Fall 2022: CSE 5301
Homework 2

Due Date: 2022-10-01, 11:59 pm

Instructions

- The assignment has to be submitted on canvas (https://uta.instructure.edu)
- If its typed, make sure the extension is (.pdf)
- If its handwritten, make sure to scan at high enough dpi that the text is legible and readable
  - Save as .pdf
- If your submission is a single file name it as <net-id>_hw2.<extension>
- If your submission is made of multiple files, zip them together into a single archive
  - Only .zip archives accepted
  - Name the file <net-id>_hw2.zip
  - Contact the instructor or TA if you have any issues creating archives
- **ALL WORK HAS TO BE INDIVIDUAL WORK.**

Questions

PDF file is attached for reference pages. Solve following questions from attached file.

Chapter 4 Exercises: 4.4, 4.7, 4.30, 4.31(40p)

Entropy:

1. Given two random variable X and Y and their joint distribution P(X,Y): (50 p)

P(X,Y) Y:	X:	2	4	6
Sensor 1		0.22	0.17	0.03
Sensor 2		0.15	0.1	0.11
Sensor 3		0.06	0.16	0

Find following measures:

a.H(X), b. H(Y), c.D(X||Y),   d.H(X|Y), e.H(Y|X),   f.H(X,Y), g.H(Y)-H(Y|X),   h.I(X;Y)

i. If X is the number of senores on a vehicle and Y is the battery level of the vehicle, what does I(X;Y) tell us? (let's say we can observe the number of senores easily but not the battery level)

2. The entropy of a probability distribution is 5.8 bits. Is this enough information to calculate how many Hartleys the entropy of the same distribution is? If it can be calculated, how many Hartleys is it? How would the answer change if we were asking about nat-s? Note: Hartley is base 10 logarithms. (20p)

3. Quadrature Amplitude Modulation (QAM) is a signal modulation technique that uses both frequency shift keying and amplitude modulation. QAM16 is a version, where a transmitted symbol can encode 16 different possibilities (i.e., a single transmitted symbol can be seen to contain four bits of data). The original alphabet is 8bits long, with values between 0 and 255 (a byte).

   3.A. What is the maximum expected code length in number of QAM16 symbol (assuming that the appearance probabilities over the original alphabet have the worst distribution possible)? (10p)

   3.B. How would this change if we knew that the probability distribution over the original alphabet could be (more or less) modeled by a Binomial distribution with parameters n=255, p=0.19 (20p)