

Exercises Week 4

Information Theory

1. Find a Shannon code for the following information source

$$S : \begin{pmatrix} s_1 & s_2 & s_3 & s_4 & s_5 \\ \frac{1}{2} & \frac{1}{10} & \frac{3}{10} & \frac{1}{10} & \frac{1}{10} \end{pmatrix}$$

- a. Draw the graph of the code
 - b. Compute the efficiency and the redundancy of the code
2. Find a Shannon code for the following information source

$$S : \begin{pmatrix} s_1 & s_2 \\ 0.95 & 0.05 \end{pmatrix}$$

- a. Find the average codeword length, the efficiency and the redundancy of the code
 - b. Can you optimize the code? How?
 - c. What is the efficiency and redundancy of your optimized code? Is it a big improvement?
3. Find a distribution such that the following code is optimal:

Message	Code A
s_1	0
s_2	101
s_3	100
s_4	11

4. We perform Shannon coding on an information source with $H(S) = 20\text{b}$.
 - a. What are the possible values for the efficiency of the code?
 - b. What are the possible values for the redundancy of the code?
 - c. What is the minimum number of messages the source may possibly have?