Information Theory and Source Coding
EQ2845

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Why is Source Coding Relevant?

- Store data files on disk efficiently
- Store audio files (MP3)
- Store digital images (JPEG, JPEG2000)
- Store digital video (MPEG, H.264, H.265, H.266)
- Efficient telecommunication
- Mobile communication (LTE, 5G, 6G)
- Video conferencing (Zoom)
- Audio / Video streaming over the Internet
- 3D Television

Example: Video Coding

frame size	1280x960
bit-depth	12 bpp
frame rate	30 fps

uncompressed data rate:
442 Mbps

Some interesting bit-rates

– Terrestrial TV broadcasting channel	~20 Mbps
– DVD (4.7…17 GB/length of movie)	5...20 Mbps
– Ethernet/Fast Ethernet	100/1000 Mbps
– Cable broadband	50…500 Mbps
– Mobile broadband	1...100 Mbps

Outline EQ2845

- Information and Entropy
- Lossless Coding
- Shannon's Noiseless Source Coding Theorem
- Lossy Coding
- Rate Distortion Theory
- Shannon's Noisy Source Coding Theorem
- Quantization
- Transform Coding
- Predictive Coding
- Machine Learning and Compression

Prerequisites EQ2845

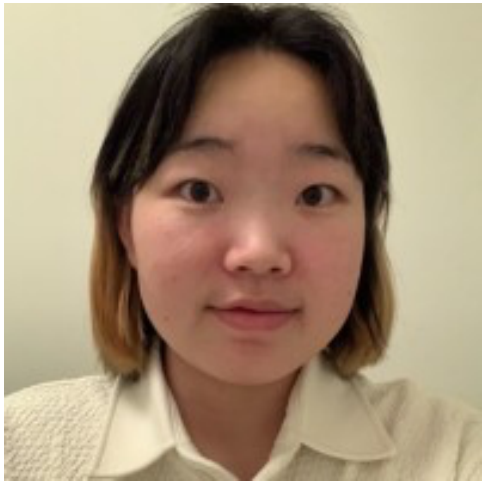
- Signals and Systems
- Recommended: Signal Theory or equivalent, e.g., EQ1220

EQ2845 Organisation

- Regularly check class home page:

  https://canvas.kth.se/courses/59227

- Assistant:



Shudi Weng

- Office hours: Markus Flierl: Email

EQ2845 Organisation

- Access to files: KTH Canvas
- Homework assignments
  - We hand out homework assignments
  - You solve them individually
  - Return your assignments by the due date
- Exercise sessions
  - Organized by assistants
  - Take the opportunity to discuss assignment problems among your peers (groups of 2-3 students)

EQ2845 Organisation

- Grading
  - Hand in all homework assignments
  - Final exam
  - Both final exam and homework assignments contribute to final grade

Further Reading

- Slides available as hand-outs
- Course book:
  - T.M. Cover and J.A. Thomas, “Elements of Information Theory,” John Wiley & Sons, Inc., New York, 2022.
- Additional books:
  - D.S. Taubman and M.W. Marcellin, “JPEG2000 Image Compression Fundamentals, Standards and Practice,” Kluwer Academic Publishers, Boston, 2004.
  - W.B. Kleijn, “A Basis for Source Coding,” KTH Stockholm.
- Additional papers:
  - G. Chechik, A. Globerson, N. Tishby, and Y. Weiss, Information Bottleneck for Gaussian Variables, JMLR, no. 6, 2005.