

**Pries: M460 - Information and Coding Theory, Spring 2015**  
**Handout 6W: Introduction to entropy**

There is a trade-off between information and redundancy. For example, a textbook has a high-information rate while newspaper has a low information rate.

Complete the following sentences. Which is missing the most information?

1. After rushing to the airport yesterday, I was annoyed to see that my flight was ....
  2. Luckily, we landed only .... minutes late and I caught my shuttle.
  3. When I got home, I was surprised to see that....
1. Because the weather forecast called for rain, she took her ...
  2. The weather forecast called for ...
  3. It was raining and she surprised everyone by ...

English is highly redundant. Some parts of a message are more critical. There is not a uniform distribution of information. Which typo causes more uncertainty?

1. I cano go with you.
  2. I can go wih you.
1. iyoaeaiyoaeao00
  2. fucnrdthsucngtdjb.

The amount of information obtained from receiving a signal or the amount of uncertainty in a communications situation can be measured mathematically. The following functions will be helpful.

1. Let  $0 < q \leq 1$ . Let  $I(q) = \log(\frac{1}{q})$ .
  - (a) Show that  $I(q) \geq 0$ .
  - (b) Show that  $I(q_1q_2) = I(q_1) + I(q_2)$ .
2. Let  $0 < q < 1$ . Let  $H(q) = qI(q) + (1 - q)I(1 - q)$ .
  - (a) With a graphing calculator, graph  $H(q)$  for  $0 < q < 1$ .
  - (b) Show that  $H(0) = H(1) = 0$ . Hint: start with showing  $\lim_{x \rightarrow \infty} \frac{\log(x)}{x} = 0$ .
  - (c) Show that  $H(q)$  has a maximum at  $q = 1/2$ .

**Pries: M460 - Information and Coding Theory, Spring 2019**  
**Homework 6: Due Monday 3/4**

Read handout about Huffman encoding.

start reading Bremaud Discrete Probabilities Models, Chapter 11.

1. Handout, just after Table 2.1.1, #3.
2. Do either one part or the other of this problem:
  - (a) end of Section 2.2, #1,2,3,4,6.
  - (b) end of Section 2.2, #7.
3. end of Section 2.2, #9.