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Heuristic of Relevant Features and Perception of Randomness

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Experimentation during the last few decades has repeatedly underlined the presence of a consistent gap between man and machine (fed by classical probabilistic and statistical principles) in tasks of recognition and generation of random stimuli.

We develop an heuristic of relevant features aimed at explaining some salient aspects of this man / machine discrepancy. It proposes in essence that the perceptual probability $p(x)$ of stimulus x, as inferred by a human subject, can be estimated from the corresponding mathematical probability $P(x)$ as

$$p(x) = \sum_{x \in [x]} P(x)$$

where $[x]$ denotes the equivalence class of all stimuli z exhibiting exactly the same relevant features $\{C\}$ as x does. Equivalently, two stimuli possibly differing by details but identical with respect to their relevant features correspond to the same percept in first approximation. For instance, stimuli $x_1 = 110101$ and $x_2 = 111111$ have the same mathematical (supposedly uniform) probability $P(x_1) = P(x_2) = 2 - 6 = 0.016$, but different perceptual probabilities $p(x_1) = 62/64 = 0.97$ and $p(x_2) = 2/64 = 0.03$ when assumming $C =$ “constancy / non-constancy” to be the unique relevant feature.

In the statistical-like description of information processing (such as exemplified by signal detection theory, but applied here to discrete rather than continuous signal), the way man extracts percepts $[x]$ (models) from stimuli x (data) betrays the presence of post hoc testing and multiple comparisons in perceptual decisions. Finite range effects open up the possibility of simulating sequences percieved as random by penalizing the apparition of patterned words.