1. (2pt) Compute the entropy in bits for each of the following random variables:
   (i) Pixel values in an image whose possible grey values are all the integers from 0 to 255 with uniform probability.
   (ii) Humans classified according to whether they are, or are not, mammals.
   (iii) Gender in a tri-sexed insect population whose three genders occur with probabilities 1/4, 1/4, and 1/2.
   (iv) A population of persons classified by whether they are older, or not older, than the population's median age.

2. (3pt) Let p(x, y) be as shown in the table below.

X\Y	0	1	2
0	1/12	1/6	1/12
1	1/6	1/6	1/6
2	0	1/12	1/12

   Find
   (a) (0.5pt) H(X), H(Y),
   (b) (0.5pt) H(X,Y)
   (c) (1pt) H(Y|X)
   (d) (0.5pt) I(X;Y)
   (e) (0.5pt) Draw a Venn diagram for the quantities in (a) through (d)

3. (2pt) We have a dataset in the following table where A, B denote attributes and Y denotes labels. We want to build a decision tree to classify them according to Y.

Y	A	B
−	1	0
−	1	0
+	1	0
+	1	0
+	1	1
+	1	1
+	1	1
+	1	1

   Which attribute should be selected for the next split? Give your explanation.
   1) A
   2) B
   3) A or B (tie)
   4) Neither

4. (3pt) Consider a stock market with the state space S={Up, Steady, Down}. The transition probability matrix P is given as follows:

$$P = \begin{bmatrix} 0.6 & 0.3 & 0.1 \\ 0.2 & 0.5 & 0.3 \\ 0.1 & 0.4 & 0.5 \end{bmatrix}$$

   where P_{ij} represents the probability of transitioning from state i to state j.

   (a) Given that today is Up, what is the probability that it will be Down three days from now?

(b) Suppose today there is a 40% chance of being Up, a 30% chance of being Steady, and a 30% chance of being Down. What is the market state distribution for tomorrow?
(c) Suppose today there is a 40% chance of being Up, a 30% chance of being Steady, and a 30% chance of being Down. What is the market state distribution three days from today?