CS 6301.503 Spring 2019 Scott C. Waggener (scw180000)

Homework 4 (Probability) Problem 1

Complete

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Homework 4 (Probability) Problem 2

Complete

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Homework 4 (Probability) Problem 3

(a) You're person B and want to win, which version of the game do you play?

Solution: The standard version ■

Proof: First a qualitative answer: In the standard version of the game answers are received immediately after each question, meaning that the answer to question $q-1$ will inform what should be asked for question q. Expressed mathematically, the conditional probability of possible objects at iteration i will be of the form

$$P(O = o_n) = P\left(o_n \middle| a_{i-1}, a_{i-2}, \dots a_1\right) \tag{1}$$

where a_i is the answer to the ith question. If person B wants to maximize $P(O = o_n)$ for some object, they need □

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Homework 4 (Probability) Problem 4

Solution: The plot was generated using 100 trials for each of the possible number of known questions. Sampling was done using `np.random.binomial` with $n = 1,\ p = 0.25,\ \text{size} = (100 - \text{known})$

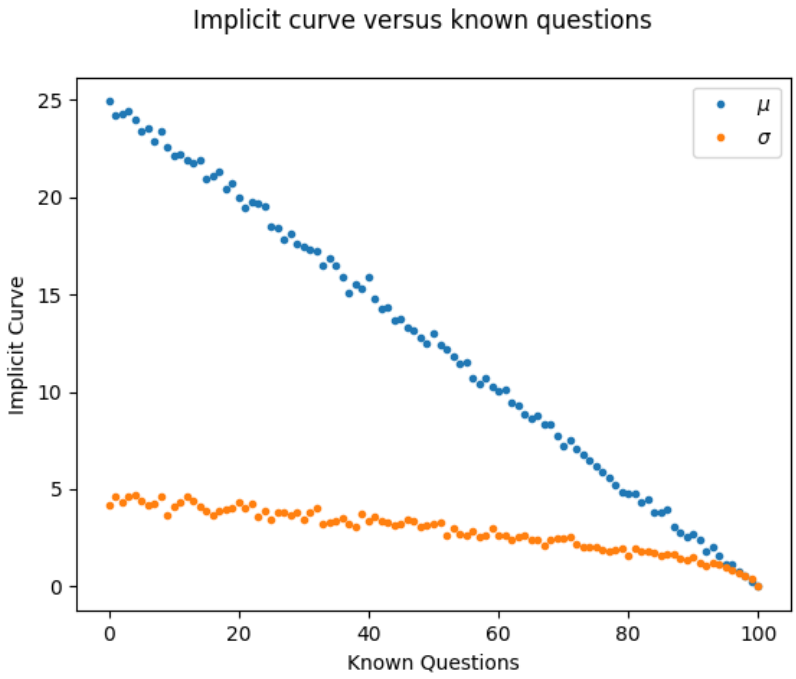

Figure 1. Implicit curve μ, σ versus number of known questions.

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Homework 4 (Probability) Problem 5

Assume ImageNet has 1.28 million images of size 3 x 256 x 256 with 1280 images each in 1000 different classes. How many bits of information are in the ImageNet labels?

Solution: 10 bits ■

Proof: Since entropy can informally be defined as the information in the realization of a random variable, we can compute the entropy for the given problem. We have 1280 images in each of the 1000 classes, meaning

$$H(x(s)) = -\sum_{i=1}^{1000} \frac{1}{1000} \log_2\left(\frac{1}{1000}\right) \tag{2}$$

$$= -\frac{1000}{1000} \log_2\left(\frac{1}{1000}\right) \tag{3}$$

$$= \log_2 1000 \tag{4}$$

$$\approx 9.97 \tag{5}$$

□