

# A hardware interpretation of the evolution of the genetic code

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A quantitative rationale for the evolution of the genetic code is developed considering the principle of minimal hardware. This principle defines an optimal code as one that minimizes for a given amount of information encoded, the product of the number of physical devices used by the average complexity of each device. By identifying the number of different amino acids, number of nucleotide positions per codon and number of base types that can occupy each such position with, respectively, the amount of information, number of devices and the complexity, we show that optimal codes occur for 3, 7 and 20 amino acids with codons having a single, two and three base positions per codon, respectively. The advantage of a code of exactly 4 symbols is deduced, as well as a plausible evolutionary pathway from a code of doublets to triplets. The present day code of 20 amino acids encoded by 64 codons is shown to be the most optimal in an absolute sense. Using a tetraplet code further evolution to a