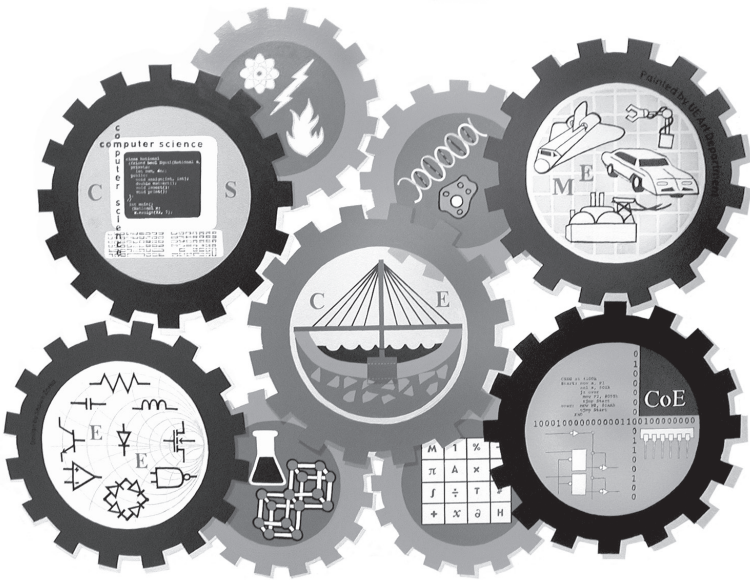


2017-2018



Software Engineering Guide Book



UNIVERSITY OF
EVANSVILLE.

NOTES

SOFTWARE ENGINEERING PROGRAM GUIDE BOOK 2017-18

Table of Contents

What is Software Engineering?	2
Electrical Engineering and Computer Science Objectives	3
Electives	3
Four-Year Degree Plan.....	8
Co-op Program	9
Harlaxton College Option	12
Honors Program	13
Undergraduate Research	14
Faculty and Staff.....	16
Computer Science Course List	17
Frequently Asked Questions.....	20

WHAT IS SOFTWARE ENGINEERING?

An Essay by Don Roberts, PhD

Broadly speaking, software engineering is a discipline within computer science. Generic computer science studies the limits and applications of computing systems. Software engineering focusses on the development of applications to solve problems by applying general engineering principles to the process of software development.

In more detail, while both computer science graduates and software engineering graduates will have similar skills, computer science graduates will have a broader exposure to computer science topics such as hardware architecture and theory of computation, while software engineering graduates will have more exposure to topics typically encountered during software development such as project planning, quality assurance, and coordinating with large groups of developers.

In terms of employment, a four-year graduate of a software engineering program can perform the same work as those who have majored in computer science. In addition the software engineering graduates will have had more exposure to practical software currently in use in industry and are better prepared to work on large projects where project management, structured design and analysis, documentation, and software maintenance are critical.

Software engineering is a good choice for students who plan to work in industry after receiving a four-year degree; computer science, which is more theoretical than software engineering, is probably a better choice for those students bound for graduate school or who desire a more general background in computing.

ELECTRICAL ENGINEERING AND COMPUTER SCIENCE DEPARTMENT OBJECTIVES

All programs in the Department of Electrical Engineering and Computer Science share the following objectives:

These objectives apply to our graduates in the three to five years after their graduation.

Objective 1 Graduates will be engaged in a professional career or continued advanced study in their chosen field. This implies that graduates will recognize the value and necessity of lifelong learning.

Objective 2 Graduates will be engaged in applications of problem solving and communication skills for a wide variety of problems in engineering or computer science, either as individuals or in teams.

Objective 3 Graduates will be active participants in a local, national, or global engineering or computer science community.

ELECTIVES

The electives in the software engineering program can be classified in five categories: mathematics electives, natural science electives, computer science electives, general education electives, and free electives. There are some restrictions on which courses can be taken in each of these categories and these are discussed below.

Mathematics Electives

Choose one from Engineering 390, Mathematics 341, or Mathematics 365.

Natural Science Electives

The two natural science electives must be chosen to complete a two-semester sequence in one of biology, chemistry, or physics in combination with the required physics course (Physics 210). The University requires that two of the courses be in different disciplines. Thus there are four possible combinations that fulfill the software engineering program natural science requirements.

Natural Science Course Combinations

Chemistry 118, Physics 210, Physics 211

Biology 107, Physics 210, Physics 211

Chemistry 118, Chemistry 240 or 280, Physics 210

Biology 107, Biology 119 or 120, Physics 210

Software Engineering Electives

The four software engineering electives should be chosen from the following list in consultation with a computer science advisor

Hardware-Oriented Courses

Course	Hours	Title
CS 320	3	Computer Architecture
CS 376	3	Small Computer Software
CS 478	3	Embedded Systems and Real-Time Programming
EE 354	3	Digital Systems
EE 454	3	Microcontroller Applications
EE 456	3	Small Computer System Design

Software-Oriented Courses

Course	Hours	Title
CS 350	3	Computer/Human Interaction
CS 355	3	Computer Graphics
CS 375	3	UNIX System Programming
CS 381	3	Formal Languages
CS 415	3	Cryptography
CS 430	3	Artificial Intelligence
CS 440	3	Databases
CS 445	3	Programming in the Large
CS 455	3	Advanced Graphics
CS 472	3	Concurrent and Parallel Programming
CS 473	3	Mobile Application Development
CS 475	3	Networks
CS 499	3	Special Topics in Computer Science

Enduring Foundations General Education Electives

The general education program has the following outcomes:

1. Critical reading and thinking – 3 hours
2. Engagement with imaginative expressions of the human condition – 3 hours
3. Knowledge of human history and the historical context of knowledge – 3 hours
4. Engagement with fundamental beliefs about human identity, core values, and humankind's place in the world – 3 hours
5. Understanding of human aesthetic creation and artistic creativity – 3 hours
6. Linguistic and cultural competence in a language other than one's own – 3 hours
7. Quantitative literacy – 3 hours
8. Scientific literacy – 7 hours

9. Understanding of core concepts of society, human behavior and civic knowledge – 6 hours
10. Knowledge and responsibility in relation to health and wellness – 1 hour
11. Ability to think critically and communicate effectively, orally and in writing/capstone – 3 hours

In addition to taking courses to meet the outcomes above, student must complete the writing overlay requirement. The writing overlay requirement consists of four courses. In software engineering these are: FYS 112, CS 495, CS 497 and one additional writing course which may also satisfy one of the outcomes. Outcomes 2, 3, and 5 have some courses which also satisfy the writing overlay requirement. Students should meet with an advisor and carefully choose courses in these outcomes to meet the writing overlay.

Outcome 1, critical reading and thinking, is met by taking First-year Seminar 112. Students who do not meet the writing entrance requirements must take First-year Seminar 111 as a prerequisite to First-year Seminar 112.

Outcome 6, linguistic and cultural competence in a language other than one's own, may be met with a foreign language competency test. Students who have successfully completed two years of foreign language their final two years in high school can, in general, meet this requirement by passing the competency test.

Outcome 7, quantitative literacy, and outcome 8, scientific literacy, are met automatically by the math and science requirement for any degree in engineering or computer science.

Outcome 11, ability to think critically and communicate effectively, orally and in writing/capstone, is met by taking Computer Science 495, the computer science senior design project.

A complete list of courses that meet the general education requirements is available online at www.evansville.edu/registrar/calendars.cfm

Free Electives

The 18 hours of free electives may be taken as any course in the University that is given for University credit with a few exceptions. Courses labeled Chemistry 10x; Computer Science 105, 205; English Language; Mathematics 1xx; and Physics 1xx may not be counted as free electives. At least 9 hours of the free elective requirement must be chosen from courses at the 300 or 400 level.

A minor in mathematics may be completed by taking one additional upper level course. Taking both Mathematics 341 and Mathematics 365 is recommended.

The abundance of electives in the software engineering program allows software engineering students enough room in their program to concentrate in a field of application that meets the student's interests and future goals. Courses suitable for concentration in some common areas of application are shown below and on the next page.

Computational Mathematics/Graduate School

Mathematics elective: Mathematics 341

Natural science electives: Chemistry 118, Physics 211

Computer science electives: Computer Science 355,

Computer Science 415, Computer Science 430, Computer Science 455

Professional development elective: Philosophy 231

Free electives: Mathematics 365, Mathematics 445, Mathematics 466,
Mathematics 495

A second Bachelor of Science degree in mathematics requires a total of 154 hours. This typically can be completed in eight semesters by taking 18 hours each term where possible plus 12 hours of summer school or pre-admission transfer credit.

Computational Science

Mathematics elective: Mathematics 365

Natural science and free electives: minor in biology, chemistry, or physics

Free electives: Mathematics 373, Philosophy 345

Artificial Intelligence/Cognitive Science

Mathematics elective: Mathematics 341

Natural science electives: Biology 107

Computer science electives: Computer Science 350, Computer Science 430

General education and free electives: Cognitive Science 111, Philosophy 241

Philosophy 447, minor in psychology or minor in cognitive science.

Embedded Systems

Natural science electives: Chemistry 118, Physics 211

Computer science electives: Computer Science 376,

Computer Science 478, Electrical Engineering 354,

Electrical Engineering 454, Electrical Engineering 456

Free electives: Electrical Engineering 210, Electrical Engineering 215,
Mathematics 324

Internet Applications

Computer science electives: Computer Science 350, Computer Science 75, Computer Science 415, Computer Science 430, Computer Science 440, Computer Science 473, Computer Science 475

General education and free electives: Communication 251, Communication 350, Communication 485, Economics 102, Management 311, Management 445, Marketing 325, Psychology 121

Business

General education and free electives: minor in business administration.

Bachelor of Science in Software Engineering

FALL			SPRING		
FRESHMAN					
CHEM 118	Principles of Chemistry	4	CS 210	Fundamentals of	3
or BIOL 107	General Biology			Programming I	
CS 101	Introduction to Computer	3	MATH 222	Calculus II	4
	Science		PHYS 210	Calculus Physics I	4
FYS 112	First-Year Seminar	3		General Education	3
MATH 221	Calculus I	4		Foreign Language 112*	3
	Foreign Language 111*	3			17
		17			
SOPHOMORE					
CS 215	Fundamentals of	3	CS 290	Object-Oriented Design	3
	Programming II		ENGR 390	Applied Engineering	3
MATH 323	Calculus III	4		Mathematics	
PHYS 211	Calculus Physics II	4	MATH 370	Discrete and Combinatorial	3
	General Education	3		Mathematics	
	Free Elective	3		General Education	3
		17		General Education	3
				Free Elective	3
					18
JUNIOR					
CS 380	Programming Languages	3	CS 315	Algorithms and Data	3
CS 390	Software Engineering	3		Structures	
CS 413	Software Security	3	CS 391	Software Engineering II	3
	Software Engineering	3	CS 395	Software Project	3
	Elective			Management	
	General Education	3	CS 470	Operating Systems	3
		15	CS 494	Senior Project Seminar	0
				General Education	3
					15
SENIOR					
CS 495	Senior Project I	3	CS 497	Senior Project II	3
CS 491	Software Quality Assurance	3		Software Engineering	3
	Software Engineering	3		Elective	
	Elective			Software Engineering	3
	Free Electives	6		Elective	
	Health and Wellness	1		Free Electives	6
		16			15

*Note: Only if necessary to meet University foreign language requirement.

Figure 1 - A typical four-year degree plan for a BSSE degree.

CO-OP PROGRAM

Software engineering majors are encouraged to participate in cooperative education (co-op program). In this program, a student completes the BSSE degree requirements in five years, but at the end of that time, the student has a BSSE plus four terms of industrial experience.

The typical computer science co-op student goes to school the first two years just as a non co-op student does. At the end of the sophomore year, the co-op student goes to work and works through the summer. The student is back in school in the fall and out to work in the spring. Thereafter, the student alternates between work and school.

CO-OP CALENDAR			
Year	Fall	Spring	Summer
1	School 1	School 2	Work option
2	School 3	School 4	Work 1
3	School 5	Work 2	School/Work option
4	Work 3	School 6	Work 4
5	School 7	School 8	

Some students who are exceptionally well prepared to enter the work force may begin their co-op period in the summer after the freshman year. This is unusual, and most students begin after the sophomore year. The summer after the junior year may be either school or work as needed. Many students work through this summer thereby completing a full calendar year on the job.

To enter the co-op program, students should enroll in Experiential Education 90. This is a noncredit course which should be taken during the fall of the sophomore year. This course covers such topics as résumé writing, interviewing and what is expected on the job. During the spring of the sophomore year the typical co-op student interviews with prospective employers. The career placement office takes care of contacting employers and arranging interviews for students. Actual placement in a co-op position is dependent on the outcome of the interview process.

Co-op students in software engineering have a wide range of employers to choose from. Employers are located in the immediate Evansville area, in the surrounding region of Indiana, Kentucky, and Illinois, and at various places throughout the country. If a student wants to work for a company that the University does not presently have a co-op program with, the Center for Career Development will contact that company and attempt to establish a program. The requirement to qualify as a legitimate co-op employer is that the company must provide a software engineering oppor-

tunity for a prospective software engineering professional that is relevant to the student's education and chosen profession.

The real value of the co-op program is in the experience that it provides the student. A co-op job can be a financial benefit, but one term at work does not typically cover the cost of one term of education. The co-op program gives employers a chance to look at a student as a prospective employee without making a commitment to long-term employment.

Likewise, the co-op program gives the student a chance to look at a company and gain some experience before entering the work force as a working professional.

Co-op students normally get a higher salary offer upon graduation than do non-co-op students. In many cases the co-op employer provides a long-term employment opportunity for the co-op student upon graduation. About 25 percent of students participate in the co-op program.

HARLAXTON COLLEGE OPTION

The University of Evansville's Harlaxton College is located just outside of Grantham, England, in the rolling English countryside. Harlaxton College is about a one-hour ride by train from London. Software engineering students who choose to spend a semester studying at Harlaxton College have easy access to England's culture, history, and entertainment.

Harlaxton College is housed in a large Victorian manor, where about 300 students and faculty members live and hold classes. The manor has a state dining room, a library, and a number of historic state rooms where classes are held. A soccer field, sports hall, student lounges, bistro, and tennis courts are also available on the grounds.

Software engineering students who wish to study one semester in England are encouraged to do so during the first semester of their sophomore year. At Harlaxton College, computer science students typically take calculus, British studies, and general education courses. Harlaxton is on the semester system and all courses earn credit at UE in the same way they would if they were taken in Evansville. Since the computer science program requires a number of general education courses, all courses taken at Harlaxton count as required courses toward the computer science degree. Tuition at Harlaxton College is the same as tuition at UE's Evansville campus and all scholarships and loans may be applied to Harlaxton costs.

Students at Harlaxton College are encouraged to travel on weekends. The college arranges eight to ten weekend field trips to locations such as Stonehenge, Nottingham, London, and Scotland. During some semesters, less frequent but longer trips are arranged to Ireland and the continent.

Harlaxton College has its own resident British faculty as well as visiting faculty members from the home campus and other selected campuses in the United States. Likewise, students at Harlaxton come from the Evansville campus, England, and various other campuses around the United States.

Figure 2 shows a degree plan for a four-year BSSE degree with the physics sequence with the fall semester of the sophomore year at Harlaxton College.

Harlaxton College Costs

While tuition and housing at Harlaxton College are the same as on the University of Evansville campus and all scholarships and loans apply to Harlaxton, there are additional costs, namely those of travel. The typical airfare round trip is about \$1,500. The typical student at Harlaxton College will spend an additional \$4,000 on weekend trips, souvenirs, and miscellaneous expenses.

Harlaxton College Option Plan of Study

FALL			SPRING		
FRESHMAN					
CHEM 118 or BIOL 107	Principles of Chemistry General Biology	4	CS 210	Fundamentals of Programming I	3
CS 101	Introduction to Computer Science	3	MATH 222	Calculus II	4
			PHYS 210	Calculus Physics I	4
FYS 112	First-Year Seminar	3		General Education	3
MATH 221	Calculus I	4		Foreign Language 112*	3
	Foreign Language 111*	3			17
		17			
SOPHOMORE					
ID H282/382	The British Experience	6	CS 215	Fundamentals of Programming II	3
	General Education	3			
	General Education	3	CS 220	Logic Design and Machine Organization	3
	Free Elective	3			
		15	MATH 370	Discrete and Combinatorial Mathematics	3
			ENGR 390	Applied Engineering Mathematics	3
				General Education	3
				Free Elective	3
					18
JUNIOR					
CS 380	Programming Languages	3	CS 290	Object-Oriented Design	3
CS 390	Software Engineering	3	CS 315	Algorithms and Data Structures	3
CS 413	Software Security	3			
PHYS 211	Calculus Physics II	4	CS 391	Software Engineering II	3
MATH 323	Calculus III	4	CS 395	Software Project Management	3
		17			
			CS 470	Operating Systems	3
			CS 494	Senior Project Seminar	0
				Free Elective	3
					18
SENIOR					
CS 495	Senior Project Phase I	3	CS 497	Senior Project Phase II	3
CS 491	Software Quality Assurance	3		Software Engineering Elective	3
	Software Engineering Electives	6		Software Engineering Elective	3
	Free Elective	3		Free Electives	6
	Health and Wellness	1			15
		16			

*Note: Only if necessary to meet University foreign language requirement.

Figure 2 - A typical four-year plan for a BSSE degree with the fall semester of the sophomore year at Harlaxton College.

HONORS PROGRAM

The Honors Program is open to selected students on entrance to the University. Admittance to the Honors Program is determined by the University Honors Committee on the basis of standardized test scores, an essay, and other student work completed in high school. The Honors Program provides participants with the opportunity to interact with other Honors Program students both socially and academically. Special honors courses and other academic events are available for honors students both in general education and in the major. Honors students are able to register early, have access to an honors lounge, and receive a University Honors designation on official transcripts.

1. Honors students must maintain a cumulative grade point average of 3.5 or better to remain in the program.
2. To complete the program, honors students must acquire a total of at least 21 points in the Honors Program made up of the following:

A minimum of 15 points from

Honors Courses (generally three points each) Honors courses offered on a regular basis include various courses that fulfill the general education requirements, and honors courses in other departments that are not part of the general education requirements.

Honors Colloquia (generally one point each) Honors colloquia are offered on a variety of topics and include small group discussion of a book, a research topic, or a topic of current interest.

Major Courses (generally three points each) These are courses within the major which are given the H section designation.

Contract Courses (points vary) See Alternative Courses below.

A minimum of three points from

Senior Honors Project In computer engineering this requirement is satisfied by the Electrical Engineering 494/495/497 senior project sequence. This is a year-long sequence in which computer engineering students write a proposal, complete a design, and construct a project. Honors projects in computer engineering are typically more challenging and are often research oriented.

Harlaxton College

Students who spend one semester in a study abroad program get two points for the Honors Program.

Alternative Courses (points vary)

Alternative honors courses include courses taken for independent study and contract courses. A contract course is a non-honors course in which a written contract is written requiring additional or alternative course work. The contract must be pre-approved by the instructor, the department chair, and the honors director.

Honors Activities (points vary)

Students may receive honors program points for activities other than traditional course work. These might include a summer research experience for undergraduates (REU) program, an internal research project, a paper or poster presentation, a summer internship, completion of the co-op program, participation in an IEEE or ACM sponsored contest, participation in community projects, or a leadership role in a student professional organization.

UNDERGRADUATE RESEARCH

There are numerous opportunities to conduct undergraduate research. All students are encouraged to participate in at least one undergraduate research project at some point in their four years at UE. Students who have an interest in graduate school are strongly encouraged to participate in multiple programs. Some of the undergraduate research opportunities available to students studying computer science are described below.

NSF Sponsored Research Experience for Undergraduates (REU)

This program is sponsored by the National Science Foundation. It allows undergraduates to participate in research projects at major research institutions across the country. Participating students typically have a B+ or better grade point average and have achieved junior status. Most REUs provide a stipend (about \$2,000 to \$4,000 for 10 weeks), and some provide a housing or moving allowance. All REUs take place during the summer. See the website at www.nsf.gov/crssprgm/reu/index.jsp for more information.

UE Sponsored Undergraduate Research

The University of Evansville also sponsors summer research projects which typically provide a housing allowance or a stipend (about \$2,000). Almost all academic areas participate in these projects, which are awarded to students on a competitive basis. All result in a student publication or presentation at a national or regional conference.

Special Topics and Independent Study

Many professors are willing to sponsor research projects during the school year. Students typically register for Electrical Engineering 498 or Computer Science 498 and receive 1 to 3 hours of credit for such study.

National Competition Projects

The Department of Electrical Engineering and Computer Science participates in two major national competitions, and all students in the department (including freshmen) are eligible to participate in these projects. The IEEE sponsors a robot competition each year which takes place at a southeastern university. This is a team (4 to 6 students) project and requires a one-year effort. Trinity University in Connecticut sponsors a national fire-fighting robot competition in which a robot must find its way through a maze, locate a candle, and extinguish it. Some of these projects are done by students as senior design projects but most often the projects are sponsored by the student chapters of IEEE and ACM.

Students who wish to publish or present their research results may do so in several forums. There is a national conference on undergraduate research, a paper contest at the IEEE southeastern spring meeting, and a regional undergraduate research conference at Butler University.

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COMPUTER SCIENCE COURSE LIST

CS 101 Introduction to Computer Science (3) Restricted to computer science majors and minors. Fall.

CS 210 Fundamentals of Programming I (3) Prerequisite: None. Fall, spring.

CS 215 Fundamentals of Programming II (3) Prerequisites: Computer Science 210. Fall, spring.

CS 220 Logic Design and Machine Organization (3) Prerequisite: None. Spring.

CS 290 Object-Oriented Design (3) Prerequisite: Computer Science 215. Spring.

CS 310 Puzzle Programming (1) Prerequisite: Computer Science 215 or permission of the instructor. May be repeated for up to three credit hours. Fall.

CS 315 Algorithms and Data Structures (3) Prerequisites: Computer Science 215, Mathematics 370. Spring.

CS 320 Computer Architecture (3) Prerequisites: Computer Science 210, and Computer Science 220 or Electrical Engineering 254. Spring.

CS 350 Computer/Human Interaction (3) Prerequisite: Computer Science 215.

CS 355 Computer Graphics (3) Prerequisites: Computer Science 215, Mathematics 323.

CS 375 UNIX System Programming (3) Prerequisite: Computer Science 215.

CS 376 Small Computer Software (3) Prerequisites: Engineering 123 or Computer Science 210, and Electrical Engineering 254 or Computer Science 220. Fall.

CS 380 Programming Languages (3) Prerequisite: Computer Science 215. Fall.

CS 381 Formal Languages (3) Prerequisites: Computer Science 210, Mathematics 370. Fall.

CS 390 Software Engineering (3) Prerequisite: Computer Science 215. Recommended: Computer Science 290. Fall.

CS 391 Software Engineering II (3) Prerequisite: Computer Science 390, Spring

CS 395 Software Project Management (3) Prerequisite or concurrently: Computer Science 390.

CS 413 Software Security (3) Prerequisite or concurrently: Computer Science 390.

CS 415 Cryptography (3) Prerequisites: Computer Science 215, Mathematics 370.

CS 430 Artificial Intelligence (3) Prerequisite: Computer Science 215. Recommended: Computer Science 315, Computer Science 380.

CS 440 Databases (3) Prerequisites: Computer Science 215, Mathematics 222.

CS 445 Programming in the Large (3) Prerequisite: Computer Science 380, Spring.

CS 455 Advanced Graphics (3) Prerequisites: Computer Science 355.

CS 470 Operating Systems (3) Prerequisite: Computer Science 215. Recommended corequisite: Computer Science 320. Spring.

CS 472 Concurrent and Parallel Programming (3) Prerequisite: Computer Science 470

CS 473 Mobile Application Development (3) Prerequisites: Computer Science 215. Recommended: Computer Science 290

CS 475 Networks (3) Prerequisites: Computer Science 215, Mathematics 222.

CS 478 Embedded Systems and Real-Time Programming (3) Prerequisite: Electrical Engineering 354 or Computer Science 220, and Electrical Engineering 356/Computer Science 376 or Computer Science 215. Spring.

CS 491 Software Quality Assurance (3) Prerequisite or concurrently: Computer Science 390.

CS 494 Senior Project Seminar (0) Prerequisite: 12 hours of 300-level computer science courses. Computer engineers may substitute Electrical Engineering 494. Spring.

CS 495 Senior Project Phase I (3) Prerequisites: Computer Science 494, GPA of at least 2.0. Computer engineers may substitute Electrical Engineering 495. Fall.

CS 497 Senior Project Phase II (3) Prerequisite: Computer Science 495. Computer engineers may substitute Electrical Engineering 497.

CS 498 Independent Study in Computer Science (variable credit)

Requires faculty sponsor and approved detailed study plan.

CS 499 Special Topics in Computer Science (1-3) Prerequisites will be announced when scheduled.

COMPUTER ENGINEERING FREQUENTLY ASKED QUESTIONS

What degrees are offered by the Department of Electrical Engineering and Computer Science?

Bachelor of Science in Computer Engineering

Bachelor of Science in Computer Science

Bachelor of Science in Electrical Engineering

Bachelor of Science in Software Engineering

What are the general education requirements for the engineering degree?

What are the general education requirements for the engineering degree?

The general education requirements in engineering and computer science are the same as for any degree:

1. Critical reading and thinking – 3 hours
2. Engagement with imaginative expressions of the human condition – 3 hours
3. Knowledge of human history and the historical context of knowledge – 3 hours
4. Engagement with fundamental beliefs about human identity, core values, and humankind's place in the world – 3 hours
5. Understanding of human aesthetic creation and artistic creativity – 3 hours
6. Linguistic and cultural competence in a language other than one's own – 3 hours
7. Quantitative literacy – 3 hours
8. Scientific literacy – 7 hours
9. Understanding of core concepts of society, human behavior and civic knowledge – 6 hours
10. Knowledge and responsibility in relation to health and wellness – 1 hour
11. Ability to think critically and communicate effectively, orally and in writing/capstone – 3 hours

There is an additional writing overlay requirement that is met by taking writing intensive courses. In electrical and computer engineering, the writing overlay is met by taking FYS 112, EE 495, EE 497, and one additional writing course that may be chosen from those courses also satisfying outcomes 2, 3, or 5. Students should meet with an advisor and choose courses for outcomes 2, 3, or 5 that also meet the writing overlay requirement.

Is it necessary that engineering and computer science majors take a foreign language?

The requirement is for six hours of course work or demonstrated proficiency. On entry, all students have the opportunity to take a proficiency exam in a foreign language of their choice. Students who have had two or more years of a foreign language during the last two years of high school usually pass this exam.

What is the average class size in electrical engineering and computer science?

The student to faculty ratio is about 13:1. Lower division classes tend to run 20 to 30 students per section. Upper division classes are smaller with 12 to 18 being typical. Some upper level electives have as few as six students.

What is the size of the engineering program at UE?

UE offers degrees in electrical, mechanical, civil, and computer engineering, and computer science. The number of students in these programs is about 360. About 160 of these students are in the electrical engineering, computer science or computer engineering programs. There are currently 11 faculty members in the Department of Electrical Engineering and Computer Science and 10 faculty members in the Department of Mechanical and Civil Engineering.

I am undecided between computer engineering, electrical engineering, computer science, and software engineering. How soon do I have to choose my major?

Computer engineering majors share a common freshman year with computer science majors. At the beginning of the sophomore year, computer engineering majors take the electrical engineering circuits courses that are not taken by the computer science majors. You should decide between computer engineering and computer science by the end of the freshman year.

The only difference between the computer engineering and electrical engineering curriculum in the first year is the programming course. Computer engineering majors take Computer Science 210 (with the computer science majors) and electrical engineering majors take Engineering 123. Both emphasize structure and understanding of a language, but Computer Science 210 also emphasizes design and documentation. Preferably, students decide between electrical engineering and computer science or electrical engineering and computer engineering by the end of the first semester. As a practical matter, bright students can change majors from electrical engineering to computer science without having to make up course work at the end of the freshman year. Well-prepared electrical engineering majors can choose between electrical engineering and computer engineering as late as the end of the first semester of the soph-

omore year. There is extensive overlap between the CS and SE curriculae, as such, students can easily switch between those programs up until their junior year.

Is a personal computer required in electrical engineering, computer engineering, computer science, or software engineering?

Yes. All students are expected to have their own computer. This means that classes are taught in such a way that assumes students have ready access to a computer at home or in the residence hall for homework and projects. Most courses have websites and many professors communicate with students frequently by e-mail.

The department does not endorse a particular brand of computer, but most student software runs on Windows-based machines. In computer science, software engineering, and computer engineering, at the junior and senior level, a dual boot Linux/Windows machine may be more convenient. Mac computers run Windows and Linux via virtual machines and work quite well.

UE is a Microsoft campus and lab machines typically support Windows-based software. Some computer science labs are Linux-based.

Can I study abroad and still complete the program in four years?

Yes. UE's Harlaxton College is located in Grantham, England, about one hour northeast of London. Electrical engineering, computer science, and computer engineering majors can spend one semester at our British campus and still graduate in four years. Tuition, room and board, and financial aid are the same as they are on the Evansville campus. Engineering and computer science students typically go to Harlaxton during the fall term of their sophomore year. At Harlaxton they take calculus and general education classes. Often, technical sophomore level courses are taught at Harlaxton by visiting faculty members from the engineering college. Computer science students also have gone to Harlaxton during other terms with appropriate planning.

How does the co-op program work?

Students attend two regular school years, then go to work during the summer after their sophomore year. They are back in school during the fall and out to work during the spring. After the sophomore year students alternate work and school between summer, fall, and spring. It is a five-year program. After five years, students obtain a BS degree and they have about two years of work experience. About 25 percent of students choose the co-op program.

Interested students attend Experiential Education 90, a noncredit course, during the first term of the sophomore year. In this class students learn

about employment opportunities and résumé writing and also attend a job interview. UE arranges interviews, but the final job placement is made between the student and the employer. Most employers are in the local region, but there are choices nationwide. The Center for Career Development is very good at working with employers to establish co-op programs when students wish to work for employers with whom we do not already have an agreement in place.

What do I do if I want to go to graduate school after earning my degree?

It is common for students who receive an undergraduate degree in engineering or computer science to attend graduate school at a different university. At UE about 20 percent of electrical and computer engineering, software engineering and computer science majors go on to graduate school after completing their undergraduate degree. For students who have a 3.5 grade point average or better and who do relatively well on the Graduate Record Examination (GRE), graduate school is usually paid for by a fellowship or an assistantship. These typically cover 100 percent of tuition and provide modest living expenses. Over the past five years, UE graduates in electrical engineering, computer engineering, software engineering and computer science have gone on to attend graduate school at universities such as University of Colorado, University of Toronto, University of Washington, Vanderbilt University, Washington University in St. Louis, Missouri, Worcester Polytechnic Institute, and others.

How should I prepare for going to graduate school?

Good grades are very important. This is particularly true of courses in your major. Typically, students who continue on to graduate school have a 3.5 grade point average or better. Most graduate schools also consider your scores on the Graduate Record Examination (GRE). Undergraduates who intend to go on to graduate school are encouraged to get some research experience as an undergraduate student. This can be done at UE or by participating in the summer research programs for undergraduates sponsored by the National Science Foundation. The academic advisor can help you choose appropriate courses.

Graduate school applications are typically due in December of the year in which you graduate with the expectation that you will enter graduate school in the following fall.

What is the GRE?

The Graduate Record Examination is given in two parts: A general test and a test in a specific area called a subject test. The general test measures verbal, quantitative, and writing skills that have been developed over a long period of time and are not necessarily related to any particular field of study. Most graduate schools require the general test for admission.

The computer science subject test was discontinued in 2013.

Students who plan to take the GRE should register for the exam very early in their senior year. The general test is computer-based. Students register for a time slot, go to a testing center to take the exam, and get their scores immediately upon completion. In Evansville, the general test is given by Prometric Testing Center at 923 South Kenmore Drive in the Hebron Office Plaza. The website www.gre.org has useful information about the GRE, including a free test practice book.

Tell me about a professional engineering license in electrical engineering, computer engineering, software engineering and computer science.

Professional engineering licenses are granted by individual states. A few states, such as Texas, also license software engineers. In general, engineering licensure is not required to practice engineering unless you practice in an area that involves public health and safety. Such areas might include engineering consultants who advertise themselves as engineers, engineers who work for public utilities, or engineers who work in or for the government. Computer scientists and software engineers, rarely, if ever, participate in the professional engineering license procedure.

What is the difference between computer science and software engineering?

Computer science deals primarily with software. There are some hardware-related topics in computer science such as computer architecture and logic design, but computer scientists deal mostly with the design and development of algorithms and software for computer solutions to problems. Computer scientists design and implement programs that tend to be large and reusable. This makes documentation and program structure very important.

Software engineering has less hardware and theory courses than does a typical computer science program. Software engineers tend to work in teams, have strong analytical skills, and work on large projects. Software engineering has more emphasis on developing large software programs, typically involving teams of programmers.

What are some examples of senior design projects in software engineering?

Just about any project with a significant computational component is acceptable. Computer science students have developed mobile and web applications. In spring 2013, two students developed Android game apps and one student developed a weather balloon tracking app for Android. In spring 2014, two students developed an advising and planning web application. One student developed the frontend using a scenario-based development technique that included usability testing with functional prototypes, while the second student developed the backend database and queries. At the other end of the spectrum, students have done research in computer science, computational mathematics, and cognitive science. Also in spring 2014, a student wrote a traffic simulator to research how to use neural networks to control traffic signals, and another student developed an algorithm and program that composes music in the Serialism genre with only general parameters set by the user.

What are some areas of specialty in software engineering?

The software engineering program at UE provides for 12 hours (four courses) of technical electives and 18 hours (six courses) of free electives. Technical electives are chosen from computer science or electrical engineering courses. Free electives should be chosen in an area of application such as a minor in mathematics, natural science, etc., or for more depth in computer science. Areas of specialty include computational mathematics, artificial intelligence or cognitive science, graphics, computational science, Internet applications, and embedded systems.

How much mathematics is required in the software engineering program?

Software engineering majors at UE are required to take three semesters of calculus, one semester of discrete mathematics (combinatorics), and one mathematics elective, which may be applied engineering mathematics, probability, or linear algebra.



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