Biologically-plausible synapses exhibit the palimpsest property: memory traces decay over time, overwritten by ongoing plasticity. This makes retrieval from memory difficult. Here, we propose a **probabilistic framework for optimal retrieval** from palimpsest synapses. We compare two possible solutions for dealing with the unknown pattern age: 1. integrating it out as an unknown quantity or 2. estimating it in a separate subsystem, in which age is treated as an auxiliary variable. We show that the dual system, inspired by hippocampal and perirhinal cortex connectivity, exhibits significantly better performance. In a recognition task, the same system exhibits several characteristics similar to human and animal experiments. Our results suggest a normative motivation for dual module models for recognition memory, as being beneficial even when the task to solve is recollection.

**PLASTICITY IN A SINGLE SYNAPSE**

- Discrete state-synapses, example: cascade model (Fusi et al. 2005)
- **Palimpsest memory:** memory trace is a perturbation away from the stationary distribution of synaptic weights; it decays over time back to baseline
- Signature of a memory depends on age: it decays over time back to baseline

**AUTOASSOCIATIVE MEMORY NETWORK**

- **Binary patterns**
- **Recurrent network of excitatory neurons**
- **All-to-all connectivity** (can be relaxed)

**APPROXIMATELY OPTIMAL RETRIEVAL: MONOLITHIC SYSTEM**

- **Goal of optimal recall**: represent distribution over patterns given information in the weights and recall cue (Sommer Dayan 1998, Lengyel et al. 2005)
- **Sampling-based representation** of the full distribution over patterns
- **Alternative representations** possible (mean-field)

**APPROXIMATELY OPTIMAL RETRIEVAL: DUAL SYSTEM**

- **Idea**: joint Gibbs in \((x, t)\) space
- **Familiarity module**
- **Recollection module**

**A LINK TO BEHAVIOUR: RECOGNITION MEMORY**

- **Task**: has the current pattern been seen before?
- **Familiarity** is more important for recent memories (Fortin et al. 2004)
- **Future work**: a generative model for recognition, modeling hippocampal/perirhinal lesions

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