ECS 452: In-Class Exercise # 3

Date: 19 / 01 / 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. Write each of the following quantities in the form X.XXX (possibly with the help of your calculator).
   a. $-\log_2(1/16)$

   $= -\log_2\left(\frac{1}{16}\right) = -\log_2 2^{-4} = -(-4) = \approx 4.000$

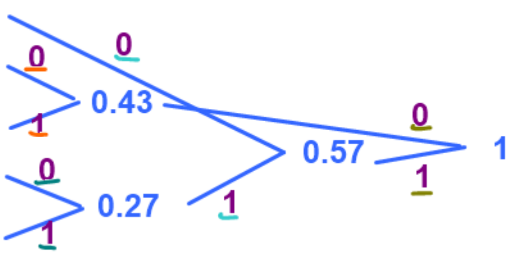
   b. $-\log_2(0.3)$

   ≈ 1.737

   c. $\underbrace{-(0.3)\log_2(0.3)}_{0.5211} \underbrace{-(0.7)\log_2(0.7)}_{0.3602} \approx 0.881$

2. Consider a random variable X which has five possible values. Their probabilities are shown in the table below.

x	$p_X(x)$	$c(x)$	$\ell(x)$
a	0.30	10	2
e	0.23	00	2
c	0.20	01	2
n	0.15	110	3
t	0.12	111	3



   a. Find a binary Huffman code (without extension) for this random variable.
      Put the values of the codewords and the codeword lengths in the table above.
   b. Find the expected codeword length when Huffman coding is used (without extension).

   (0.3+0.23+0.2)x2 + (0.15+0.12)x3 = 0.73x2 + 0.27x3 = **2.27 bits per source symbol**

   c. Find the entropy (per symbol) of this random variable.

   $H(X) = \underbrace{-0.3\log_2 0.3}_{0.5211} \underbrace{-0.23\log_2 0.23}_{0.4877} \underbrace{-0.2\log_2 0.2}_{0.4644} \underbrace{-0.15\log_2 0.15}_{0.4105} \underbrace{-0.12\log_2 0.12}_{0.3671}$

   ≈ 2.2508 bits ← note that this is less than the expected codeword length found earlier.