Sabancı Üniversitesi

Faculty of Eng. & Natural Sci.

EE654-202102

Information Theory

Instructor(s)

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Course Content

Entropy and mutual information concepts, Markov chains and entropy rate. Shannon?s lossless source coding, channel capacity, white and colored Gaussian channels, rate distortion theory with applications to scalar and vector quantizer design. Multi-user information theory and applications.

Objectives

Developing a strong abstract thinking to study limits of the communications and signal processing.
Understanding the fundamentals of compression applications such as Zip, JPEG, MPEG, etc., as well as the meaning of transmission capacity of channels, and the ways to achieve the capacity.

Recommend or Required Reading

Textbook

Cover, Thomas, Elements of Information Theory

Assessment Methods and Criteria

	Percentage(%)	Number of assessment methods
Final	50	
Exam		0
Participation	10	
Individual Project	40	1

Course Outline

? The mathematical theory behind solving the problems of compression and communication, culminating in two famous theorems proved by Claude Shannon in 1948 that give us limits on how well any method can do.
? Practical algorithms (which took much longer to appear) for actually doing compression/communication that is almost optimal according to the theory. Examples: arithmetic coding, linear codes, low-density parity-check codes.
? Modelling issues; i.e. how we can take a real-world problem and cast it into the mathematical form necessary for us to analyze it with Shannon's theorems and apply known algorithms to it. Examples: source modeling using dictionary methods such as PPM and Lempel-Ziv (on which gzip is based); channel models such as binary symmetric channels.
? Possible Extra Topics (time permitting)
o Shannon's rate-distortion theory for lossy data compression.
o Information theory with continuous random variables (as opposed to discrete symbols).
o Applications and extensions of Information Theory, e.g., Cryptography, Network Coding, Semantic Communications.

Learning Outcomes

Building a mathematical model of concrete concepts.
Understanding the limits of compression and transmission
Analyze and design compression and error correction control algorithms

Course Policies

Attendance is required. Knowledge of basic probability theory, linear algebra, and some experience in high-level programming, e.g., Matlab or Python needed as a prerequisite. The project will be an original work proposed and completed during the semester. The students are expected to prepare a final paper suitable for submission to the IEEE ISIT conference.