



The Edward S. Rogers Sr. Department
of Electrical & Computer Engineering
UNIVERSITY OF TORONTO

ECE421H1: Introduction to Machine Learning

Winter 2022

1. Course Description

An Introduction to the basic theory, the fundamental algorithms, and the computational toolboxes of machine learning. The focus is on a balanced treatment of the practical and theoretical approaches, along with hands on experience with relevant software packages. Supervised learning methods covered in the course will include: the study of linear models for classification and regression, neural networks and support vector machines. Unsupervised learning methods covered in the course will include: principal component analysis, k-means clustering, and Gaussian mixture models. Theoretical topics will include: bounds on the generalization error, bias-variance tradeoffs and the Vapnik-Chervonenkis (VC) dimension. Techniques to control overfitting, including regularization and validation, will be covered.

2. Relationship to Wider Context

See notes from the first lecture for an overview of the course and some real-world applications.

Students should refer to ECE IRIS to visualize the relationship between all ECE courses and application areas: <https://ececourses.ece.utoronto.ca>

3. Learning Outcomes

- Fundamentals: basic theory and the fundamental algorithms
- Analysis: ML algorithms for classification, regression and unsupervised learning
- Algorithm Design: using computational toolboxes of machine learning

4. Instructors

Section	Instructor	Email	Office	Lecture Times
Lec 0101	B Liang	liang@comm.utoronto.ca	BA 4122	Tuesday 16:00-17:00 Wednesday 16:00-17:00 Friday 15:00-16:00
Lec 0102	A Khisti	akhisti@comm.utoronto.ca	BA 4128	Thursday 18:00-19:00 Friday 16:00-18:00

5. Lecture Schedule

Week of Jan 10	Intro/Linear Classification		
Jan 17	Linear Regression, Regularization	Tut 1	Assignment 1 posted
Jan 24	Logistic Regression	Tut 2	
Jan 31	Gradient Descent	Tut 3	Assignment 1 due, Assignment 2 posted
Feb 7	Multiplayer Perceptron, Backpropagation	Tut 4	
Feb 14	Deep Learning	Tut 5	
Feb 21	Reading Week		
Feb 28	Unsupervised Learning: Clustering and Density Estimation	Tut 6	Assignment 2 due, Assignment 3 posted
Mar 7	EM Algorithm	Tut 7	Midterm Exam
Mar 14	Support Vector Machine	Tut 8	
Mar 21	Support Vector Machine, PAC Learning	Tut 9	
Mar 28	PAC Learning	Tut 10	
Apr 4	PAC Learning, Bias-Variance Tradeoff	Tut 11	Assignment 3 due
Apr 11	Validation, Cross-Validation		Last day of class: Apr 14

6. Course Website

The course website is on Quercus.

Have a Question?

In general, all questions related to the course material, programming assignments, and homework should be posted on Piazza, so that everyone can benefit from the answer. Email correspondence should be limited to administrative issues such as handling a missed programming assignment or homework.

7. Textbook and Reference Materials

Learning from Data, by Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin, AMLBook, 2012 (required)

Deep Learning, by Ian Goodfellow and Yoshua Bengio, and Aaron Courville, MIT Press, 2016 (recommended)

Machine Learning and Pattern Recognition, by Christopher Bishop, Springer, 2006 (recommended)

8. Marking Scheme

Total	100%	Date
Weekly homework	10%	
Three programming assignments	30%	
Midterm exam	25%	March 7
Final exam	35%	

9. Academic Integrity Policies

For the university's academic integrity policies and consequences, see:

<http://www.academicintegrity.utoronto.ca/> and

<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>.

10. Tutorials

The TAs will discuss the course content and homework problems in weekly tutorials.

Section	Day	Time	Location
Tut 0101	Friday	09:00-11:00	BA 1220
Tut 0102	Friday	10:00-12:00	SF 3202

Tut 0103	Monday	12:00-14:00	GB 221
Tut 0104	Tuesday	09:00-11:00	BA 1210

11. Labs

There will be three programming assignments in the course. These will be done individually using the TensorFlow package. Each assignment is worth 10% of the grade.

12. Homework

Homework will be assigned each week. They should be submitted on Quercus, and they will be marked for effort instead of correctness.

13. Absences and Term Work Petitions

If you are unavoidably absent and miss term work (e.g. test, quiz, assignment, lab), discuss the matter with your instructor immediately. If necessary, submit a term work petition.

All term work petitions must be submitted through the online petition system, which is accessible through the Engineering Portal:

<https://portal.engineering.utoronto.ca>.

Term work petitions must be submitted within seven days of the term work in question and include valid documentation (see <https://undergrad.engineering.utoronto.ca/petitions/term-work-petitions/> for more details).

14. Additional Information and Resources

14.1. Statement on Inclusivity, Equity and Diversity at U of T

You belong [here](#).

The University of Toronto commits to all students, faculty and staff that you can learn, work and create in a welcoming, respectful and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach [here](#).

We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. Engineering denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the [Ontario Human Rights Code](#). If you experience or witness any form of harassment or

discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can disclose incidents of discrimination or harassment to our Assistant Dean, Diversity, Inclusion and Professionalism through [email](#) or through a disclosure [form](#). You can also talk to anyone you feel comfortable approaching, including your professor or TA, an [academic advisor](#), the [Engineering Equity Diversity and Inclusion Action Group](#), any staff member, or contact the [U of T Equity Office](#).

You are not alone.

[Here](#) you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

14.2. Accessibility Services

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register as soon as possible with [Accessibility Services](#).

To schedule an appointment:

Phone: 416-978-8060

Email: accessibility.services@utoronto.ca

14.3. Mental Health Awareness

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have a [First-Year Advisor](#), a Departmental [Undergraduate Academic Advisor](#) or a Departmental [Graduate Administrator](#) who can support you by advising on personal matters that impact your academics. You can book an appointment with your advisor or an engineering learning strategist on the [Engineering Portal](#). Other resources that you may find helpful are listed on the [U of T Engineering Mental Health & Wellness webpage](#), and a small selection are also included here:

- [Accessibility Services](#) & the [On-Location Advisor](#)
- [Graduate Engineering Council of Students' Mental Wellness Commission](#)
- [Health & Wellness Services](#) and [the On-Location Health & Wellness Engineering Counsellor](#)
- [Inclusion & Transition Advisor](#)
- U of T Engineering's [Learning Strategist](#) and [U of T Academic Success](#)

- U of T Engineering's [Mental Health Programs Officer](#)
- [My Student Support Program \(MySSP\)](#)
- [The Registrar's Office](#)
- [SKULE Mental Wellness CLub](#)
- [Scholarships & Financial Aid Office & Advisor](#)

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at [My Student Support Program \(MySSP\)](#) or visiting [U of T Engineering's Urgent Support - Talk to Someone Right Now webpage](#).

15. Land Acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

For more information motivating this acknowledgement visit [Indigenous U of T](#).