Software Engineering

Undergraduate Study
For the undergraduate curriculum in Software Engineering (http://www.se.iastate.edu) leading to the degree Bachelor of Science.

This curriculum is jointly administered by the Department of Computer Science and the Department of Electrical and Computer Engineering at Iowa State University. The Software Engineering program provides undergraduate students with the opportunity to learn software engineering fundamentals, to study applications of state-of-the-art software technologies, and to prepare for the practice of software engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The software engineering curriculum offers emphasis areas in software engineering principles, process, and practice. Students may also take elective courses in computer engineering and computer science.

Program Educational Objectives
Within five years of graduation, the graduates should:
1. attain a productive career in Software Engineering or related fields;
2. attain leadership roles and become effective collaborators to advance professional and organizational goals;
3. engage in continuous learning and professional development.

We expect that these objectives will be manifested in our graduates through the following five key attributes: (a) peer-recognized expertise, (b) engagement in professional practice, (c) sustained learning, (d) leadership, and (e) teamwork.

Demonstration of expertise involves applying state-of-the-art practices for solving problems in the design, development, validation, evolution and maintenance of (software) products. Demonstration of professional engagement involves contributing locally and globally to the use of ethical, competent, and creative practices in industry, academia or the public sector. Demonstration of sustained learning involves the ability to adapt to rapid technological, environmental, and organizational changes through self-study and group study and through opportunities of professional development or graduate study. Demonstration of leadership involves the ability to take initiative, and to facilitate the advancements of individuals and the community by influencing others and by having a widespread, positive impact on critical issues and projects. Finally, demonstration of teamwork involves the ability to work with collaborators who have varied expertise, and with diverse cultural and interdisciplinary backgrounds.

As a complement to the instructional activity, the Department of Computer Science and the Department of Electrical and Computer Engineering provide opportunities for each student to have experience with broadening activities. Students have the opportunity to gain practical industry experience in the cooperative education and internship program. Students have the opportunity to participate in advanced research activities. Through international exchange programs, students learn about engineering practices in other parts of the world.

Curriculum in Software Engineering
Administered by the Department of Electrical and Computer Engineering in the College of Engineering and the Department of Computer Science in the College of Liberal Arts and Sciences.

Leading to the degree bachelor of science.

Total credits required: 125 cr. See also Basic Program and Special Programs.

International Perspectives: 3 cr. ¹
U.S. Diversity: 3 cr. ¹

Communication Proficiency/Library requirement (minimum grade of C): ³
ENGL 150 Critical Thinking and Communication 3
ENGL 250 Written, Oral, Visual, and Electronic Composition 3
LIB 160 Information Literacy 3

Technical Communication Electives: 15 cr. ²
Choose one course from the following:
ECON 101 Principles of Microeconomics 3
ECON 102 Principles of Macroeconomics 3
IE 305 Engineering Economic Analysis 3
Arts and Humanities 6
Social Sciences 3
Additional Arts and Humanities or Social Sciences course 3

Total Credits 15

Basic Program: 27 cr.

Complete with 2.00 GPA including transfer courses:

CHEM 167 General Chemistry for Engineering Students 4
or CHEM 177 General Chemistry I 4
ENGL 150 Critical Thinking and Communication 3
ENGL 250 Written, Oral, Visual, and Electronic Composition (see above for grade requirements) 3
ENGR 101 Engineering Orientation R
or SE 101 Software Engineering Orientation 4
SE 185 Problem Solving in Software Engineering 3
LIB 160 Information Literacy 1
MATH 165 Calculus I 4
MATH 166 Calculus II 4
PHYS 221 Introduction to Classical Physics I (See Basic Program rule) 5

Total Credits 27

Math and Physical Science: 11 cr.

COM S 227 Introduction to Object-oriented Programming 4
COM S 228 Introduction to Data Structures 3
MATH 267 Elementary Differential Equations and Laplace Transforms 4

Total Credits 11

Software Engineering Core: 34 cr.

CPR E 281 Digital Logic 4
Choose one of the following:
COM S 229 Advanced Programming Techniques 3
CPR E 288 Embedded Systems I: Introduction 3
Choose one of the following:
COM S 321 Introduction to Computer Architecture and Machine-Level Programming 3
CPR E 381 Computer Organization and Assembly Level Programming 4

Total Credits 34

Note: CPR E 288, CPR E 381 and CPR E 308 are 4-credit courses. The core credit requirement (34 credits) is given in terms of 3-credit courses. If the 4-credit courses are taken instead, then the extra credits will be used as credits for Supplementary Electives.
Other Remaining Courses: 38 cr.

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>S E 491</td>
<td>Senior Design Project I and Professionalism</td>
<td>3</td>
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<tr>
<td>S E 492</td>
<td>Senior Design Project II</td>
<td>2</td>
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<tr>
<td>S E 494</td>
<td>Software Engineering Portfolio Development</td>
<td>R</td>
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<tr>
<td>SP CM 212</td>
<td>Fundamentals of Public Speaking</td>
<td>3</td>
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<tr>
<td>STAT 330</td>
<td>Probability and Statistics for Computer Science</td>
<td>3</td>
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<tr>
<td>One of the following ENGL courses (with a minimum grade of C)</td>
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<tr>
<td>ENGL 309</td>
<td>Report and Proposal Writing</td>
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<tr>
<td>ENGL 314</td>
<td>Technical Communication</td>
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<tr>
<td>Math Elective: Choose one from the following list</td>
<td>3</td>
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<tr>
<td>MATH 207</td>
<td>Matrices and Linear Algebra</td>
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<tr>
<td>MATH 304</td>
<td>Introductory Combinatorics</td>
<td></td>
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<tr>
<td>MATH 314</td>
<td>Graphs and Networks</td>
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<tr>
<td>MATH 317</td>
<td>Theory of Linear Algebra</td>
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<tr>
<td>Software Engineering Electives ²</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Technical Elective ²</td>
<td>3</td>
<td></td>
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<tr>
<td>Supplementary Elective ²</td>
<td>9</td>
<td></td>
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<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
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<tr>
<td>Total Credits</td>
<td>38</td>
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Seminar/Co-op/Internships

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<thead>
<tr>
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<tbody>
<tr>
<td>S E 166</td>
<td>Careers in Software Engineering</td>
<td>R</td>
</tr>
<tr>
<td>Co-op or internship (S E 396, S E 397, S E 398) is optional</td>
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Transfer Credit Requirements

The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in software engineering. These 30 credits must include S E 491 Senior Design Project I and Professionalism, S E 492 Senior Design Project II, and credits in the core professional curriculum and/or in technical electives. The software engineering degree program requires a grade of C or better for any transfer credit course that is applied to the degree program.

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
   U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.
2. Choose from department approved lists.
   Note: International perspectives and U.S. diversity courses are used to meet the general education electives.

Courses primarily for undergraduates:

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<thead>
<tr>
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<tbody>
<tr>
<td>S E 101</td>
<td>Software Engineering Orientation</td>
<td>Cr. R.</td>
</tr>
<tr>
<td>S E 166</td>
<td>Careers in Software Engineering</td>
<td>Cr. R.</td>
</tr>
<tr>
<td>S E 185</td>
<td>Problem Solving in Software Engineering</td>
<td>(3-1) Cr. 3.</td>
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<tr>
<td>S E 298</td>
<td>Cooperative Education</td>
<td>Cr. R. F.S.SS.</td>
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S E 319. Software Construction and User Interfaces. (Cross-listed with COM S), (3-0) Cr. 3. F. Prereq: COM S 228
   Introduction to formal specification and model-based software design. Introduction to domain-specific software engineering. Nonmajor graduate credit.

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

S E 339. Software Architecture and Design. (Cross-listed with CPR E), (3-0) Cr. 3. Prereq: S E 319

S E 342. Principles of Programming Languages. (Cross-listed with COM S), (3-1) Cr. 3. F.S. Prereq: COM S 321; COM S 330 or CPR 310; either COM S 309, COM S 362 or COM S 363; ENGL 250
   Study of concepts in programming languages and major programming paradigms, especially functional programming. Special emphasis on design tradeoffs that enable students to make sound choices of programming languages for a given software development task. Programming projects. Nonmajor graduate credit.

S E 396. Summer Internship.
   Cr. R. Repeatable. SS. Prereq: Permission of department and Career Services
   Summer professional work period.

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

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

S E 409. Software Requirements Engineering. (Dual-listed with S E 509), (Cross-listed with COM S), (3-0) Cr. 3. F. Prereq: COM S 309, ENGL 250, SP CM 212
   The requirements engineering process, including identification of stakeholders, requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required. Nonmajor graduate credit.

S E 412. Formal Aspects of Specification and Verification. (Cross-listed with COM S, CPR E), (3-0) Cr. 3. Prereq: S E 319, COM S 309
   Introduction to propositional/predicate/temporal logic, program verification using theorem proving, model-based verification using model checking, and tools for verification. Nonmajor graduate credit.

S E 416. Software Evolution and Maintenance. (Cross-listed with CPR 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. Nonmajor graduate credit.
(Cross-listed with COM S). (3-0) Cr. 3. S. Prereq: COM S 309, COM S 319, ENGL 250, SP CM 212
Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white box testing techniques), integration, regression, system testing methods, and software testing tools. Nonmajor graduate credit.

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

S E 491. Senior Design Project I and Professionalism.
(2-3) Cr. 3. Prereq: S E 329, completion of 29 credits in the S 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; project poster. First of two-semester team-oriented, project design and implementation experience.

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

S E 494. Software Engineering Portfolio Development.
Cr. R. F.S. Prereq: Credit or enrollment in S E 491
Portfolio assessment for Software Engineers. Guidelines and Advice to improve software engineering portfolios and to better use portfolios as a tool to enhance career opportunities.

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