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Critical Phenomena in Population Coding JOHN BERKOWITZ, TATYANA SHARPEE, Salk Institute for Biological Studies — Populations of neurons that code for sensory stimuli are often modeled as having sigmoidal tuning curves where the midpoint and slope of the curve represent, respectively, an intrinsic firing threshold and noise level. Recent studies have shown for two subpopulations of neurons that states below a critical noise level are associated with symmetry breaking between the populations' thresholds. In this work we consider the case of up to seven distinct subpopulations encoding a common gaussian stimulus. We optimized the mutual information between output patterns and stimuli by adjusting the thresholds for a fixed noise level. In the high-noise regime the optimal thresholds are fully redundant whereas the low noise limit predicts distinct threshold values that achieve histogram equalization of the input signal. Between the two limits, the thresholds exhibit a complex branching process that occur at successive values of the noise level. Each branch corresponds to a critical point of a continuous phase transition. The behavior of the system in the limit of a large number of subpopulations is also investigated, and critical phenomena are also present in the distribution of thresholds in this limit.

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