

**EE 410: INFORMATION AND CODING THEORY**  
**Spring 2020-2021**

**Instructor:** Yunus Sarıkaya

Office: FENS G001B

E-mail: [ysarikaya@sabanciuniv.edu](mailto:ysarikaya@sabanciuniv.edu)

**Office Hours:** by appointment

**Lectures:** Monday: 13.40-15.30 (Online through Zoom, Zoom Meeting ID: 5179244142)

Tuesday: 18.40-19.30 (Online through Zoom, Zoom Meeting ID: 5179244142)

**Note:** Lectures will be uploaded on Google drive as well.

**PREREQUISITES:** Knowledge on basic probability theory, linear algebra

**REFERENCES:**

Elements of Information Theory, Thomas Cover and Joy Thomas. (available at Pandora.com.tr)

Applied Coding and Information Theory for Engineers, Richard B. Wells.

Information Theory, Inference and Learning Algorithms, David MacKay. Available at:

<http://www.inference.phy.cam.ac.uk/mackay/itila/book.html>

“A Mathematical Theory of Communication,” Claude E. Shannon.

**GRADING:** 1 Midterm (%35) + 1 Final (45%) + Project (20%) + Lecture Attendance (5% Bonus)

**MAIN TOPICS OF THE COURSE :** • Review of probability theory • Entropy • Mutual information • Data compression • Huffman coding • Asymptotic equipartition property • Universal source coding • Channel capacity • Differential entropy • Block codes and Convolutional codes.

**What will this course cover?**

- 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 are 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 in 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, Quantum Information Theory.

### **Exam Policy**

- During midterm, we will do online proctoring through Zoom. You will need to have working cameras, which will show your face and some part of your desk. If there is any technical issue during the exam coming from your side, you are allowed to take make-up exam. But taking make-up exam is not recommended.
- Final Exam will be a take-home exam and you will be given limited amount of time (e.g. 1 day).
- Projects will be about different applications of the theory studied in the classroom. The project will involve a thorough treatment of a research topic (involving not only a survey but also simulation analysis). The grade on the project will depend on the final report.