Information Theory — Tutorial 2

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Remember to put any questions and comments on any of the lecture materials hosted on NB. Please treat reviewing the material as a serious part of your tutorial work.

1. **Entropy separability:** MacKay's book Exercise 4.2, p68.

2. **Entropy decomposition:** MacKay's book Exercise 2.28, p38.

3. **Symbol code statistics:** MacKay's book Exercise 5.31, p104.
   (The ensemble X and code C_3 were defined on pp. 92–93: symbols with probabilities $\mathcal{P}_X = \{1/2, 1/4, 1/8, 1/8\}$ are encoded with codewords $C_3 = \{0, 10, 110, 111\}$.)

4. **Real-valued variables** We have focussed on discrete random variables, X, taking on values $\{x_i\}_{i=1}^I$. When compressing many observations of such a variable, the number of bits/symbol required is given by the entropy:

   $$H(X) = \sum_i P(x_i) \log \frac{1}{P(x_i)}.$$

   How many bits/outcome are required to encode draws from a unit Gaussian distributed variable, which has probability density $p(x) = \exp(-x^2/2)/\sqrt{2\pi}$? How many bits on average would be required to store the answers to 3 decimal places?