

SOFTWARE ENGINEERING

Information for
highschool students.



UNIVERSITY OF
WATERLOO



What is Software Engineering?

- The application of $\left\{ \begin{array}{l} \text{math} \\ \text{science} \\ \text{engineering} \end{array} \right\}$ to software dev.

- **Multi-person** development of **multi-version** software.

Faculty of *Engineering*

- A **collaboration** between ECE and CS

Faculty of *Mathematics*

Software Engineering is Collaboration

ECE

- Electrical & Computer Eng.
- Faculty of *Engineering*
- 90+ profs
- Largest ECE dept. in Canada
- Computers are electronic devices
- Teaches half of SE courses

CS

- Computer Science
- Faculty of *Mathematics*
- 80+ profs
- #1 in Canada [US News 2016]
- Computation is a way of thinking
- Teaches half of SE courses

Why Waterloo?

- *Employment*

- Largest **co-op program** in the world
- Graduate with **24 months** of work experience
- All **major tech companies** hire at Waterloo

- *Rankings*

- Most **Innovative** University [Macleans 2020, 28 years in a row]
- **Top 50** in the world [Times Higher Education 2019]
- **#1** in the world for student-employer connections [QS Rankings '19]

Waterloo Co-op: Alternate Work + Study

- 6 x 4-month work terms = 24 months of co-op work
- 8 x 4-month study terms = 32 months of school
- 4 years + 8 months to graduate

<i>Year 1</i>			<i>Year 2</i>			<i>Year 3</i>			<i>Year 4</i>			<i>Year 5</i>	
F	W	S	F	W	S	F	W	S	F	W	S	F	W
ST	ST	WT	ST	WT	ST	WT	ST	WT	ST	WT	ST	WT	ST

- Salary ranges from \$18/hour to \$40/hour
- <https://uwaterloo.ca/co-operative-education/about-co-op/co-op-earnings>

Other Programs to Consider

All programs have great employment outcomes!

Faculty of Engineering

- Computer Engineering
- Electrical Engineering
- Mechatronics
 - Robots, embedded systems
- Management Engineering
 - User interfaces, Databases
- Systems Design Engineering
 - User interfaces

Faculty of Mathematics

- Computer Science
- Data Science
 - BCS Data Science
 - BMath Data Science

We will discuss
Computer Engineering
and *Computer Science*
in more detail.

Why Software Engineering?

True stories of students who left SE.

Because you *like*:

- Software
- Engineering
- Math
- Science
- Hardware/Circuits
- *Teamwork*
- *Open-ended design challenges*

But please not ...

- “I really wanted to do Electrical Engineering, but my uncle thought SE was more prestigious.”
- “I didn’t know what SE was ... I just applied because it was hard to get in to.”
- “I don’t like teamwork, science, circuits, open-ended design challenges, etc.”

What's in First Year SE?

Like all Engineering:

- Algebra
- Calculus
- Physics
- Professional Practice

Discipline-Specific:

- CS137 Programming in C
- CS138 Programming in C++
- ECE124 Digital Circuits
- ECE140 Analog Circuits
- MATH135 Proofs

Curriculum Comparison: SE + Computer Eng.

		Software Eng.	Computer Eng.
Similar	Math	8	8
	Science	5	5
	Professional	3	3
	Capstone Project	3	2
	Electives	7	8
Different	Software	15	8
	Hardware / Circuits	3	8
	Controls	1	3

How to make robots/machines move.

Software Topics in SE + CE Curricula

In Both SE + CE

- Programming
- Algorithms + Data Structures
- Operating Systems
- Databases
- Networks
- Compilers
- Parallel Programming

Extra in SE

- Human-Computer Interaction
- Software Requirements
- Software Design & Architecture
- Software Testing

Curriculum Comparison: SE + CS

		Software Eng.	CS
Similar	Math	8	7
	Professional	3	2
	Electives	7	6
More Software	Software	15	23
Less Science, Hardware	Science	5	2
	Capstone Project	3	0
	Hardware / Circuits	3	0
	Controls	1	0

CS students may study these topics, but do not have to.

Structure Comparison: SE + CS

Software Engineering

- **Cohort-based System**
 - 75% of courses with cohort
 - Know your classmates
 - Elected class reps
- **Rigidly** defined core curriculum
 - 75% of courses chosen for you
 - Scheduling pre-determined
 - Enforced technical breadth

Computer Science

- **Credit-based System**
 - Individual course choice
 - Harder to know classmates
 - No elected class reps
- **Loosely** defined core curriculum
 - Choose courses from short lists
 - Choose your own scheduling
 - Focus on your interests

Open-Ended Design Challenges

Textbook Problems

- Minutes or hours to solve
- Well defined
- Single correct answer
- Possible to be perfect
- Obviously you are good at these

CS students can choose their mixture of textbook + design

Open-Ended Design

- Weeks or months to solve
- Loosely defined
- Many possible solutions
- All answers have trade-offs
- Make some students nervous

All engineering programs require open-ended design

SE Student + Faculty Relations

- Monthly meeting with student class reps + professors
- Teaching quality survey for every course every term
- Student Government:
 - Cohort-level: *Class Reps*
 - SE Program-level: *SE Society*
 - Faculty-level: *Engineering Society & Math Society*
- Graduating students often describe student + faculty relations as a strength of the SE program

SE Enrichment Opportunities

Curricular Options

- >50 Technical Elective Courses
- AI From ECE + CS
- Human-Computer Interaction
- Management Sciences
- Sustainability Diploma
[*from Faculty of Environment*]
- International Exchange
- And more!

Extra-Curricular

- Citizen Hacks [*hackathons organized by SE students*]
- UWBluePrint.org
[*software for non-profits*]
- Watonomous.ca
[*autonomous vehicle team*]
- Game Development Club
- Engineering Competitions
- SE Society / student government

Making Your Decision

- *Employment*
 - All UW programs have good employment outcomes
 - The major tech companies hire from all UW programs: SE, ECE, CS, etc.
 - What you do with your education matters more than which program you are in.
- *Choose SE at Waterloo if you like:*
 - Software
 - Teamwork
 - Open-ended Design Challenges
 - Hardware/Circuits
 - Science
 - Cohort-based system

See you in September!



SE Curriculum Links

- <http://ugradcalendar.uwaterloo.ca/page/ENG-Software-Engineering>
- <https://uwaterloo.ca/software-engineering/current-undergraduate-students/class-homepages>
- <https://profbillanderson.com/2013/09/23/engineering-economics/>

Student Perspectives

- <https://engiegirlsatuwaterloo.wordpress.com/2013/08/29/computer-engineering-software-engineering-or-computer-science/>
- <https://aimango.postach.io/post/university-of-waterloo-software-engineering-vs-computer-science>

SE Capstone Projects You Can Use

- <https://uwflow.com/>
- <https://dynalist.io/>
- <https://lettucemeet.com/>
- <https://tutturu.tv/>