

ECE368H1 S

Probabilistic Reasoning

Winter 2026 Syllabus

Course Meetings

ECE368H1 S

Section	Day & Time	Delivery Mode & Location
LEC0101	Monday, 11:00 AM - 12:00 PM	In Person: SF 1101
	Thursday, 10:00 AM - 12:00 PM	In Person: BA 1160
TUT0101	Monday, 12:00 PM - 1:00 PM	In Person: BA 2195
TUT0102	Thursday, 2:00 PM - 3:00 PM	In Person: UC 144
TUT0103	Tuesday, 1:00 PM - 2:00 PM	In Person: GB 303

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

Additional Notes: Use email for administrative issues only. For technical questions (lecture, homework, etc.), please use Piazza.

Course Overview

This course will focus on different classes of probabilistic models and how, based on those models, one deduces actionable information from data. The course will start by reviewing basic concepts of probability including random variables and first and second-order statistics. Building from this foundation the course will then cover probabilistic models including vectors (e.g., multivariate Gaussian), temporal (e.g., stationarity and hidden Markov models), and graphical (e.g., factor graphs). On the inference side topics such as hypothesis testing, marginalization, estimation, and message passing will be covered. Applications of these tools cover a vast range of data processing domains including machine learning, communications, search, recommendation systems, finance, robotics and navigation.

Course Learning Outcomes

1. Understand joint distributions, marginal distributions, conditionals, and Bayes' rule.
2. Understand vector-based probabilistic models, e.g., jointly Gaussian vectors and linear inference.
3. Understand graphical models and message-passing inference rules.

4. Understand hidden Markov models (HMMs), the forward-backward algorithm, and the Viterbi algorithm.
5. Be able to model decision problems in engineering as probabilistic reasoning.
6. Be able to identify which type of probabilistic model (vector, graphical, temporal) to use for different engineering applications.

Prerequisites: ECE286H1/ECE302H1

Corequisites: None

Exclusions: CSC412H1

Recommended Preparation: None

Credit Value: 0.5

Graduate Attributes:

- 1A. Knowledge Base for Engineering: Demonstrate competence in mathematics and modeling. [Applied] **Measured in Course**
- 1C. Knowledge Base for Engineering: Demonstrate competence in specialized engineering knowledge appropriate to the program. [Developed] **Measured in Course**
- 5A. Use of Engineering Tools: Demonstrate ability to use fundamental modern techniques, resources and engineering tools. [Applied] **Measured in Course**
- 5B. Use of Engineering Tools: Demonstrate ability to use discipline specific techniques, resources and engineering tools. [Applied] **Measured in Course**

Marking Scheme

Assessment	Percent	Details	Due Date
Midterm Exam	35%		2026-03-03
Computer Labs	15%	There are three take-home computer labs. They can be done in teams of two	No Specific Date
Homework	10%	Homework problem sets will be assigned each week. They will be marked for effort instead of correctness.	No Specific Date
Final Exam	40%		Final Exam Period

Late Assessment Submissions Policy

5% per day of lateness.

Course Schedule

Week of	Probability Review		
---------	--------------------	--	--

Jan 5			
Jan 12	Sample Mean & Convergence, Maximum Likelihood (ML) Estimation, Frequentist vs. Bayesian Views	Tut 1	
Jan 19	Maximum a Posteriori (MAP) Estimation, Least Mean Square (LMS) Estimation, Conjugate Priors	Tut 2	
Jan 26	Binary Hypothesis Testing, Bayesian Hypothesis Testing	Tut 3	
Feb 2	Gaussian Random Vectors, Linear and Quadratic Discriminant Analysis	Tut 4	
Feb 9	Bayesian Inference in Gaussian Systems	Tut 5	
Feb 16	Study Break		
Feb 23	Linear Regression, Bayesian Linear Regression	Tut 6	
Mar 2	Midterm Review, Logistic Regression		Midterm Exam 6 - 8 pm, Mar 3
Mar 9	Markov Chain, Transient State Probabilities, Stationary Distribution	Tut 7	
Mar 16	Bayesian Network, Markov Random Field, Message-Passing Algorithm	Tut 8	
Mar 23	Hidden Markov Model, Forward-Backward Algorithm, Viterbi Algorithm	Tut 9	
Mar 30	Factor Graph, Inference on Tree Graph Models	Tut 10	
Apr 6	Last day of class: Apr 7		

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](#) if you are interested.

Indigenous students at U of T are also invited to visit 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

Your personal wellness and mental health are important. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that can support your well-being.

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 Student & Community Wellness Coordinator](#)
- [Health & Wellness](#) and the [On-Location Engineering Wellness Counsellor](#)
- [Health & Wellness Peer Support Program](#)
- [Accessibility Services](#) & the [On-Location Advisor](#)
- [Graduate Engineering Council of Students' Mental Wellness Commission](#)
- [SKULE™ Mental Wellness](#)
- [U of T Engineering's Learning Strategist](#) and [Centre for Learning Strategy Support](#)
- [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. You may reach out to the counsellors at [U of T Telus Health Student Support](#) for 24/7 free and confidential counselling support.

If you find yourself feeling distressed and in need of more immediate support visit uoft.me/feelingdistressed or 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 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](#)

Use of Generative Artificial Intelligence Tools

Students may use artificial intelligence tools, including generative AI, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit.

Students may not use artificial intelligence tools for taking tests, writing research papers, creating computer code, or completing major course assignments. However, these tools may be useful when gathering information from across sources and assimilating it for understanding.

The knowing use of generative artificial intelligence tools, including ChatGPT and other AI writing and coding assistants, for the completion of, or to support the completion of, an examination, term test, assignment, or any other form of academic assessment, may be considered an academic offense in this course.

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](#).

Lecture Capture by Instructor

If lecture recordings are provided, they are only for the exclusive use of enrolled students, for their personal learning. Lecture recordings are not to be shared in any way beyond enrolled students.

Video Recording and Sharing (Download Permissible; Re-use Prohibited)

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.