SOFTWARE ENGINEERING

Information for highschool students.
What is Software Engineering?

- The application of \{ \text{math science engineering} \} to software dev.

- \textbf{Multi-person} development of \textit{multi-version} software.

- A \textbf{collaboration} between ECE and CS
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

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<th>Year 1</th>
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- Salary ranges from $18/hour to $40/hour
- https://uwaterloo.ca/co-operative-education/about-co-op/co-op-earnings
Other Programs to Consider

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

All programs have great employment outcomes!

We will discuss Computer Engineering and Computer Science in more detail.
Why Software Engineering?

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.”

True stories of students who left SE.
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.

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<td>Controls</td>
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**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

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<tr>
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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

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

CS students can choose their mixture of textbook + design

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
Curricular Options

- >50 Technical Elective Courses
- AI
- 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
Student Perspectives

- https://engiegirlsatuwaterloo.wordpress.com/2013/08/29/computer-engineering-software-engineering-or-computer-science/

SE Capstone Projects You Can Use

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