ECS 452: In-Class Exercise # 4

Date: 06 / 02 / 2018			
Name	ID (last 3 digits)		
Prapun	5	5	5

Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups.** Only one submission is needed for each group.
2. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
3. **Do not panic.**

1. A discrete memoryless source emits two possible messages Y(es) and N(o) with probabilities 0.2 and 0.8, respectively.
   a. Find the expected codeword length when Huffman binary code is used without extension.

      Y
      N

      There are only two symbols. Hence, there is only one way to group them.
      Therefore, each codeword length must be 1 bit. $\Rightarrow \mathbb{E}[\ell(X)] = 1$

   b. Find the codeword lengths when Huffman binary code with second-order extension is used to encode this source. Put the values of the corresponding probabilities and the codeword lengths in the table below.

x_1x_2	$p_{X_1,X_2}(x_1,x_2)$	$\ell(x_1,x_2)$
YY	0.2x0.2 = 0.04	3
YN	0.2x0.8 = 0.16	3
NY	0.8x0.2 = 0.16	2
NN	0.8x0.8 = 0.64	1

0.20 0.36 1

   c. Find L_2.
      (This is the expected codeword length **per source symbol** of the Huffman binary code for the second-order extension of this source.)

$$\mathbb{E}[\ell(X_1,X_2)] = \frac{1}{100} \times \left(\underbrace{(4+16)}_{20} \times 3 + 16\times 2 + 64 \times 1\right)$$

$$= \frac{60+32+64}{100} = \frac{156}{100} = 1.56 \text{ bits per two source symbols}$$

$$L_2 = \frac{1.56}{2} = 0.78 \text{ bits per source symbol}$$