Faculty of Eng. & Natural Sci.

EE410-202102

Information and Coding Theory

https://sabanciuniv.zoom.us/j/92549718030?pwd=M3g1cndNRGsvOS91dHlSYkU3TVNiZz09

Instructor(s)

Name	Email	Office	Phone	Web	Office Hours
Özgür Erçetin	oercetin@sabanciuniv.edu	FENS-1111	9608	http://people.sabanciuniv.edu/~oercetin/	**Monday 9.40-10.30 (https://sabanciuniv.zoom.us/j/5955007342) Friday 9.40-10.30 (FENS 1111)**

Course Content

Mathematical models for communication channels and sources; entropy, information, lossless data compression, Huffman coding, channel capacity, Shannon's theorems rate-distortion theory.

Objectives

To learn about information, how to measure it and how to use it to better design information systems.

Recommend or Required Reading

Textbook

Thomas and Cover, "Elements of Information Theory", 2nd Edition

Readings

Shannon's seminal papers on Information Theory and Secrecy. Additional papers illustrating the applications of Information Theory in real life systems will also be provided.

Assessment Methods and Criteria

	Percentage(%)	Number of assessment methods
Final	40	
Midterm	40	1
Exam	10	4
Participation	10	

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

Define the information content of an information source mathematically and define information theoretical measures such as entropy, conditional entropy, joint entropy mutual information, differential entropy etc.
Describe the fundamental limit in source coding and learn Shannon?s Source Coding Theorem
Design and implement some of the practical source codes
Describe the fundamental limit in maximum information rate at which the information is sent reliably and learn Shannon?s Channel Capacity Theorem.
Design and implement some of the practical channel codes
Describe the capacity of Gaussian Channel and optimal power allocation over Gaussian Channel using Water-Filling algorithm.
Describe the application of information theory to some of engineering problems through the course project.

Course Policies

Attendance is required. 4 quizzes will be given at random during the semester. The rest of the grades will be based on 1 midterm and 1 final exam.