BS Computer Science

Applied Option, Software Engineering

The following proposed Applied Option in Software Engineering supplements the Computer Science core requirements with courses that:

1. Bridge the gap between introductory programming (1xx) and software engineering (3xx)
2. Address modern industry needs, (e.g. recent IAB feedback)
3. Provide an intermediate step toward a four-year BS in Software Engineering

The Applied Option in Software Engineering includes existing 400-level CS electives and four new courses:

* One 200-level course on the development of larger software applications
* One 300-level course that extends the existing CS 361 & 362 sequence
* Two 400-level courses that extend the existing CS 466 course

These courses provide students with additional software development practice during year two, extend the existing software engineering course sequence in CS during year three, and extend the existing startup/entrepreneurship course in CS in year four, complementing the CS capstone sequence.

This applied option requires four Category 2 proposals for new courses, and the development of these four courses. Cascades campus faculty shall complete this work during AY2018-19, and make the applied option available in AY2019-20.

**Rationale for SE 201**

Students experience programming “in the small” in year one (CS 160-162), experience very few courses in year two (CS 261, 271 and 290), and then engage in “software engineering” (CS 361 & 362) in year three. Learning software engineering concepts can be challenging when students have only written short, focused programs and have never engaged in building a larger software system. The SE 201 course engages students in programming “in the large” (more OO, more practice, more APIs, more problem solving, more tools, bigger programs) in year two, providing a learning experience that helps bridge the first year and third year courses. *In the four-year BS Software Engineering curriculum, this course will be the first in a three-course sequence (SE 201 – 203).*

**Catalog Description**

160:

Introduction to the computer science field and profession. Team problem solving. Introduction to writing computer programs. Approaches to teaching course topics vary across sections. Lec/lab.

161:

Overview of fundamental concepts of computer science. Introduction to problem solving, software engineering, and object-oriented programming. Includes algorithm design and program development. Lec/lab/rec.

162:

Basic data structures. Computer programming techniques and application of software engineering principles. Introduction to analysis of programs. Lec/lab/rec.

262:

Learning a second computer programming language. Elements of C++. Object-oriented programming. Experience team work on a large programming project.

**Learning Outcomes**

160:

1. Gain experience writing computer programs, for those who have not been experienced to programming, i.e. at the completion of the course, students will be able to demonstrate an ability to create simple computer programs.

2. Explain what computer science is and what computer scientists do

3. Use computers for communication, research, productivity, etc.

4. Discover/cite sources of current computer science information

5. Produce a course of study leading to a B.S. degree at Oregon State University

6. Solve problems using abstraction and modularization

7. Identify basic computer hardware components and explain their purposes

8. Differentiate among types of software (open-source/proprietary, system/application, etc.)

9. Install/uninstall software systems

10. Use some basic tools required for success in subsequent OSU Computer Science coursework

11. Work in a team to design a simple software system

161:

1. Design and implement programs that require

a. various control statements involving selection and repetition

b. expressions with variables, constants, function calls, pointers, and arithmetic/relational operators with mixed data

c. arrays, strings, and other data structures

d. library functions and programmer-defined functions with parameter-passing by value and by reference

e. define and use classes and objects

2. Debug programming syntax and run-time errors.

3. Produce recursive algorithms

4. Describe and apply basic software engineering design principles and software quality factors

162:

1. Design and implement programs that require

a. multiple classes and structures

b. hierarchies of classes that uses inheritance and polymorphism

c. an understanding of abstraction, modularity and separation of concerns

2. Construct and use basic linear structures (arrays, stacks, queues, and various linked lists) in programs, and be able to describe instances appropriate for their use.

3. Classify moderately complicated algorithms in these complexity classes: O(1), O(log n), O(n), O(n log n), and O(n2).

4. Develop test-data sets and testing plans for programming projects.

5. Produce recursive algorithms, and choose appropriately between iterative and recursive algorithms.

**Rationale for SE 303**

The CS 361 & 362 courses address the “front end” and “back end” of a software lifecycle, from requirements analysis to verification and maintenance. Modern software engineering is a huge topic, and even our IAB has raised some curricular shortcomings, including continuous integration and delivery, automated testing, cloud computing, and infrastructure. A third course in the software engineering sequence provides more surface area for such topics and additional learning outcomes. *In the four-year BS Software Engineering curriculum, this course will be the third of a three-course sequence (CS 361, CS 362, SE 303).*

**Catalog Description**

361:

Introduction to the "front end" of the software engineering lifecycle; requirements analysis and specification; design techniques; project management.

362:

Introduction to the "back end" of the software engineering lifecycle implementation; verification and validation; debugging; maintenance.

**Learning Outcomes**

361:

1. Select the most appropriate software process model to use in a particular situation

2. Synthesize requirements for a realistic software system and write a requirements specification document

3. Model system requirements using one or more semi-formal notations such as UML, dataflow diagrams, entity-relationship diagrams, or state diagrams

4. Design software systems at an architectural level and at lower levels, using one or more techniques, such as object-oriented design or agile methods, and express these designs in design specification documents

5. Validate designs and adjust the specification or design as necessary

6. Describe several methods of estimating the cost and developing a schedule for a programming project

7. Participate effectively in a team environment

8. Produce professional-quality software-related documents

362:

1. Apply automated tools such as make and CVS in a realistic setting

2. Describe the cost-benefit trade-offs inherent in the use of automated tools for building software and configuration management

3. Describe several techniques for validating and measuring the quality of software

4. Apply testing techniques, including black-box and white-box techniques, automatic testing activities, and regression testing

5. Use appropriate techniques and tools, including a debugger, to locate program faults

6. Describe several types of maintenance processes associated with correcting and enhancing software systems

7. Participate effectively in a software inspection

8. Participate effectively in a team environment

**Rationale for SE 402 & 403**

The capstone sequence (CS 461-463) provides students a design experience in which they typically engage in a consulting model providing a service to a client. In contrast, a product-based model (such as a software startup) provides students an entrepreneurial experience that includes market analysis, product management, design, marketing, business organization, business administration, selling software, and growing a business. While the CS 466 course introduces students to entrepreneurship fundamentals, it does not provide students the time and depth necessary for a true startup experience. SE 402 and 403 shall follow CS 466 to extend this experience, and complement the capstone experience. *In the four-year BS Software Engineering curriculum, these courses will be the second and third of a three-course sequence (CS 466, SE 402, SE 403).*

**Catalog Description**

466:

Real-world, hands-on learning in a high-tech web/mobile-based company environment. Research in the development of product ideas, hypotheses, and business models to create customer experiments. Prototyping and statistical analysis to develop, optimize, and evaluate solutions. Rapid iteration/refactoring based on customer input, web analytics, and user engagement metrics.

461-3:

Utilize software engineering methodology in a team environment to develop a real-world application. Teams will be responsible for all phases of software development, including project planning, requirements analysis, design, coding, testing, configuration management, quality assurance, documentation, and delivery. Three-term sequence required.

**Learning Outcomes**

466:

* Identify the key elements of a business model and explain the importance of articulating and testing the assumptions related to web and mobile web startups
* Interview customers to iterate and refine key assumptions comprising the value proposition and business model
* Identify state-of-the-art technologies available in web/mobile delivery
* Design and deliver a minimal viable product in a web or mobile application
* Synthesize customer feedback to refine product-market fit
* Explain importance of build-measure-learn process

461-3:

1. Design, plan, organize, synthesize and complete a significant software project in three academic quarters

2. Apply all aspects of the software engineering process, including project planning, requirements documents, software design, coding, testing, walk-throughs, documentation and delivery

3. Demonstrate good communication skills in the form of weekly reports and project talks, posters, and elevator talks

4. Participate effectively in a team environment

5. Analyze and organize their own career preparation

6. Evaluate the professional, legal, and/or social implications of software product development

7. Evaluate the contributions and importance of software projects to the broad user community

8. Explain the importance of software projects to people from other disciplines and the general public

**Applied Option Criteria**

“Options consist of a minimum of 21 designated quarter credits of related course work, 15 of which must be at the upper-division level.” (Office of Academic Programs & Assessment)

The Applied CS Program must meet the following conditions:

* Minimum of 32 credits
* Recommended minimum of 20 upper division credits
* Coherent body of knowledge where applications of computer science could play an important role

## Core (20 credits)

SE 201 Software Development I (4)

SE 303 Software Engineering III (4)

CS 466 Web-based Startup Project (4)

SE 402 Business of Software II (4)

SE 403 Business of Software III (4)

## Electives (12 credits)

Choose 12 credits from the following:

CS 312 System Administration (4)

CS 373 Defense Against the Dark Arts (4)

CS 440 Database Management Systems (4)

CS 450 Introduction to Computer Graphics (4)

CS 458 Introduction to Information Visualization (4)

CS 475 Introduction to Parallel Programming (4)

CS 492 Mobile Software Development (4)

CS 493 Cloud Application Development (4)

CS 495 Interactive Multimedia Projects (4)

CS 464 Open Source Software (4)

ECE 478 Network Security (4)

CS 434 Machine Learning & Data Mining (4)

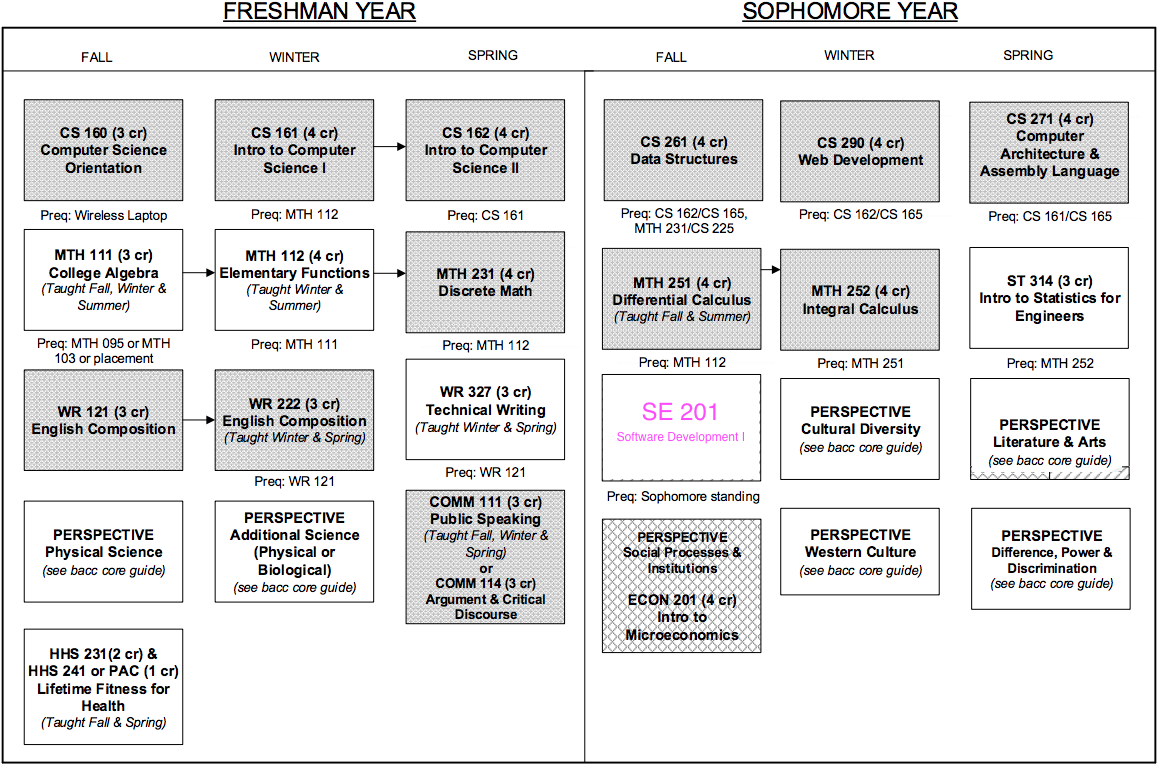
CS 447 Wireless Embedded Systems (4)

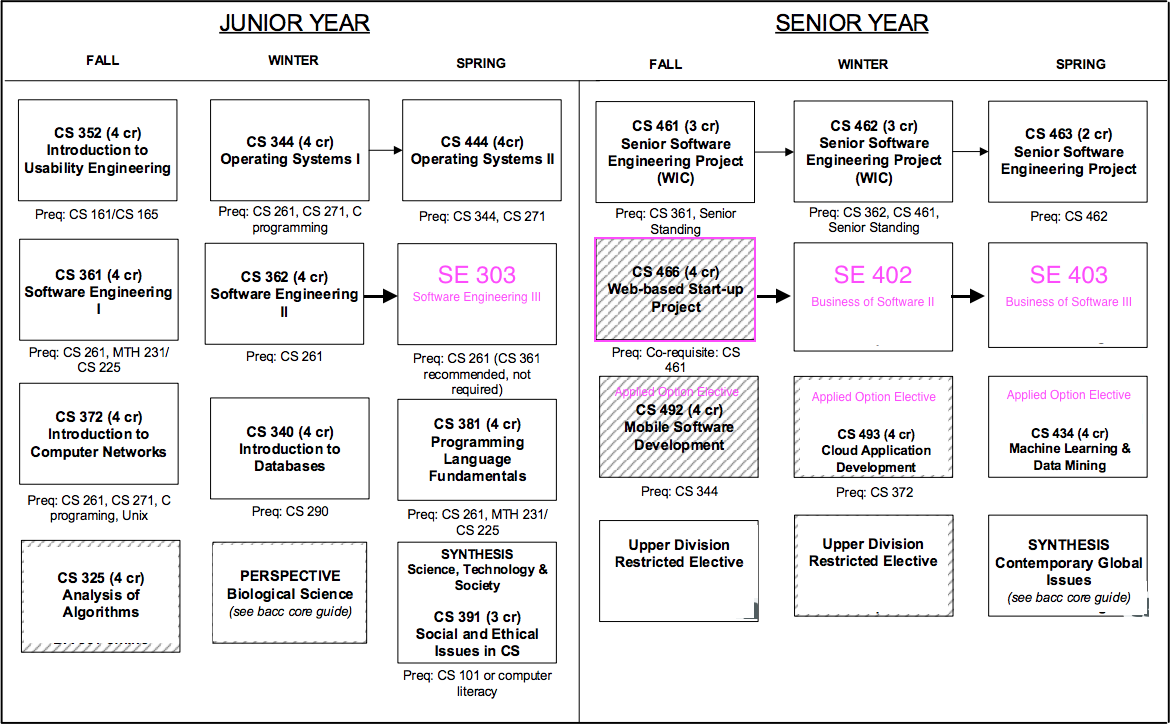
CS 406 Projects (4) or CS 401 Research (4)

4 credits at lower division (SE 201)

28 credits at upper division (SE 303, CS 466, SE 402, SE 403, and CS electives)

Example Four-Year Plan





Current Applied Option, Web and Mobile Software Development



Current Four-Year Plan, Web and Mobile Software Development

