Information Theory — Tutorial 2

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Remember to put any questions and comments on any of the lecture materials hosted on NB. Email the lecturer if you haven't got an invite to 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?