# Learning and memory with complex synapses

Subhaneil Lahiri and Surya Ganguli
Department of Applied Physics, Stanford University, Stanford CA

## Storage capacity of Hopfield networks

- Hopfield capacity $\propto N$ requires unbounded synaptic strengths.
- Bounded synapses $\implies$ capacity $\propto \log N$.
- Can be ameliorated by using complex synapses

## Area bound

We can show that the area under the SNR curve is bounded:

$$A \leq \sqrt{N}(n-1).$$

This leads to a bound on the lifetime of a memory:

$$\text{SNR}(\text{lifetime}) = 1 \qquad A \geq \text{lifetime}.$$

This is saturated by a molecular networkwith the multistate topology.

## References

## Ordering the states

Let