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Information Theory

Laboratory Exercise: Information and Entropy

- This Laboratory session is NOT assessed.
- As you proceed with this investigation, you must to complete a personalized lab answer sheet and submit it before you leave this laboratory.
- You must also keep your own notes of your observations and results.

Aims: This lab session is designed to give you some practical experience of estimating information and entropy measures in real-life examples, and to enhance your understanding of the fundamental concepts of Information Theory in general.
Equipment: Software: Matlab.

Exercise 01: In a biased coin toss experiment the distribution probability of heads and tails is $P(x)=\{p(H),p(T)\}=\{0.4,0.6\}$. Estimate the information of 'heads' in bits, nats and Hatleys.

Exercise 02: Consider a randomly selected N-digit M-base integer number. Estimate the information of this number in bits, nats and Hatleys.

Exercise 03: Given the source of information X, with

$$X=\begin{cases} A, & p(A)=1/2 \\ B, & p(B)=1/4 \\ C, & p(C)=1/8 \\ D, & unknown \end{cases}$$

Plot the distribution P(X) and estimate the entropy of X in bits/symbol, nats/symbol and Hatleys/symbol.

Exercise 04: Given the source of information X with distribution probability $P(x)=\{p(x_1),p(x_2),p(x_3)\,p(x_4),p(x_5)\}=\{0.1,0.2,0.1,0.4,0.2\}$, estimate the entropy of X in bits/symbol, nats/symbol and Hatleys/symbol.

Exercise 05: Given the binary source of information X with distribution probability $P(x)=\{p(0),p(1)\}=\{p,1-p\}$, draw the entropy of X in bits/symbol, nats/symbol and Hatleys/symbol as a function of p.

Exercise 06: Create a function that estimates the information of an event given the probability of it. The function should estimate the information in bits (default option), nats or Hatleys based on an input argument.

Exercise 07: Create a function that estimates the entropy of a discrete source of information given the distribution probability of it. The function should estimate the entropy in bits (default option), nats or Hatleys based on an input argument.