Simultaneously Learning External Actions and Internal Gating for Multi-Item Working Memory

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Presentation Abstract Summary AuGMEnT (Attention-Gated Memory Tagging) is a biologically plausible scheme for training neural networks on memory tasks via reinforcement learning (RL). It utilizes attentional feedback to form synaptic tags that allow for the appropriate local weight updates in response to a global reward prediction error. Although it simulates animal learning on a broad class of tasks, it performs poorly on hierarchical tasks that require robust, separated maintenance of multiple items. Additionally, like most networks, AuGMEnT has to learn how to encode stimuli before a task is solved, and storage of arbitrary novel stimuli is problematic. Here, we propose a new architecture that is trained via the same learning scheme, to overcome these problems. The model acquires a policy for external actions to interact with the environment, and internal actions to govern gating into working memory. We show that selective gating provides an intuitive way to simplify credit assignment in hierarchical tasks. Second, we show that encoding with random projections is sufficient to produce robust memory representations, without having to copy sensory input. Finally, we show in a delayed match to sample task that the same encoding scheme can properly memorize and act upon arbitrary stimuli that were never seen before.

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