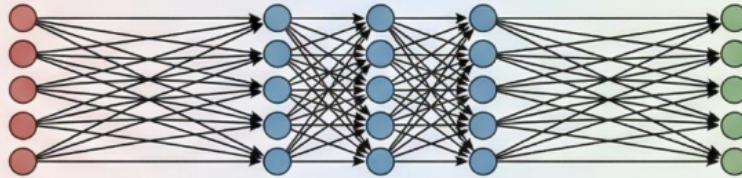


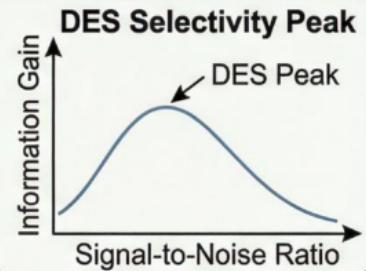
Evolutionary Conservation of Two-Factor Principle

C. elegans

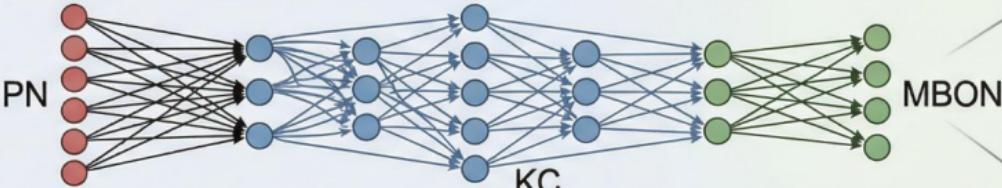
Sensory Input → Filtering & Decision → Motor Output



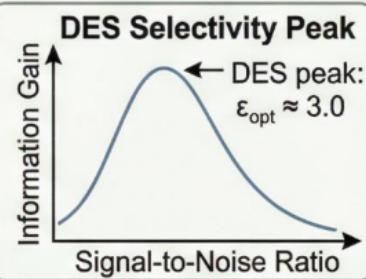
300 neurons, ~100M synapses, metabolic advantage: 1.39×



Drosophila larva Sensory Input → Filtering & Decision → Motor Output

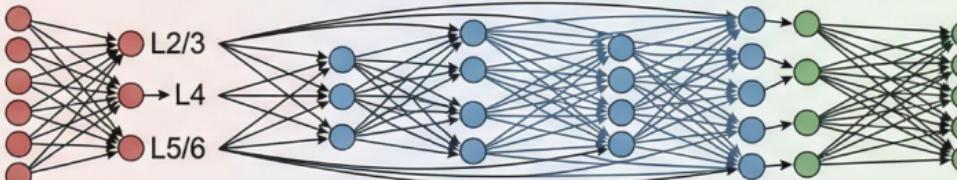


147K neurons, ~100M synapses, DES peak: $\varepsilon_{\text{opt}} \approx 3.0$

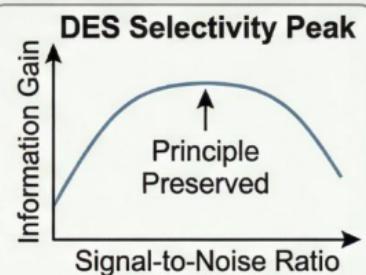


Mouse cortex

Sensory Input → Filtering & Decision → Motor Output



>100M neurons, >100B synapses, principle preserved



Universal architecture from nematode to mammal: hierarchical feedforward topology + spectral gap engineering = robust energy-efficient decision-making