

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Electrical Engineering and Computer Science
Department of Mechanical Engineering

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Information and Entropy

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Homework 5

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Problem 1

In the last lecture, you learned about how the value of the bit being held by a memory cell can change due to the environment. You are designer for the Voyager II space probe and are given the task to analyze the robustness of two memory cells. The probability of a memory cell changing a bit due to one cosmic ion is 0.1.

- Given that one cosmic ion passes by, what is the probability that there will be only one error between both memory cells? This cosmic ion can change the bit of more than one cell, but can't change the same cell's bit twice.
- Given that two cosmic ions pass by, what is the probability that there will still be only one error between both memory cells? An error occurs when the modified bit is not the original value.
- To reduce the probability of an error occurring, you use redundancy by representing each memory cell as 3 yielding a total of 6 memory cells. What is the probability of one of the two bits changing its value? Remember that a group of 3 cells holds the value for one bit.

Problem 2

You have seen Shannon's equation on how many bits are required to represent an object.

$$-\sum_{i=1}^n p_i \log_2 p_i$$

- Suppose that the only characters that you can send are {a,b,c,d,e,f,g,h}. What is the minimum number of bits required to represent the word "badge"?
- Using the same alphabet as in part a, what is the minimum number of bits required to represent the character string "abababab"?