Source Coding Basics

Information Theory

1. Consider the binary codes below:

Message	Code A	Code B	Code C	Code D	Code E	Code F
s_1	00	0	0	0	0	0
s_2	01	10	01	100	110	10
s_3	10	110	011	11	10	11
s_4	11	1110	0111	110	111	110

   For each code:

   a. Verify the Kraft inequality
   b. Determine if the code is instantaneous / uniquely decodable
   c. Draw the graph

2. Consider a memoryless source with the following distribution:

$$S : \begin{pmatrix} s_1 & s_2 & s_3 & s_4 \\ \frac{1}{2} & \frac{1}{4} & \frac{1}{8} & \frac{1}{8} \end{pmatrix}$$

   For this source we use two separate codes:

Message	Code A	Code B
s_1	00	0
s_2	01	10
s_3	10	110
s_4	11	111

   Requirements:

   a. Compute the average lengths of the two codes
   b. Compute the efficienty and redundancy of the two codes
   c. Encode the sequence $s_2 s_4 s_3 s_3 s_1$ with each code

d. Decode the sequence `0110101010101111000010101` with each code

3. Fill in the missing bits (marked with ?) such that the resulting code is instantaneous.

Message	Codeword
s_1	??
s_2	1??
s_3	11?
s_4	0?
s_5	??

(just replace the '?'; do not add additional bits)