

Assignment # 3

1. Find a probability distribution $\underline{p} = \{p_0, p_1, \dots, p_{J-1}\}$ for which there does not exist a prefix code with codeword length $n_j = \text{Floor}(-\log_2 p_j)$, $j = 0, \dots, J-1$. This explains why we have conservatively rounded up rather than down.
2. An IID source U with alphabet $A_U = \{a, b, c, d, e\}$ and a distribution $\underline{p} = \{0.4, 0.2, 0.2, 0.1, 0.1\}$.
 - (a) Find two prefix codes with source length $K = 1$ whose average lengths are minimum and whose sets of lengths are different.
 - (b) For each code, compute the average and variance of its lengths.
 - (c) Can you think of a reason why a code with smaller variance would be useful.
 - (d) Find the smallest source length K for which there exists a prefix code with rate $R \leq H(\underline{p}) + 0.1$.
3. A binary IID source with $p_0 = 0.99$ and $p_1 = 0.01$.
 - (a) Find a VLC with rate no larger than 0.4 (It should be as simple as possible).
 - (b) Compare the performance and complexity of this code with the fixed-length code in HW2.
 - (c) Is it possible to find a VLC with rate less than 0.1? If so, how large the source length K should be? To do this, find upper and lower bounds on the minimum possible source block length K .
4. An IID source has $n_2^* = 4$ and $n_3^* = 4.8$. Find upper and lower bounds on the entropy of the source. (Here: $n_K^* = \min\{\text{VLC lengths with source length being } K\}$).
5. [Cover & Thomas], Problem 5.4.
6. [Cover & Thomas], Problem 5.6.
7. [Cover & Thomas], Problem 5.12.

Note: Please copy this and sign on each H.W. assignment:

I testify that I will not refer to the solutions of the assignments of EE 575 by any means and in any form and from any source, before I submit the assignment to my instructor. For programming assignments, I testify that I will not use/refer to any ready code in any means or any form throughout and until the submission of the assignment.