Information Theory — Tutorial 4

Iain Murray

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1. **Review:** are there any previous tutorial exercises, or parts of the notes, that you would have trouble explaining to another MSc student? If so, please ask *specific* questions on NB, attached to the relevant tutorial answers, or notes.

2. **Inference and prediction:** Solve MacKay Ex 3.1 (p47). *In addition to this question*, work out the probability that the next outcome is a 1, given the sequence that you have observed. If you needed to look at the answer or otherwise needed help, also do Ex 3.2.

3. **Past exam question:** A set of positive values $\{x_1, x_2, \ldots, x_N\}$ has arithmetic mean A, and geometric mean G, where by definition:

$$A = \frac{1}{N}\sum_{n=1}^{N} x_n\,, \qquad \text{and} \qquad G = \exp\left(\frac{1}{N}\sum_{n=1}^{N} \log_e x_n\right).$$

   Show which of the following inequalities is true for all sets of positive values: a) $G \leq A$, or b) $G \geq A$. State for which sets the geometric mean is equal to the arithmetic mean.

   Hint: you may wish to rewrite the geometric mean as a function of an expectation.

   If you have trouble getting started, solve MacKay Ex 2.25 (p37), which we already looked at in class.

4. **More inference and prediction:** MacKay Ex. 3.12, p58.

   If you've answered this question intuitively, make sure you've also got a formal answer. Define notation and derive the answer using the rules of probability, as for the card prediction in lectures.

   In previous years, some non-native speakers have not known what a 'counter' is. In this context, it's a plastic disc like a poker chip.