use of standards, prototyping, configuration management, quality assurance, project reviews and reports, team management and organization, copyright, liability, and handling project failure.