1. Pixel values in an image whose possible grey values are all the integers from 0 to 255 with uniform probability.

$$X \sim Uniform(p)$$

$$p = \frac{1}{256}$$

$$H(X) = -\sum_{i=0}^{255} p * \log_2(p) = -256 * p * \log_2(p) = \frac{256}{256}\log_2(256) = 8 \ \ bits$$

2. Gender in a tri-sexed insect population whose three genders occur with probabilities 1/4, 1/4, and 1/2.

$$X \sim \{(1,1/4),(2,1/4),(3,1/2)\}$$

$$H(X) = -\sum_{i=1}^{3} p_i \log_2(p_i) = \frac{1}{4}\log_2 4 + \frac{1}{4}\log_2 4 + \frac{1}{2}\log_2 2 = \frac{3}{2} = 1.5 \ \ bits$$

3. A population of persons classified by whether they are older, or not older, than the population's median age.

The probability of being older than the median age is $p = 1/2$.

$$X \sim Ber\left(\frac{1}{2}\right)$$

$$H(X) = -\sum_{i=1}^{2} \frac{1}{2}\log(1/2) = 1 \ \ bit$$