Abstract Submitted
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Computing with scale-invariant neural representations[1] MARC HOWARD, KARTHIK SHANKAR, Boston Univ — The Weber-Fechner law is perhaps the oldest quantitative relationship in psychology. Consider the problem of the brain representing a function $f(x)$. Different neurons have receptive fields that support different parts of the range, such that the ith neuron has a receptive field at x_i. Weber-Fechner scaling refers to the finding that the width of the receptive field scales with x_i as does the difference between the centers of adjacent receptive fields. Weber-Fechner scaling is exponentially resource-conserving. Neurophysiological evidence suggests that neural representations obey Weber-Fechner scaling in the visual system and perhaps other systems as well. We describe an optimality constraint that is solved by Weber-Fechner scaling, providing an information-theoretic rationale for this principle of neural coding. Weber-Fechner scaling can be generated within a mathematical framework using the Laplace transform. Within this framework, simple computations such as translation, correlation and cross-correlation can be accomplished. This framework can in principle be extended to provide a general computational language for brain-inspired cognitive computation on scale-invariant representations.

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