



## CIVE 580 – Simulation and Optimization of Designs and Flows

Term – Fall 2020 (202009)

We acknowledge with respect the Lekwungen peoples on whose traditional territory the university stands and the Songhees, Esquimalt and WSÁNEĆ peoples whose historical relationships with the land continue to this day.

### Instructor name Ralph Evins

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Office: ECS 422

### Office Hours

Days: By appointment

Time: Fridays 11:30 - 1:20

Location: Zoom / TBD

**List all prerequisites and co-requisites: None**

### Course Objectives

This course explores the simulation and optimization tools available to engineers to help them model the performance of a design and select optimal design configurations and operation modes. Core methods of simulation include numerical (black-box), analytical (white-box) and grey-box (combining these using machine learning methods). Core optimization methods covered include meta-heuristics (like genetic algorithms) and linear programming. These will be explored using relevant literature and hands-on learning using computational tools. Students will be equipped to apply these methods to a specific problem, to assess the results, and to communicate them in a conference-style paper.

### Learning Outcomes

- Read scientific literature in the topic area of optimization and simulation, and communicate their level of comprehension orally and in written form.
- Use computational tools to apply the methods they have learnt, and analyze the results.
- Propose and implement a novel application of the methods and tools covered to a chosen topic.
- Write a term paper summarizing this to a format and standard of a conference proceeding.

### Assessment

Weight & Dates of Assessments:	Weight	Date
Reading reports and class discussion	30%	9am Monday before relevant classes
Computational assignments	30%	5pm Friday after relevant classes
Final project paper	40%	Last day of term

Course Withdrawal Deadlines: <https://www.uvic.ca/calendar/dates/index.php>

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Graduate Calendar.

**There will be no supplemental examination for this course.**

## Syllabus

Week	Topics	Assigned reading (complete before this class)
		Assignments (complete after this class)
1	<u>Overview of simulation and optimization</u> Key concepts and vocabulary; Problem types, methods and algorithms.	<u>Gray on eScience (pages xvii-xx)</u>
2	<u>Python / BESOS platform</u> Using Python and BESOS modules; Your first optimization.	<u>Pre-task: get a working BESOS login</u>
3	<u>Meta-heuristic optimization</u> Multi-objective; comparing algorithms	<u>Evins</u> (9am Monday 23 <sup>rd</sup> Sept)
4	<u>Case study: Building energy optimization</u>	<u>Optimization assignment</u> (5pm Friday 4 <sup>th</sup> Oct)
5	<u>Surrogate modelling</u> Approaches; fitness landscapes	<u>Westermann</u> (9am Monday 7 <sup>th</sup> Oct)
6	<u>Case study: Surrogate modelling</u>	<u>Surrogate model assignment</u> (5pm Friday 18 <sup>th</sup> Oct)
7	<u>Linear programming</u> Storage; networks; binaries	<u>Morvaj</u> (9am Monday 21 <sup>st</sup> Oct)
8	<u>Case study: Energy systems</u>	<u>Energy system assignment</u> (5pm Friday 1 <sup>st</sup> Nov)
9	<u>Analytical modelling</u> Equations; solvers.	<u>Wetter</u>
10	<u>Case study: Modelica</u>	
11	<u>Project discussion</u>	
12	<u>Project work</u>	
13	<u>Project work</u>	<u>(5pm Friday 6<sup>th</sup> Dec)</u>

## Computer labs

Alternate sessions (blue in the course schedule) will be conducted in the computer lab.

Some sessions (as highlighted in orange the Course Schedule) culminate in a computational assignment.

All assignments are to be submitted electronically on Course Spaces.

## Reading reports

Specific assigned readings (as highlighted in green the Course Schedule) are to be summarised in reading reports, which are 1-2 pages long (with figures or sketches where appropriate), and include:

- 3 central 'take home' concepts/issues, with justification
- 2 things you don't understand, and why you don't understand the
- 1 question you would like to ask the author, that goes beyond the article

## Project

An individual project will apply the skills learnt during the course to a topic of the student's choice.

The project mimics the typical application of knowledge and tools to a research problem.

Projects will be judged on their documented use of simulation and optimization knowledge and tools.

**Grading:** Please see the Grading information in the current calendar at:

<https://www.uvic.ca/calendar/future/grad/index.php#/policies>

### Course policies and guidelines

**Late Assignments:** *No late assignments will be accepted unless prior arrangements have been made with the instructor **at least 48 hours before** the assignment due date.*

**Coursework Mark Appeals:** *All marks must be appealed **within 7 days** of the mark being posted.*

**Attendance:** We expect students attend all lectures and labs. It is entirely the students' responsibility to recover any information or announcements presented in lectures from which they were absent.

**Electronic devices in labs and lectures:** No unauthorized *audio* or *video* recording of lectures is permitted.

**Electronic devices in midterms and exams:** Calculators are only permitted for examinations and tests if explicitly authorized and the type of calculator permitted may be restricted. No other electronic devices (e.g. cell phones, pagers, PDA, etc.) may be used during examinations or tests *unless explicitly authorized*.

**Plagiarism:** Submitted work may be checked using plagiarism detection software. Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the link given below for the UVic policy on academic integrity. Note that the university policy includes the statement that "*A largely or fully plagiarized assignment should result in a grade of F for the course.*"

**Academic Integrity:** You must make yourself aware of the University of Victoria guidelines and policy concerning fraud and academic integrity at this link, <https://www.uvic.ca/current-students/home/academics/academic-integrity/index.php>

**Policy on Academic Integrity:** <https://www.uvic.ca/calendar/future/grad/index.php#/policies>

**Standards of Professional Behaviour:** You are advised to read the Faculty of Engineering Document Standards for Professional Behaviour in current Graduate Calendar, which contains important information regarding conduct in courses, labs, and in the general use of facilities. Please find the document at this link: <https://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf>

### Notes to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

**University of Victoria Privacy Policy:** If any student has concerns about their private information being stored or accessed outside of Canada, they are required to inform the course instructor about their concerns before the end of second week of classes.

**Accommodation of Religious Observance:** See entry in current Graduate Calendar.

**Equality:** This course aims to provide equal opportunities and access for all students to enjoy the benefits and privileges of the class and its curriculum and to meet the syllabus requirements. Reasonable and appropriate accommodation will be made available to students with documented disabilities (physical, mental, learning) in order to give them the opportunity to successfully meet the essential requirements of the course. The accommodation will not alter academic standards or learning outcomes, although the student may be allowed to demonstrate knowledge and skills in a different way. It is not necessary for you to reveal your disability and/or confidential medical information to the course instructor. If you believe that you may require accommodation, the course instructor can provide you with information about confidential resources on campus that can assist you in arranging for appropriate accommodation. Alternatively, you may want to

contact the Centre for Accessible Learning located in the Campus Services Building,  
<https://www.uvic.ca/services/cal/>.

The University of Victoria is committed to promoting, providing, and protecting a positive, and supportive and safe learning and working environment for all its members.

**Sexualized Violence Prevention and Response at UVic:** UVic takes sexualized violence seriously, and has raised the bar for what is considered acceptable behaviour. We encourage students to learn more about how the university defines sexualized violence and its overall approach by visiting [www.uvic.ca/svp](http://www.uvic.ca/svp). If you or someone you know has been impacted by sexualized violence and needs information, advice, and/or support please contact the sexualized violence resource office in Equity and Human Rights (EQHR). Whether or not you have been directly impacted, if you want to take part in the important prevention work taking place on campus, you can also reach out:

**Where:** Sexualized violence resource office in EQHR; Sedgewick C119

**Phone:** 250.721.8021

**Email:** [svpcoordinator@uvic.ca](mailto:svpcoordinator@uvic.ca)

**Web:** [www.uvic.ca/svp](http://www.uvic.ca/svp)

**Policy on Inclusivity and Diversity:** See the entry in the current Graduate Calendar.

#### **Course Lecture Notes**

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

#### **Syllabus statement**

A note to remind you to take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone.

**Counselling Services** - *Counselling Services can help you make the most of your university experience. They offer free professional, confidential, inclusive support to currently registered UVic students.*

<https://www.uvic.ca/services/counselling/>

**Health Services** - *University Health Services (UHS) provides a full service primary health clinic for students, and coordinates healthy student and campus initiatives.* <http://www.uvic.ca/services/health/>

**Centre for Accessible Learning** - *The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations* <https://www.uvic.ca/services/cal/>. *The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.*

**Elders' Voices** - *The Office of Indigenous Academic and Community Engagement (IACE) has the privilege of assembling a group of Elders from local communities to guide students, staff, faculty and administration in Indigenous ways of knowing and being.*

<https://www.uvic.ca/services/indigenous/students/programming/elders/index.php>

The **Office of the Ombudsperson** is an independent and impartial resource to assist with the fair resolution of student issues. A confidential consultation can help you understand your rights and responsibilities. The Ombudsperson can also clarify information, help navigate procedures, assist with problem-solving, facilitate communication, provide feedback on an appeal, investigate and make recommendations.

Phone: 250-721-8357; Email: [ombuddy@uvic.ca](mailto:ombuddy@uvic.ca); Web: [uvicombudsperson.ca](http://uvicombudsperson.ca).