

COURSE OUTLINE

ECE 537: Applied Data Analysis

Term – SUMMER 2020 (202005)

Instructor

Dr. Stephen W. Neville

E-mail: sneville@ece.uvic.ca

Office Hours

Days: Wed.

Time: 2:30-3:30

Location: On-line via Blackboard or Zoom (link will be posted on the course web site)

Main course web page: <https://onlineacademiccommunity.uvic.ca/sneville/ece-537/>

- All submissions will be via a companion course web page on CourseSpaces.

Note: All course emails **MUST** have “ECE 537:” in the subject line and **MUST** be sent from UVic email accounts.

Emails without proper subject lines or sent from off-campus email accounts will likely be dropped by UVic’s email spam filters or be automatically redirected to junk email folders.

Course Objectives

This course builds and augments the students’ prior data analysis and statistical pattern recognition background by exploring specific issues and concerns that commonly arise concurrently and interdependently within real-world data sets. This is done through a flipped classroom approach in which the students proceed through a guided set of in-class exercises, each designed to expose particular data analytics issues and concerns.

The course requires ECE 485/535 as its pre-requisite. As such, ECE 537 is tailored to students who already have an ECE 535/485 (or an equivalent) level of data analysis and statistical pattern recognition background and knowledge. ECE 537 is not appropriate for students without this necessary foundational background.

ECE 537 is **not** structured as or intended to be an introductory data analysis course. It is an advanced course focusing on the applied aspects and concerns that arise commonly across real-world data analytics problem domains.

Learning Outcomes

Students successfully completing this course will gain an understanding of:

- Sensitivities of decision boundaries to outliers, normalization processes, noise processes, sample volumes, etc.
- The impacts of improper normalization processes and unbalanced data sets.
- Quantitative and qualitative difference and distinctions between classical and machine learning based data analytics approaches.
- Assessment methodologies for non-stationary and non-ergodic behaviours and their impacts on decision processes.
- Applied impacts of classical statistical pattern recognition’s No Free Lunch and Ugly Duckling theorems.
- Inter-dependent nature of these issues and concerns within real-world data sets.

If time permits, an understanding as to how such issues also apply to an impact supervised and non-supervised clustering methodologies, as well as the data analysis impacts and concern that arise when common methodologies are applied to data arising from adversarial systems and environments.

Syllabus

The exact pacing of the syllabus materials will vary in accordance with each delivery of the course and the relative backgrounds and knowledge of the students, as such the given syllabus solely denotes a provisional pacing and topics lists which may or may not change during the course delivery.

The course will be structured following the general flipped classroom model in which students will progress in class through assigned sets of exercises highlighting specific data issues and concerns, while support via the resulting in-class discussions and guidance.

- Course introduction
- Development of multi-dimensional multi-class Bayes classifier
- Comparison to multi-dimensional multi-class neural network classifier
- Impacts of outliers on classification boundaries
- Impacts of noise and non-informative features, including application of denoising methods
- Impacts of normalization processes, unbalanced data sets, and training sample densities
- Impacts of mutual information in feature vectors
- Assessing time and frequency domain measurement features
- Impacts and assessment of non-stationary and non-ergodic behaviours
- Implications of No Free Lunch and Ugly Duckling theorems on machine learning solutions
- Applications of multi-stage analysis and decision approaches

If time permits, issues associated with supervised and non-supervised clustering approaches may also be explored, as well as the added issues and concerns arising within adversarial systems and environments.

A-Section(s): A01 & A02 / CRN 30339 & 30340

Days: Friday

Time: 11:30-2:20

Location: On-line via Blackboard or Zoom (link will be posted on the course web site)

Required Text

Title: Pattern Classification (2nd Edition)

Author: Richard O. Duda, et al

Publisher: John Wiley & Sons, Inc.

Online Course Delivery:

As this course will be conducted **synchronously** online during this term, students will need to complete and submit exercises online.

Students will require access to a computer which has the following software installed:

- Matlab (student version available at: <https://matlab.engr.uvic.ca/>)
- UVic or Engineering VPN (available at: <https://www.uvic.ca/systems/support/internettelephone/remotearchive/index.php> or <https://servicecatalog.engr.uvic.ca/students/>)
- PDF reader, e.g., Adobe Reader, or similar application (Adobe Reader is available at: <https://get.adobe.com/reader/>)
- Access to Microsoft Teams, UVic Blackboard, and Zoom video conferencing systems (information on these tools will become available on UVIC Learning and Teaching website: <https://onlineacademiccommunity.uvic.ca/learnanywhere/>)

Students are expected to participate and actively work on assigned course exercises in and during all on-line course periods. The course **cannot** be taken asynchronously.

The UVic FAQ for on-line course delivery (due to Covid-19) can be found at: <https://www.uvic.ca/covid-19/students/classes/index.php>

The Faculty of Engineering's FAQ (due to Covid-19) can be found at: <https://www.uvic.ca/engineering/home/covid/index.php#faq>

UVic's orientation to on-line learning student course is available at: https://www.uvic.ca/til/onlinelearning/home/for_students/welcome-to-online-learning/index.php

Assessment:

Exercises	75%	Due Dates:	Each in-class assigned exercise will be due one week after its assigned date via on-line submission as a commented, documented, and executable Matlab LiveScript file to be submitted to the CourseSpaces website.
Final Exam	25%		

Important: All deadlines and schedules for this course reference Pacific Daylight Time.

Notes:

- Students **must** successfully complete and pass **each** of the assigned exercises to pass the course.
- Students **must** successfully pass the final exam to pass the course.

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.

<https://www.uvic.ca/calendar2020-05/grad/index.php#/policy/B13jeiMdE?bc=true&bcCurrent=07%20-%20Grading&bcltemType=policies>

Note 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.

Course Withdrawal Deadlines:

- May 16, 2020: Withdrawal with 100% reduction of tuition fees
- June 6, 2020: Withdrawal with 50% reduction of tuition fees
- July 1, 2020: Last day for withdrawal (no fees returned)

Accommodation of Religious Observance:

<https://www.uvic.ca/calendar2020-05/grad/index.php#/policy/SkmigiMOV?bc=true&bcCurrent=17%20-%20Accommodation%20of%20Religious%20Observance&bcltemType=policies>

Policy on Inclusivity and Diversity:

Engineering: <https://www.uvic.ca/engineering/about/equity/index.php>

Academic Calendar: <https://www.uvic.ca/calendar2020-05/grad/index.php#/policy/HkQ0pzdAN>

Standards of Professional Behaviour:

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour, which contains important information regarding conduct in courses, labs, and in the general use of facilities.

<http://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf>

Academic Integrity:

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the entry in the current Graduate Calendar for the UVic policy on academic integrity.

<https://www.uvic.ca/calendar2020-05/grad/index.php#/policy/BUjesME?bc=true&bcCurrent=02%20-%20Policy%20on%20Academic%20Integrity&bcltemType=policies>

In particular, software tools may be used to assess student submission for similarity to other students work (past or present) and to Internet available materials. Submitted work deemed by such processes to have high similarity will not be marked, will receive a zero grade, and be deemed as not having met the requirement to be a student submission for the given exercise and/or exam.

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. 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.

Course Lecture Notes:

All course materials supplied to students in this course have been prepared by and copywritten 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 constitutes a breach of academic integrity as defined in the UVic Calendar as well as a breach in the Faculty of Engineering's Standards for Professional Behaviour Policy.

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. 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

Web: www.uvic.ca/svp

Office of the Ombudsperson:

The [Office of the Ombudsperson](http://www.uvic.ca/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

Web: <https://uvicombudsperson.ca/>