

## **Push-pull Feedback Implements Hierarchical Associative Memory**

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**Abstract:**

Experimental data has revealed that in addition to feedforward connections, there exist abundant feedback connections in a hierarchical neural pathway. Although the importance of feedback in neural information processing has been widely recognized in the field, the detailed mechanism of how it works remains largely unknown. Here, we investigate the role of feedback in hierarchical memory retrieval. Specifically, we consider a multi-layer network which stores hierarchical memory patterns, and each layer of the network behaves as an associative memory of the corresponding hierarchy. We find that to achieve good retrieval performance, the feedback needs to be dynamical: at the early phase, the feedback is positive (push), which suppresses inter-class noises between memory patterns; at the late phase, the feedback is negative (pull), which suppresses intra-class noises between memory patterns. Overall, memory retrieval in the network progresses from rough to fine. Our model agrees with the push-pull phenomenon observed in neural data and sheds light on our understanding of the role of feedback in neural information processing.