2\textsuperscript{ND} YEAR: YOUR PROGRAM!

LeAnne Golinsky
Admissions and Advising Officer
Program Declaration

https://servicecatalog.engr.uvic.ca/students/declare/

• You declare: now – April 30
• Requires 2^{nd} year standing (12+ units applicable to program)
• Minimum C+ avg., No grade less than C, PLUS competitive GPA
• After spring grades arrive (by May 31st)
• Students moved into programs for September 2020 (Summer courses must meet conditions)
• Email confirmation – includes program planning and advisor

Have you enrolled in the ENGR Advising Site yet??
So, which program is for you??
Civil Engineering
Designing Infrastructure for Civilization
<table>
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<tbody>
<tr>
<td>BC</td>
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<td>Alberta</td>
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<tr>
<td>Quebec</td>
<td>886</td>
<td>413</td>
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</tbody>
</table>

Lots of jobs for Civil Engineers in BC ...
... and our alumni are getting them.
Climate Change
Writing the code for Smart Cities
Problem-based Learning
Addressing Indigenous Challenges
Welcome to Canada's Green Civil Engineering Program
What is Computer Engineering?

- **Cyber** world (Computer Science, Software Engineering)
  - Software algorithms, software architecture, AI, Internet, cybersecurity, databases, operating systems, etc...

- **Physical** world (Electrical Engineering)
  - Sensors, circuits, signal processing, wireless communication, control systems, power, electromagnetics, quantum, etc...

- **Computer Engineering** translates **Cyber** into **Physical**
  (must speak both languages)
  - Digital hardware, embedded code, computer architecture, portable devices, communication networks, etc...
Computer Engineering on a small scale

A look inside: Apple WATCH
Transportation of the future: **vehicle-to-everything (V2X) networks**
New era: Cyber-Physical Systems (CPS)

• What is a CPS?
  “An integration of computation with physical processes whose behavior is defined by both cyber and physical parts”

• CPS examples:
  – “Smart” anything (power grid, buildings, appliances, etc.)
  – Medical robotics
  – Autonomous vehicles
  – Internet of Things (IoT)
Why choose Computer Engineering?

• Anything **cyber-physical** involves Computer Engineering

• “I want to develop **innovative** solutions to **challenging** problems”
  – Energy-efficient **design**: digital **hardware** + embedded **software**
  – Robust **integration**: embedded **system** + communication **network**

• “I want my work to have a positive and **significant** impact”
  – Green computing
  – Mobile healthcare
  – Ambient intelligence
  – And much, much more...
More examples of Computer Engineering work and impact...
Software needs physical **chips** – like **CPUs** and **GPUs** – to run on.

**INTRODUCING ICE LAKE: 10NM CPU**

**NEW SUNNYCOVE CORES**
Up to 4 Cores / 8 Threads
Up to 4.1GHz

**NEW CONVERGED CHASSIS FABRIC**
High Bandwidth / Low Latency
IP and Core Scalable

**NEW MEMORY CONTROLLER**
LP4/x-3733 4x32b up to 32GB
DDR4-3200 2x64b up to 64GB

**FIRST INTEGRATED THUNDERBOLT™ 3**
Full 4x DP/USB/PCIe mux on-die
Up to 40Gbps bi-directional per port

**NEW GEN11 GRAPHICS**
Up to 64EU and 1.1GHz
>1TFLOP

**NEW 2X MEDIA ENCODERS**
Up to 4K60 10b 4:4:4
Up to 8K30 10b 4:2:0

**NEW 3X DISPLAY PIPES**
Up to 5K60 or 4K120
DP1.4, BT.2020

**NEW IMAGE PROCESSING UNIT 4**
Up to 16MP
Up to 1080p120, 4K30
Software is not the only way to compute: behold **adaptable hardware** – **FPGAs**.
Accelerated computing

Using *adaptable hardware* can speed up computations 100-fold!
Unlike general-purpose computers, **embedded systems** are engineered to meet specific application needs.
Automotive computing

Processing System

- **embedded coding**
  - Safety Critical Functions
  - Image Warping and Graphics Overlay
  - Control Decisions Diagnostics Comms.
  - DA Application Processing

- Display Controller
  - DisplayPort Interface

- Scratchpad Memory
  - OCM

- LPDDR3 or LPDDR4
  - DDR Controller
  - Off-Chip Memory

Programmable Logic

- Object List Processing
- Sensor Fusion Acceleration
- Characterized Image Data
- Raw Image Retrieval
- Raw Image Storage

- Capture
- Capture
- Capture
- Capture
- Capture
- Capture
- Capture
- MIPI Standard I/O

- Motion Estimation
  - Gaussian Filter, Edge Detect & Thin, Lane Pattern Search
  - Characterized Image Data

- Scaling
- Scaling

- Blind Spot Detect
- Lane Departure
- Driver Monitor
- Pedestrian Detect

Digital design

Key:
- Vehicle Sensors/Radar
- Functional Safety
- Hard Block
- Soft Block

Driver Assist

Automotive Qualified
ISO 26262 Certified

ZYNQ MPSoC

XILINX

Multi-camera Inputs (rear, forward, right, left...)

Video Memory, Frame Buffers, Application Code, Status Repository
Making IoT secure

Computer Engineering plays a critical role in enabling IoT security.
Electrical Engineering

Dr. Ilampararithi Thirumarai-Chelvan

Akshdeep and Tylynn of the Formula Hybrid Team
EENG career paths

**Traditional entry level jobs**
- Operation & Maintenance
- Testing & validation
- Installation & commissioning

**Modern entry level jobs**
- Design & development
- Simulation & analysis
- Control & automation
Clean energy generation

ECE 370 – Electromechanical Energy Conversion
ECE 427 – Photovoltaics
Transportation electrification

Hybrid electric island class ferry

All electric sea-plane

ECE 482 – Electric Drive Systems;
ECE 410 – Power Electronics
Next generation communication

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<tr>
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<tbody>
<tr>
<td>SMS</td>
<td>SMS Internet</td>
<td>SMS Internet</td>
<td>HD, 3D and ultra Video</td>
</tr>
<tr>
<td>0.1 MB/Second</td>
<td>0.1-8 MB/Second</td>
<td>15 MB/Second</td>
<td>1-10 GB/Second</td>
</tr>
</tbody>
</table>

ECE 350, ECE 450 – Communications Theory and Systems (1 & 2)
ECE 456 – Wireless and Mobile Communication
Smart grids

ECE 470 – Artificial Intelligence
ECE 488 – Power System Analysis
Autonomous robots & control

Driverless car

Human carrying drone

ECE 360, ECE 460 – Control Theory and Systems (1 & 2)
ECE 426 – Robotics
Image & video processing

Edge detection

Medical image processing

ECE 471 – Computer Vision
ECE 435 – Medical Image Processing
Some employers...
EENG career paths

**Traditional entry level jobs**
- Operation & Maintenance
- Testing & validation
- Installation & commissioning

**Modern entry level jobs**
- Design & development
- Simulation & analysis
- Control & automation

*If you have the will*
*we show you the way!*
What is Biomedical Engineering?

→ Biomedical Engineers use their training/expertise to analyze problems in biology and medicine, and to design/create technology that provides an overall enhancement of health care and medicine.

→ These technologies may include:
  - Bioinstrumentation & Biosensors
  - Biomaterials & Tissue Engineering
  - Biomechanics
  - Clinical Engineering
  - Medical Implants
  - Medical Imaging
  - Medical Devices & Equipment
  - Rehabilitation Engineering
  - Others . . .
Three important components of a biomedical engineer:

(1) Firm foundation in engineering (science, mathematics, design)
(2) Working knowledge of human biology
(3) An understanding of medicine and clinical practice
Examples of Biomedical Engineering Activities:

Biomaterials & Tissue Eng.

Detection of Biomarkers (Proteins, Molecules, abnormal cells, etc.)

Prosthesis and Artificial Limbs

Medical Imaging such as: MRI, Ultrasound, or CT (X-Ray).

Vibrating nanowires, allow for early cancer detection by weighing disease molecules.
Needs and Demands for Biomedical Engineering

→ Growing demand for Biomedical Engineers in Canada, and worldwide.

→ BME is projected as a fast growing profession by various sources [1-2].

→ Search/Google: “Canada Biomedical Engineering Jobs”

Needs and Demands for Biomedical Engineering

→ Biomedical engineering encompasses all areas of the public and private sectors involved with medical, biological and human healthcare.

→ Biomedical engineers are needed in the medical technology industry, hospitals and medical institutions, and various research facilities, to design, develop and evaluate technologies aimed at medicine and healthcare.
Needs and Demands for Biomedical Engineering: Examples:

→ Design and development of better healthcare equipment, including performance testing, and establish safety standards for new devices.
→ Health care management and operations
→ Medical equipment specification, maintenance and operations (e.g. Royal Jubilee Hospital, or medical facilities)
→ Medical equipment certification and analysis (e.g. CSA, UL, or private).
→ Medical devices industry (sales, distribution and marketing).
BME Vision Statement

→ Our program prepares graduates for work with the biomedical community and industry, with healthcare professionals, medical doctors, bio-scientists, and engineers.

→ The program will train biomedical engineers in the application of biological and medical science discoveries to the design, development and application of practical technologies needed for human healthcare, medicine and society.

Info from: uvic.ca/annualreview
UVic BME Strategic Focus

- Bioinstrumentation and Medical Devices
- Biomaterials and Tissue Engineering
- Biomechanics, Orthotics and Prosthetics
- Medical Imaging
Fast Program Facts

→ First accredited program in Western Canada
→ Recently we renewed our accreditation for another 3 years
→ Our graduates go on to a variety of opportunities, including medical school, graduate school, and industry
→ Currently have ~171 students in the program
UVic Biomedical Engineering Program:

- BME engineering is a combination of BME, MECH, ELEC and CSC courses.
- Unique BME courses at the 2\textsuperscript{nd} and 3\textsuperscript{rd} Year Level:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BME 200</td>
<td>Learn about molecular and cellular physiology from an engineering perspective</td>
</tr>
<tr>
<td>BME 201</td>
<td>Learn about human physiology and the major organ systems</td>
</tr>
<tr>
<td>CHEM 231</td>
<td>Study the fundamentals of organic chemistry</td>
</tr>
<tr>
<td>BIOC 299</td>
<td>Study the fundamentals of biochemistry and microbiology</td>
</tr>
<tr>
<td>BME 335</td>
<td>Learn about biosensors and instrumentation</td>
</tr>
<tr>
<td>BME 350</td>
<td>Design a biomedical device/product in a team-based environment</td>
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</tbody>
</table>
UVic Biomedical Engineering Program:

- The 4th Year Level - Electives:

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<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BME 403</td>
<td>Medical Image Processing: Learn about image processing and applications to CT, X-ray, MRI and ultrasound</td>
</tr>
<tr>
<td>BME 434</td>
<td>Biophotonics: Optics and application to biology and photobiology</td>
</tr>
<tr>
<td>BME 481</td>
<td>Biomaterials and Tissue Engineering.</td>
</tr>
<tr>
<td>MECH 450</td>
<td>Human Biomechanics</td>
</tr>
<tr>
<td>MECH 483</td>
<td>Mechanics &amp; Energy Conversion in Living Cells.</td>
</tr>
<tr>
<td>PHYS 432</td>
<td>Biomedical Physics</td>
</tr>
<tr>
<td>BME 499</td>
<td>Capstone Design: biomedical device/system in a team-based environment</td>
</tr>
<tr>
<td>BME 401C</td>
<td>Human Factors and Usability Engineering</td>
</tr>
</tbody>
</table>
UVic Biomedical Engineering Program, UG Students:

- On campus Co-op opportunities with research laboratories in:
  - Medical device development
  - Tissue engineering
  - Medical imaging

- BMED student design team, http://www.uvicbiodev.com


- 4th year Thesis and Honor’s Thesis research work on biomedical projects

- On campus volunteer work with research groups
All Engineering Programs

UVic Student Teams for All Engineering Students:

- EcoSat project, building a microsatellite
- Formula SAE, race car team
- Autonomous underwater vehicle (AUV) team
- UVic Aero unmanned aerial vehicle (UAV) team at Victoria Airport
- UVic EcoCar, Canada-US competition, hybrid vehicle
- Computer programming competitions
Mechanical Engineering Program
Dr. Nikolai Dechev

Serving the Needs of Society
and Advancing the Frontiers of Technology and Discovery
Mechanical Engineering Program

Mechanical Engineers use their training/knowledge in energy transfer, mechanics and fluid dynamics to design and create critical technologies for society.

These technologies include:

- Energy Systems (Solar, Wind, Hydro, Ocean, Fusion)
- Aerodynamics and Aerospace (Planes, Spacecraft)
- Mechatronics and Robotics
- Ground Transportation (Cars, Rail, Ships)
- Ocean Engineering and Naval Architecture
- Advanced Materials (Composites, Crystals, Biomat)
- Computer-Aided Engineering and Manufacturing
- Advanced Sensors and Optics
- Computational and Continuum Mechanics
Mechanical Engineering

Mechanical Engineers do activities like:

- Design & Product Creation
- Research and Development
- Analysis, Testing & Simulation
- Manufacturing
- Business Management
- Entrepreneurship
Future of Mechanical Engineering

• **Energy Systems Development**

- Solar Concentrators
- Tidal Turbines
- Carbon Engineering
  CO2 capture
Future of Mechanical Engineering

• Aerodynamics,
• Aerospace,
• Space Systems
Future of Mechanical Engineering

• **Ground Transportation**

• **Ocean Engineering and Naval Architecture**

• **Mechatronics and Robotics**
Future of Mechanical Engineering

- Advanced Materials
- CAD and Manufacturing
- Advanced Sensors and Optics

3D Printed Structures
Growing Crystal Materials
Magnetic Refrigeration
Mechanical Engineering Jobs

- Mechatronics Engineer
- Aircraft Systems Engineer
- Automation Engineering
- Electric Motor Designer
- Fuel Cell Engineer
Mech Engineering Student Teams

UVic AERO

UVic Submarine

UVic Formula SAE
Mech Engineering Student Teams

UVic Rocketry

UVic Robotics

UVic Hybrid Electric
Software Engineering
UVIC BSEng Program

Stephen W. Neville, PhD, PEng (BC)

Director, Software Engineering
Assoc. Prof., Electrical & Computer Engineering
Co-manager, Entrepreneurship@UVic

www.seng.uvic.ca
Software Engineering

Engineering – a practical definition:

Designing and constructing real-world scale systems that:
 • Behave predictably
 • Day-in day-out 24/7/365

As Engineers we do not like surprises!

Software Engineering:

Doing this for the large-scale, software-centric systems the societies rely on:

 • Critical Infrastructure
 • eCommerce and M-Commerce
 • Social Media and Entertainment
 • Banking and Finance
 • eGovernment
 • Business-to-Business Systems

 • Transportation Systems
   • Autonomous Vehicles
 • Cyber-Physical Systems/Internet-of-Things
 • eHealth and Advanced Health Care
Computing-centric Degrees

Large-scale Systems:
- Global-scale Systems
- Cloud computing
- etc.

Embedded Systems/Devices:
- Firmware
- FPGAs
- etc.

Software Engineering

Computer Engineering

Computer Science

Engineering: “Making the possible into the day-to-day!”

Science: “What is possible?”

System Scale
Where is technology going?

(over the next decade or so)
Over the Next Decade (or so …)

Self-driving Cars:
- Software is responsible for the “self-driving”
Smart Buildings:
- Software provides the “Smarts”
Smart Cities: 

- Software provides the “smarts”
Over the Next Decade (or so …)

Data-driven Agriculture:

Software converts measurements into actionable decisions.
Over the Next Decade (or so ...)

Advanced Healthcare:

Software is at the heart of advanced medical machines and eHealth.
Growth of Data vs. Growth of Data Analysts

Stored Data accumulating at 28% annual growth rate
Data Analysts in workforce growing at 5.7% growth rate

Data Analyst shortage
Cars Run on Code

100-200 mil. lines . ~100 processors . 70% effort in SW

> 50% warranty costs due to SW
Your Generation:

Is the one that is going to make the above real!

**Challenges:**

- Creating systems on massive scales
  - Current Internet: 1B-5B Internet devices
  - Anticipated growth: 50B-100B+ devices
- Cyber-security and privacy concerns
- Reliability/performance/maintainability
- Significant and substantial human and environmental health and safety concerns
Careers:
(SENG is one of the fastest growing Engineering fields in Canada at >10% a year)

- Chief Technology Officer
- Cyber-Security/Privacy Analyst
- Project Manager
- Designer (e.g., U/X), System Architect
- Data Analyst/Data Engineer/Data Scientist
- High-tech Entrepreneur

“All you need is a computer (and good software people) to create a company that can sell products and services globally.”

Hunter Macdonald, CEO of Tutela Technologies Inc.
Career Advantages:

• Creative and collaborative work
• Well paid (to extremely well paid …)
• High flexibility:
  – Where you work: company, industry, country, etc.
  – How you work: locations, schedules, etc.
• Global demand is only rapidly accelerating across all industries!
• Small teams can make global impacts!

*If you can imagine it, you can build it!*
The SE Program @UVIC

Largest accredited SENG program in Western Canada
- >300+ students as of Fall 2019
- Growing at >10% per year

SENG Specializations:
- Data mining and analysis, artificial intelligence, and machine learning
- Cyber-physical and smart systems
- Cyber-security and privacy
- Performance and scalability
- Interaction design and data visualization
- Visual computing (vision/graphics)

Accredited program: [Canadian Engineering Accreditation Board](https://www.cea.ca/en/programs/eng-seng)
High-tech in Victoria:

Victoria’s high-tech is predominately software-centric:

- Vibrant and rapidly growing:
  - 900+ local companies
  - >4.3B+ in annual revenues
  - >18,000 employees
- Victoria companies compete very successfully globally!

- High-tech is one of BC’s largest industry sectors:
  - >100,000 people employed
  - Larger than the mining, oil and gas, and forestry sectors combined

Plentiful co-op opportunities! (locally, regionally, and globally)

Last term >70% of SENG co-op courses were in Victoria’s high-tech sector!
Accelerating Demand for Software Engineers: (24/02/2019)

LinkedIn Jobs

Software Engineer jobs in United States

195,000+ jobs

Software Development Engineer
Amazon Web Services (AWS)
New York City, NY, US
The ideal candidate is an experienced and highly-independent software development engineer, who is comfortable working on ...

Software Engineer
Radiant Solutions
Arlington, VA, US
Radiant Solutions is looking for a Software Engineer to participate in software development as part of an agile software development team.

Software Engineer
InventureIT
Georgia
https://www.inventureit.com/indeo-jobs/30bbf9952d5aabcdf87
/software-engineer-c-net/

Software Engineer
FLOW-3D
Santa Fe, New Mexico Area
You’ll have an opportunity to combine your creative skills with your analytic skills to contribute to a tool which is used by customers ...

Job description

AWS is hiring Software Development Engineers to build tools that provide automated architectural guidance for customers. This is a new team, so you will get a chance to help build tools from the ground-up, such as conversational interfaces and ML-enhanced search. We are building a cross-functional team of Applied Scientists. Software...
Accelerating Demand for Software Engineers: (21/02/2020)

Over the last 12 months, 100,000 more job openings
Please send questions to engr@uvic.ca