

# ECE 612: Information Theory

Winter 2024

**Instructor:** Prof. Patrick Mitran

- Office: EIT-4146
- Office Hours: 1 hour/week. Time: TBD
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## Lecture Schedule:

Consult Quest to find the date, time and location of the course.

**Discussion:** Piazza will be used for course discussion.

Self-signup: TBD

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.

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

## 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.

## 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 midterm tentatively set for week after winter break and will count for 35% of the grade. The date of the midterm may change based on how quickly/slowly the course material is covered. The duration of the midterm is tentatively set to 80 min.
- There will be a final exam that will count for 65% of the grade. The date/time of the final exam is TBD. The duration of the final is tentatively set to 2.5 hours.

*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.

**Self-Isolation:** Students who are required to self-isolate while course delivery is in-person should contact me for access to course content covered during their absence.

**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/](http://www.uwaterloo.ca/academicintegrity/) for more information.]

**Grievance:** A student who believes that a decision affecting some aspect of his/her 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](http://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 [check [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/)] to avoid committing an academic offence, and to take responsibility for his/her actions. 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 undergraduate 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](http://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](http://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 he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://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.