# ECE 612: Information Theory

*Winter 2027*

Tentative Syllabus

**Note:** This outline is for information only. The official syllabus will be the one posted on https://outline.uwaterloo.ca/

**Instructor:** Prof. Patrick Mitran

- Office: EIT-4146
- Office Hours: TBD
- E-mail: pmitran@uwaterloo.ca

**Lecture Schedule:** Wednesday and Thursday; 4pm-5:30pm.

Consult QUEST to find the room location.

**Discussion:** Piazza will be used for course discussion.
Self-signup access-code: TBD

**Pre-requisite:** Undergraduate probability and mathematical maturity.

**Aims:** This is a *first* course in information theory. It covers the basic concepts such as entropy, mutual information, channel capacity and rate distortion theory.

## Course Outline

1. Entropy, Relative Entropy, and Mutual Information
2. Asymptotic Equipartition Property
3. Entropy Rates
4. Data Compression
5. Channel Capacity
6. Differential Entropy
7. Gaussian Channel
8. Rate Distortion Theory
9. Information Theory and Statistics (time permitting)

10. Maximum Entropy (time permitting)

**Textbook and references**

Textbook: T. M. Cover and J. A. Thomas, Elements of Information Theory, Wiley, New York, 2nd Edition 2006.

I strongly recommend obtaining a copy of the textbook. The library has many additional books on information theory as well.

1) Library E-Text Licence (Price: Free)

https://onlinelibrary.wiley.com/doi/book/10.1002/047174882X

You may also try:

https://books-scholarsportal-info.proxy.lib.uwaterloo.ca/en/read?id=/ebooks/ebooks2/pda/2011-12-01/1/13568.9780471748816

2) Print (Login):ISBN 9780471241959 (Price : $183.95)

https://lb.ca/cgi-bin/cgiwrap/additem.bbx?/Z109991/I9780471241959

3) Digital (Vitalsource):ISBN 9780471748816 (Lifetime subscription: $147.99)

https://uwaterloo-store.vitalsource.com/products/elements-of-information-theory-thomas-m-cover-joy-a-thomas-v9780471748816

*First editions:* First editions of the textbook are fine, but readings and homework assignment numbers will be from the second edition, and may not match the first edition.

**Allowed Aids during Tests, Midterms and Exams**

You will be allowed to bring your own course notes. These must be hardcopy. You will not be allowed to use a computer, tablet, phone, etc, during a test, midterm or final. So if you takes notes electronically, you will not be able to use these. You may print your electronic notes and bring these to the test, midterm or final.

**Course Evaluation**

- Problem sets will be handed out. You should attempt them all. Solutions will be posted on the course website. They are not graded.
- There will be one in-class midterm tentatively set for 25 Feb 2027. The date of the midterm may change based on how quickly/slowly the course material is covered, but will be in-class.

- There will be a final exam. The date/time of the final exam is TBD. The duration of the final is tentatively set to 2.5 hours.

  If $\mathsf{mid}$ and $\mathsf{fin}$ are the your midterm and final exam grade out of 100, your course grade is the better of $0.25 \times \mathsf{mid} + 0.75 \times \mathsf{fin}$, and $0.45 \times \mathsf{mid} + 0.55 \times \mathsf{fin}$.

*I reserve the right to provide an alternative grading scheme as necessary if the class grades are below what I deem reasonable. I guarantee that no student shall receive a grade less than that of the official scheme above, but the alternate scheme, if any, may improve your grade.*

**Alternate Arrangements**: The situation may change/evolve due to several reasons. For example, the instructor becomes unavailable (e.g., the instructor is sick, the instructor is required to self-isolate, etc.), Public Health orders in-person lectures be stopped, etc. This change may be short-term (e.g., one week) or long-term. As a result, we may move to pre-recorded lectures and online testing as required. In this case, the aids that are allowed will be revised.

**Generative AI**:

This course includes the independent development and practice of specific skills, such as problem solving and mathematical reasoning. Therefore, the use of Generative artificial intelligence (GenAI) trained using large language models (LLM) or other methods to produce text, images, music, or code, like Chat GPT, DALL-E, or GitHub CoPilot, is not permitted in this class. Unauthorized use in this course, such as running course materials through GenAI or using GenAI to complete a course assessment is considered a violation of Policy 71 (plagiarism or unauthorized aids or assistance). Work produced with the assistance of AI tools does not represent the author's original work and is therefore in violation of the fundamental values of academic integrity including honesty, trust, respect, fairness, responsibility and courage (ICAI, n.d.).

You should be prepared to show your work. To demonstrate your learning, you should keep your rough notes, including research notes, brainstorming, and drafting notes. You may be asked to submit these notes along with earlier drafts of their work, either through saved drafts or saved versions of a document. If the use of GenAI is suspected where not permitted, you may be asked to meet with your instructor or TA to provide explanations to support the submitted material as being your original work. Through this process, if you have not sufficiently supported your work, academic misconduct allegations may be brought to the Associate Dean.

In addition, you should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. More information is available from the Copyright Advisory Committee: https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence

Students are encouraged to reach out to campus supports if they need help with their coursework including:

Student Success Office for help with skills like notetaking and time management Writing and Communication Centre for assignments with writing or presentations AccessAbility Services for documented accommodations Library for research-based assignments

**Academic integrity**: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

**Grievance**: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4 [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm]. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

**Discipline**: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. [check www.uwaterloo.ca/academicintegrity/] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the graduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm]. For typical penalties, check Guidelines for the Assessment of Penalties.
www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

**Appeals**: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to Policy 72, Student Appeals. [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm]

**Note for students with disabilities**: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

**Turnitin.com**: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.