Exercises Week 7

Information Theory

Chapter II:

1. A discrete memoryless source has the following distribution:

$$S : \begin{pmatrix} s_1 & s_2 & s_3 \\ 0.1 & 0.7 & 0.2 \end{pmatrix}$$

   a. *Done in previous week:* Find the average code length obtained with Huffman coding on the original source and on its second order extension.

   b. Encode the sequence $s_7 s_7 s_3 s_7 s_7 s_7 s_1 s_3 s_7 s_7$ with both codes.

2. A discrete memoryless source has the following distribution

$$S : \begin{pmatrix} s_1 & s_2 & s_3 & s_4 & s_5 & s_6 & s_7 & s_8 \\ 0.4 & 0.3 & 0.2 & 0.04 & 0.03 & 0.02 & 0.009 & 0.001 \end{pmatrix}$$

   a. Do Huffman coding of the source for a code with 4 symbols, x_1, x_2, x_3 and x_4, and encode the sequence

$$s_1 s_7 s_8 s_3 s_3 s_1$$

Chapter III:

1. For the following error control code, do the following:
   a. compute the minimum Hamming distance and indicate how many errors it can detect and how many errors it can correct, with the nearest neighbor decoding algorithm;
   b. considering two received codewords, $\mathbf{r_1} = 11100$ and $\mathbf{r_2} = 00011$, perform decoding and say if there are errors, and if so then correct the errors (find the correct codeword and indicate where the errors are located);
   c. Give an example of errors the code cannot detect, and another example of errors it can detect but it cannot correct, using the nearest neighbor decoding algorithm.

Message	Codeword
s_1	$c_1 = 00000$
s_2	$c_2 = 10011$
s_3	$c_3 = 11100$
s_4	$c_4 = 00111$

2. Design a block code consisting of 4 codewords, with minimum codeword length, which is able to detect 3 errors in a codeword.

3. Design a block code consisting of 4 codewords, with minimum codeword length, which is able to correct 2 errors in a codeword.