ENGG 5301 - Information Theory

Lecture 1

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General info

- Tu 1:30PM - 3:15PM Ho Sin-Hang Engg Bldg 801
- Th 4:30PM - 5:15PM Ho Sin-Hang Engg Bldg 801
- TA: Liu Yanxiao
- Tutorial session: TBA
- Office hours of Li Cheuk Ting: Tu 3:30PM - 4:15PM @ SHB 807 (or by appointment)
- Textbook:
  - Information Theory and Network Coding by Raymond Yeung
  - https://link.springer.com/book/10.1007/978-0-387-79234-7
- Recommended reading:
  - Elements of Information Theory by T. M. Cover and J. A. Thomas

General info

- Lecture notes and assignments are posted on Blackboard

  - Submit assignments on Blackboard

- Piazza discussion forum:
  piazza.com/cuhk.edu.hk/fall2022/engg5301
  Access code: learninfotheory

Topics

- Information measures
  - Entropy and mutual information

- Lossless source coding
  - Huffman codes
  - Source coding theorem

- Channel coding
  - Discrete channels
  - Continuous channels

- Lossy source coding
  - Rate-distortion

Compression
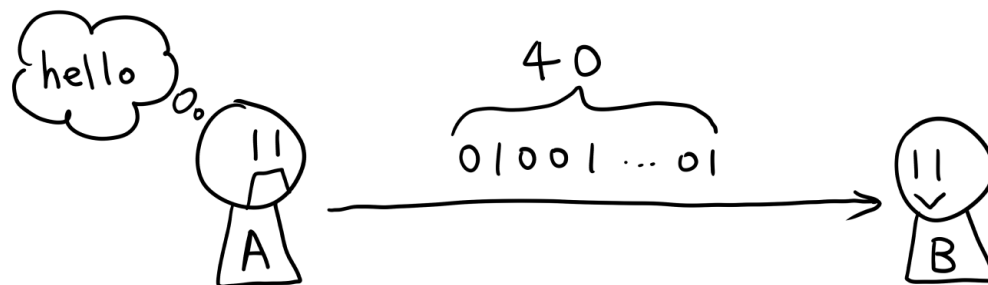
- Suppose we want to compress n English letters $X_1, \ldots, X_n$ ($X_i \in \{a, \ldots, z\}$) into k bits
  - Rate $R = k/n$

- Intuition: R is the average amount of information in each letter

- What is the optimal rate when $n \to \infty$?

Compression

- Image compression (PNG, JPG,…)

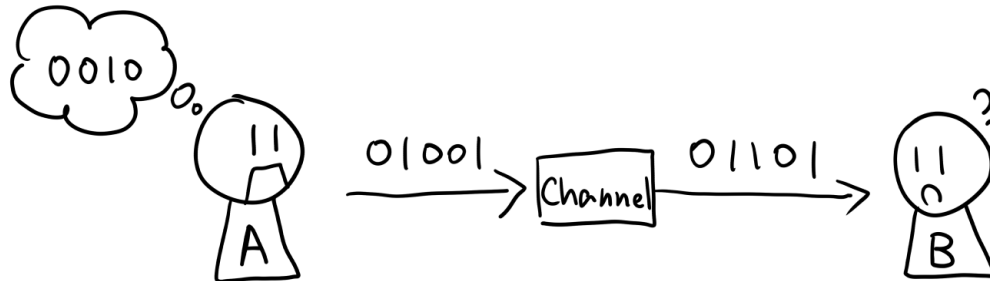BMP (516KB)   PNG (292KB)   JPG (7.4KB)

- Audio compression (MP3,…)
- General data compression (ZIP,…)

Channel coding

- Alice wants to send k bits to Bob using a noisy channel n times
    - Can send 1 bit for each channel use, but the bit may be flipped with probability α
    - Rate $R = k/n$
- Intuition: R is the average amount of information that can be transmitted per channel use
- What is the optimal rate when $n \to \infty$?

Channel coding

- QR codes

- NAND flash memory

- Compact disc

- 5G

- Deep space satellite communications