

ECE421H1 S

Introduction to Machine Learning

Winter 2024 Syllabus

Course Meetings

ECE421H1 S

Section	Day & Time	Delivery Mode & Location
LEC0101	Tuesday, 6:00 PM - 7:00 PM	In Person: GB 119
	Wednesday, 1:00 PM - 3:00 PM	In Person: GB 119
LEC0102	Monday, 4:00 PM - 5:00 PM	In Person: GB 244
	Thursday, 12:00 PM - 2:00 PM	In Person: GB 120
TUT0101	Thursday, 12:00 PM - 2:00 PM	In Person: GB 119
TUT0102	Tuesday, 12:00 PM - 2:00 PM	In Person: HA 410
TUT0103	Tuesday, 12:00 PM - 2:00 PM	In Person: BA 2175
TUT0104	Tuesday, 12:00 PM - 2:00 PM	In Person: BA 2185

Refer to ACORN for the most up-to-date information about the location of the course meetings.

Course Contacts

Instructor: Ben Liang

Email: liang@ece.utoronto.ca

Course Overview

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.

Course Learning Outcomes

- Fundamentals: basic theory, algorithms, and analysis in machine learning
- Algorithm Design: algorithms for classification, regression, and unsupervised learning

- Programming: computational toolboxes of machine learning

Prerequisites: ECE286H1/STA286H1,
ECE302H1/MIE231H1/CHE223H1/MIE236H1/MSE238H1

Corequisites: None

Exclusions: CSC411H1, ECE521H1

Recommended Preparation: None

Credit Value: 0.5

Course Materials

Textbooks:

- *Learning from Data*, by Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin, AMLBook, 2012 (**required**)
 - Also e-chapters at <https://amlbook.com/>
- *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)

Marking Scheme

Assessment	Percent	Details	Due Date
Homework	10%		No Specific Date
Programming Assignment	20%		No Specific Date
Midterm Exam	30%		2024-03-05
Final Exam	40%		Final Exam Period

- Homework problem sets will be assigned each week. They should be submitted on Quercus, and they will be marked for effort instead of correctness.
- There are four programming assignments. They can be done in teams of two.

Late Assessment Submissions Policy

- 5% per day of lateness.

Course Schedule

Week of Jan 8	Introduction, Linear Classification		
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Jan 15	Linear Regression, Regularization		
Jan 22	Logistic Regression	Tut 1	
Jan 29	Gradient Descent	Tut 2	
Feb 5	Multiplayer Perceptron, Neural Networks	Tut 3	
Feb 12	Backpropagation, Deep Learning	Tut 4	
Feb 19	Reading Week		
Feb 26	Unsupervised Learning, Clustering and Density Estimation	Tut 5	
Mar 4	EM Algorithm		Midterm Exam 1 – 3 pm, Mar 6
Mar 11	Support Vector Machine	Tut 6	
Mar 18	Support Vector Machine, PAC Learning	Tut 7	
Mar 25	PAC Learning	Tut 8	
Apr 1	PAC Learning, Bias-Variance Tradeoff	Tut 9	
Apr 8	Validation, Cross-Validation	Tut 10	Last day of class: Apr 12

Policies & Statements

University Land Acknowledgement

I 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 the Mississaugas of the Credit. 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.

Learn more about Canada's relationship with Indigenous Peoples [here](#).

Indigenous Students' Supports

If you are an Indigenous engineering student, you are invited to join a private Discord channel to meet other Indigenous students, professors, and staff, chat about scholarships, awards, work opportunities, Indigenous-related events, and receive mentorship. Email [Professor Bazylak](#) or [Darlee Gerrard](#) if you are interested.

Indigenous students at U of T are also invited to visit First Nations House's (FNH) Indigenous

Student Services for culturally relevant programs and services. If you want more information on how to apply for Indigenous specific funding opportunities, cultural programs, traditional medicines, academic support, monthly social events or receive the weekly newsletter, go to the FNH [website](#), [email](#) or follow FNH on social media: [Facebook](#), [Instagram](#), or [TikTok](#). A full event calendar is on the CLNX platform. Check CLNX often to see what new events are added!

Wellness and Mental Health Support

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 Departmental [Undergraduate Advisor](#) or a Departmental [Graduate Administrator](#) who can support you by advising on personal matters that impact your academics. 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:

- [U of T Engineering's Mental Health Programs Officer](#)
- [Accessibility Services](#) & the [On-Location Advisor](#)
- [Health & Wellness](#) and the [On-Location Health & Wellness Engineering Counsellor](#)
- [Graduate Engineering Council of Students' Mental Wellness Commission](#)
- [SKULE Mental Wellness](#)
- [U of T Engineering's Learning Strategist](#) and [Academic Success](#)
- [Registrar's Office](#) and [Scholarships & Financial Aid Office & Advisor](#)

We encourage you to access these resources as soon as you feel you need support; no issue is too small.

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

Accommodations

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, visual impairments, chronic health conditions, addictions, D/deaf, deafened or hard of hearing, 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 with Accessibility Services](#) as soon as possible.

We know that many students may be hesitant to reach out to Accessibility Services for accommodations. The purpose of academic accommodations is to support students in

accessing their academics by helping to remove unfair disadvantages. We can assess your situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. The process of accommodation is private; we will not share details of your needs or condition with any instructor.

If you feel hesitant to register with us, we encourage you to reach out for further information and resources on how we can support. It may feel difficult to ask for help, but it can make all the difference during your time here.

Phone: 416-978-8060

Email: accessibility.services@utoronto.ca

Equity, Diversity and Inclusion

Looking for community? Feeling isolated? Not being understood or heard?

You are not alone. You can talk to anyone in the Faculty that you feel comfortable approaching, anytime – professors, instructors, teaching assistants, [first-year](#) or [upper years](#) academic advisors, student leaders or the [Assistant Dean of Diversity, Inclusion and Professionalism](#).

You belong here. In this class, the participation and perspectives of everyone is invited and encouraged. The broad range of identities and the intersections of those identities are valued and create an inclusive team environment that will help you achieve academic success. You can read the evidence for this approach [here](#).

You have rights. The [University Code of Student Conduct](#) and the [Ontario Human Rights Code](#) protect you against all forms of harassment or discrimination, including but not limited to acts of racism, sexism, Islamophobia, antisemitism, homophobia, transphobia, ableism, classism and ageism. Engineering denounces unprofessionalism or intolerance in language, actions or interactions, in person or online, on- or off-campus. Engineering takes these concerns extremely seriously and you can confidentially disclose directly to the Assistant Dean for help [here](#).

Resource List:

- [Engineering Equity, Diversity & Inclusion Groups, Initiatives & Student Resources](#)
- [Engineering Positive Space Resources](#)
- Request a religious-based accommodation [here](#)
- Email Marisa Sterling, P.Eng, the Assistant Dean, Diversity, Inclusion & Professionalism [here](#)
- Make a confidential disclosure of harassment, discrimination or unprofessionalism [here](#) or email engineering@utoronto.ca or call 416.946.3986
- Email the Engineering Society Equity & Inclusivity Director [here](#)
- [U of T Equity Offices & First Nations House Resources](#)

Plagiarism Detection Tool

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>).

Academic Integrity

All students, faculty and staff are expected to follow the University's guidelines and policies on academic integrity. For students, this means following the standards of academic honesty when writing assignments, collaborating with fellow students, and writing tests and exams. Ensure that the work you submit for grading represents your own honest efforts.

Plagiarism—representing someone else's work as your own or submitting work that you have previously submitted for marks in another class or program—is a serious offence that can result in sanctions. Speak to me or your TA for advice on anything that you find unclear. To learn more about how to cite and use source material appropriately and for other writing support, see the [U of T writing support website](#). Consult the [Code of Behaviour on Academic Matters](#) for a complete outline of the University's policy and expectations. For more information, please see the [U of T Academic Integrity website](#).