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Attractor neural networks with resource-efficient synaptic connectivity CENGIZ PEHLEVAN, Flatiron Institute, ANIRVAN SENGUPTA, Rutgers University — Memories are thought to be stored in the attractor states of recurrent neural networks. Here we explore how resource constraints interplay with memory storage function to shape synaptic connectivity of attractor networks. We propose that given a set of memories, in the form of population activity patterns, the neural circuit choses a synaptic connectivity configuration that minimizes a resource usage cost. We argue that the total synaptic weight (l_1-norm) in the network measures the resource cost because synaptic weight is correlated with synaptic volume, which is a limited resource, and is proportional to neurotransmitter release and post-synaptic current, both of which cost energy. Using numerical simulations and replica theory, we characterize optimal connectivity profiles in resource-efficient attractor networks. Our theory explains several experimental observations on cortical connectivity profiles, 1) connectivity is sparse, because synapses are costly, 2) bidirectional connections are overrepresented and 3) are stronger, because attractor states need strong recurrence.

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