

Computational Principles of Memory

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Memory: The ability of persisting information

STM: min

LTM: days – life

Remarkable

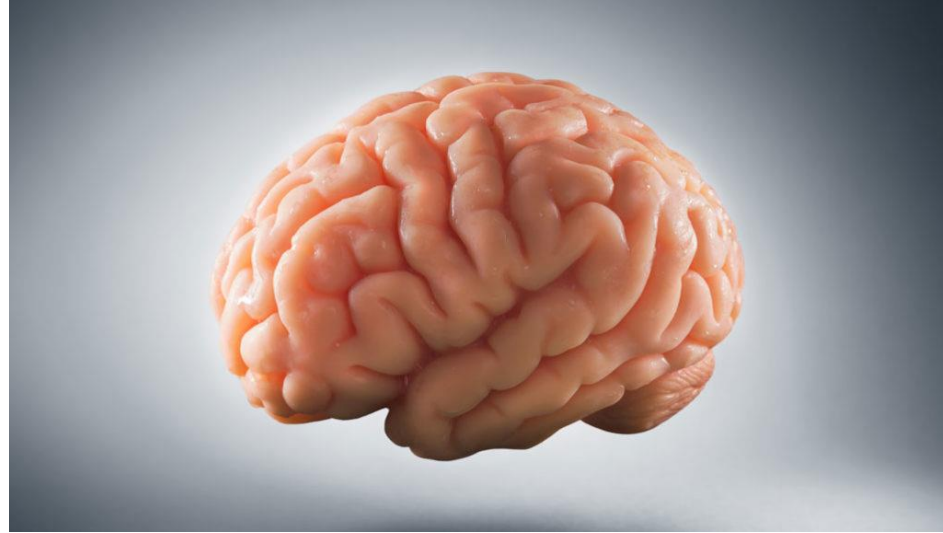


Most Biological processes are **transient**:

Time constant for membrane: ms

Post synapse Potential: 100 ms

Remarkable

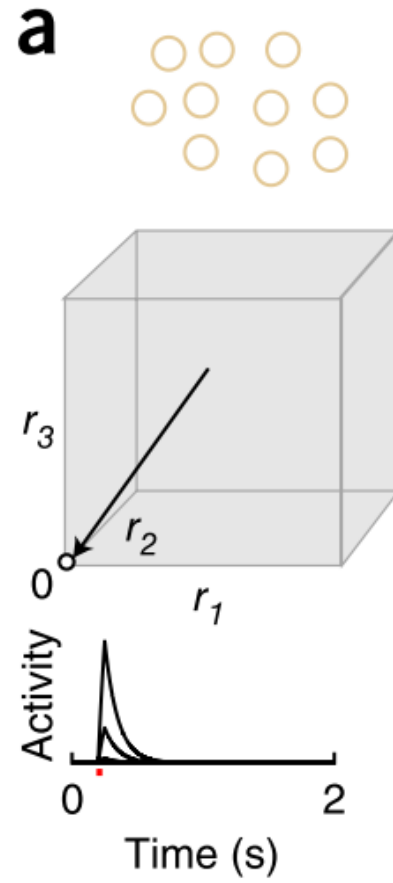


How do our brain form memory based on the transient activity?

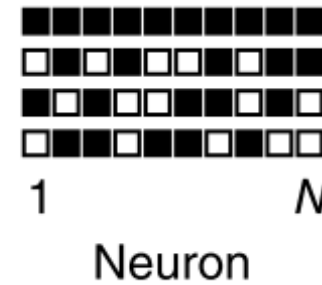
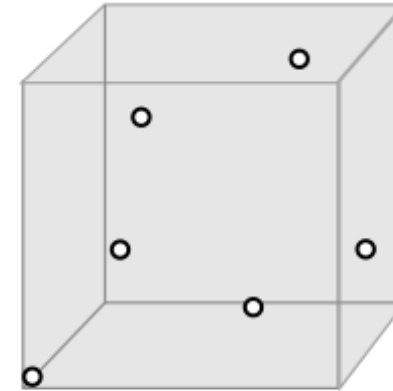
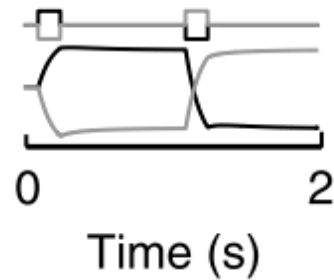
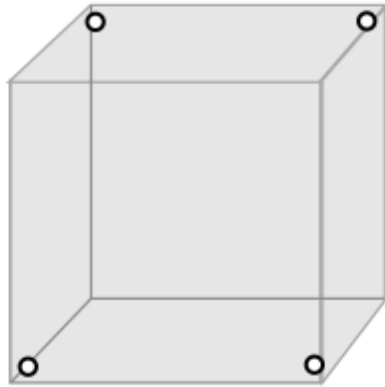
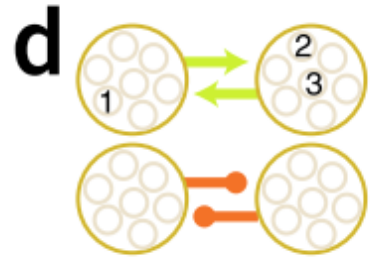
Content

1. Neural circuit models
2. Properties of those models

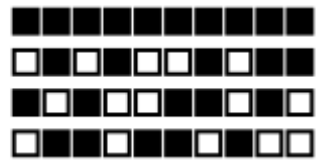
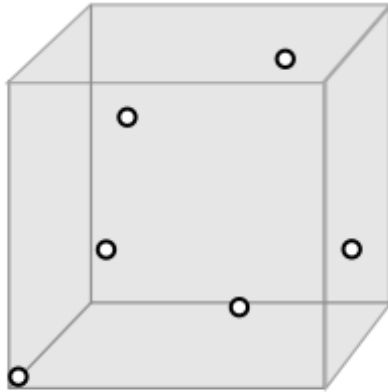
Basic Picture



Model: Discrete Attractor

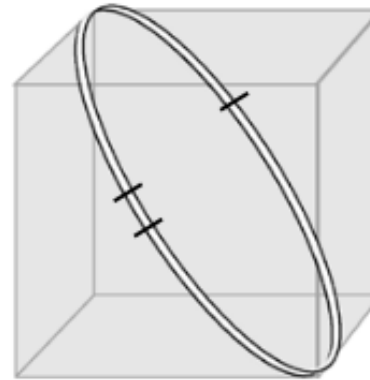
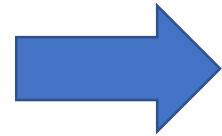


Model: Continuous Attractor



1 N

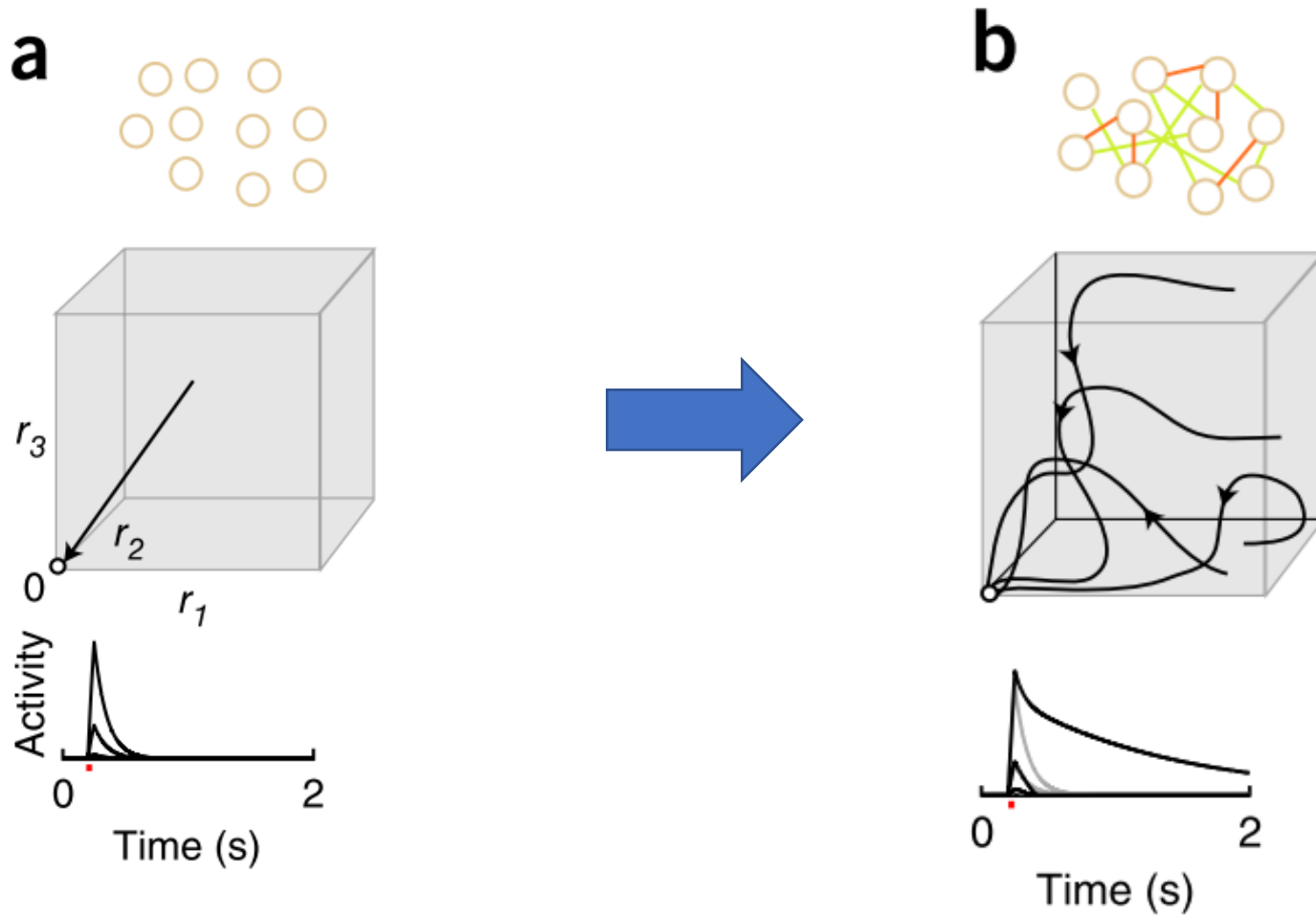
Neuron



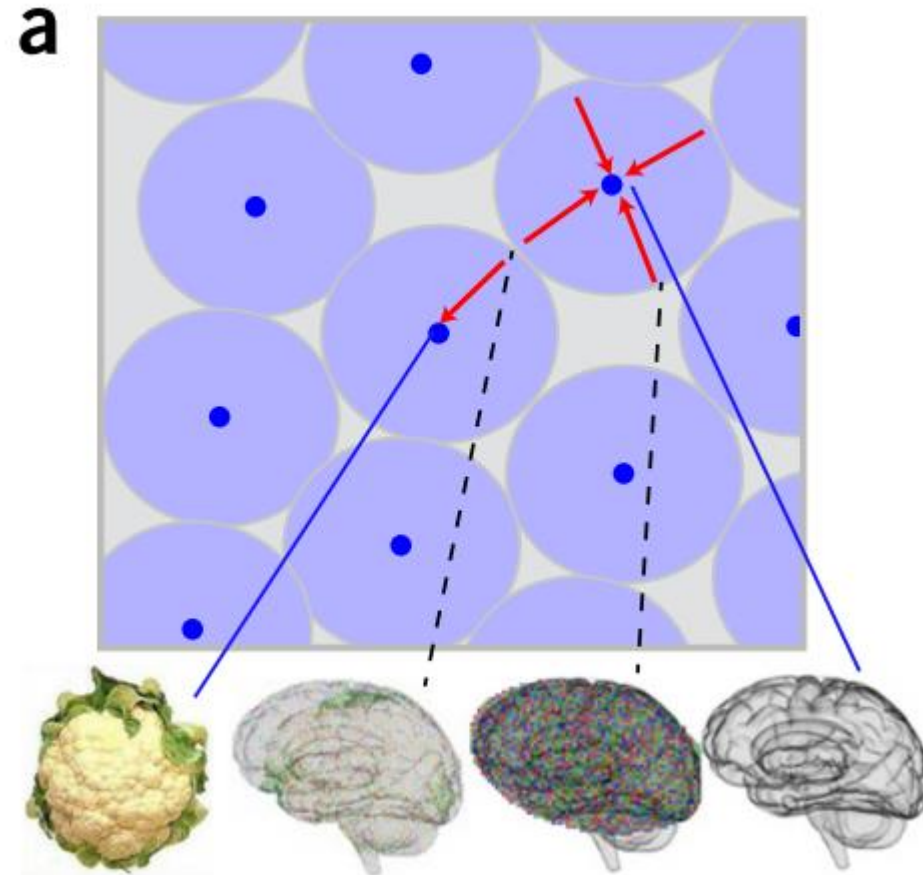
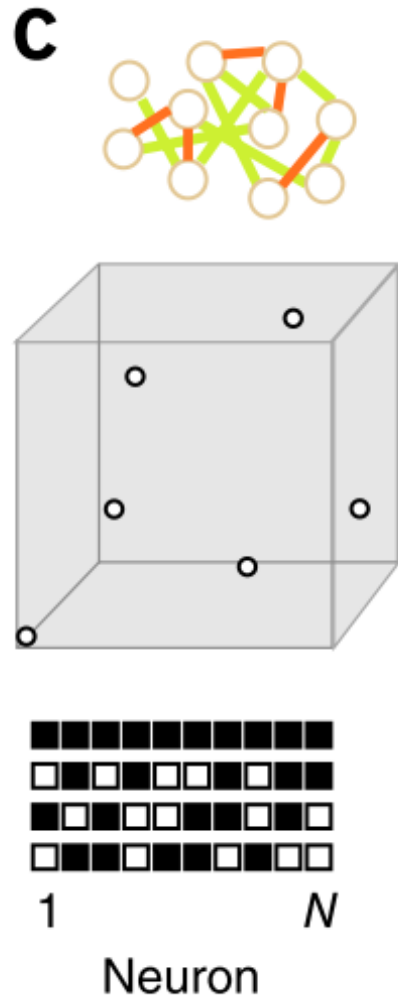
1 N

Neuron

Model: Continuous Attractor

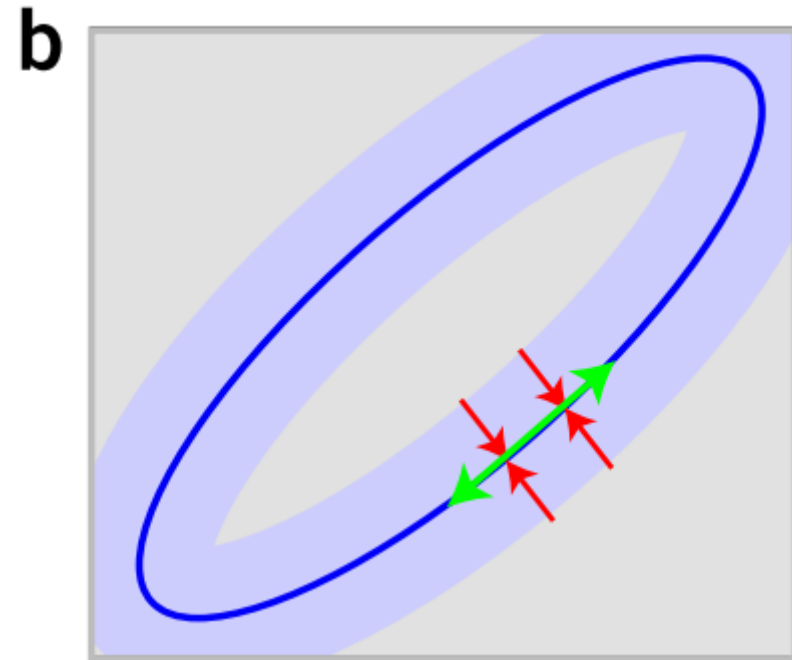
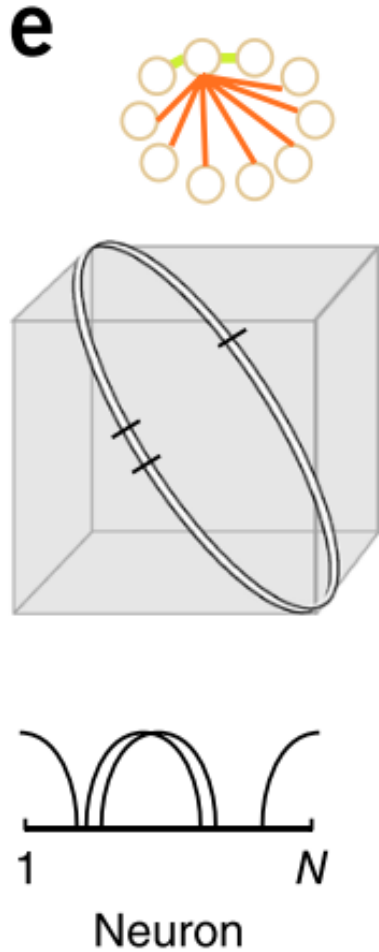


Properties: Robustness to noise

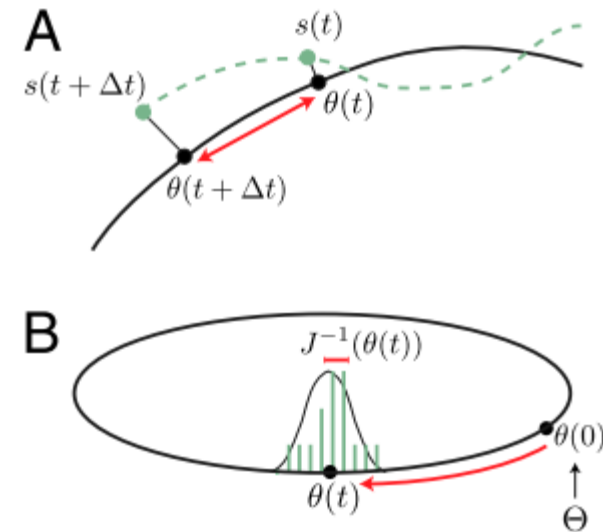
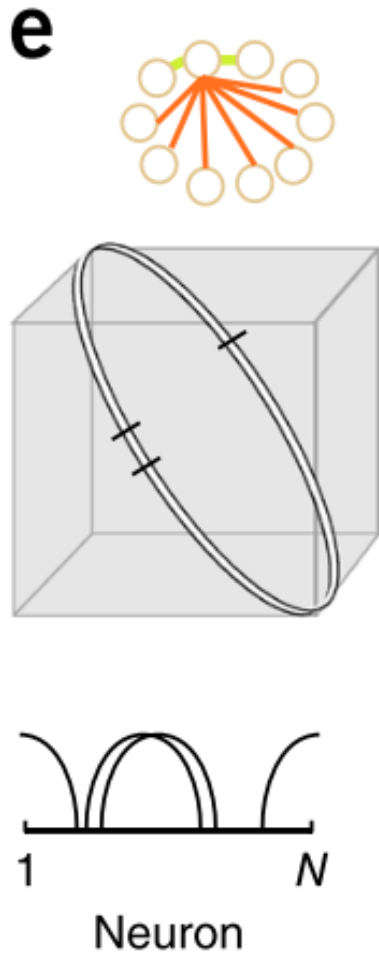


Very Robust!

Properties: Robustness to noise

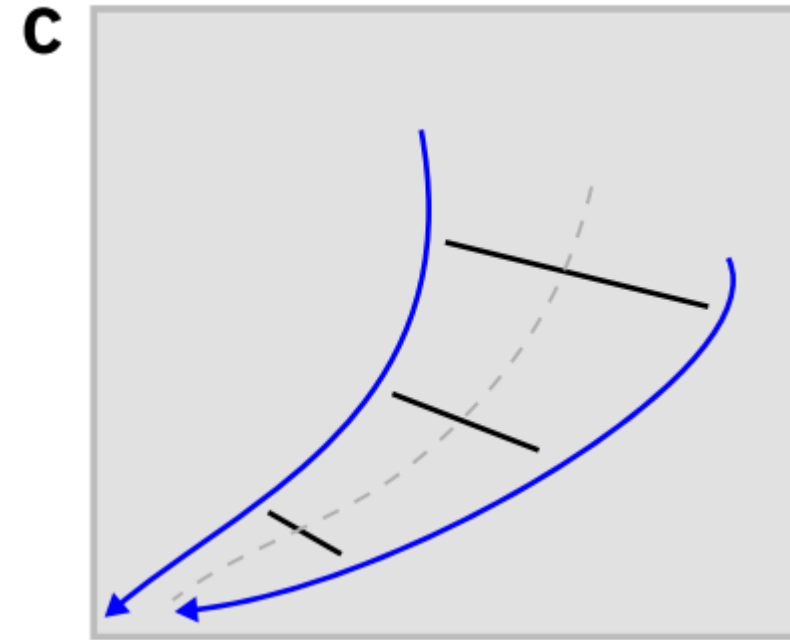
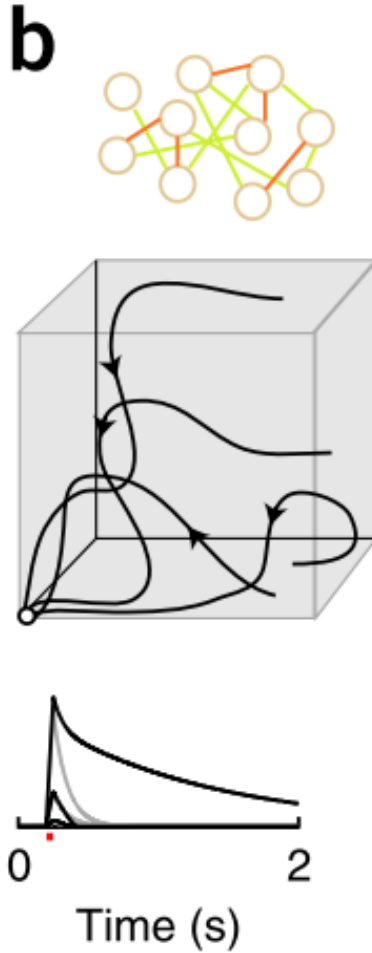


Properties: Robustness to noise



$$\langle (\theta(t) - \theta(0))^2 \rangle = 2\mathcal{D}t$$

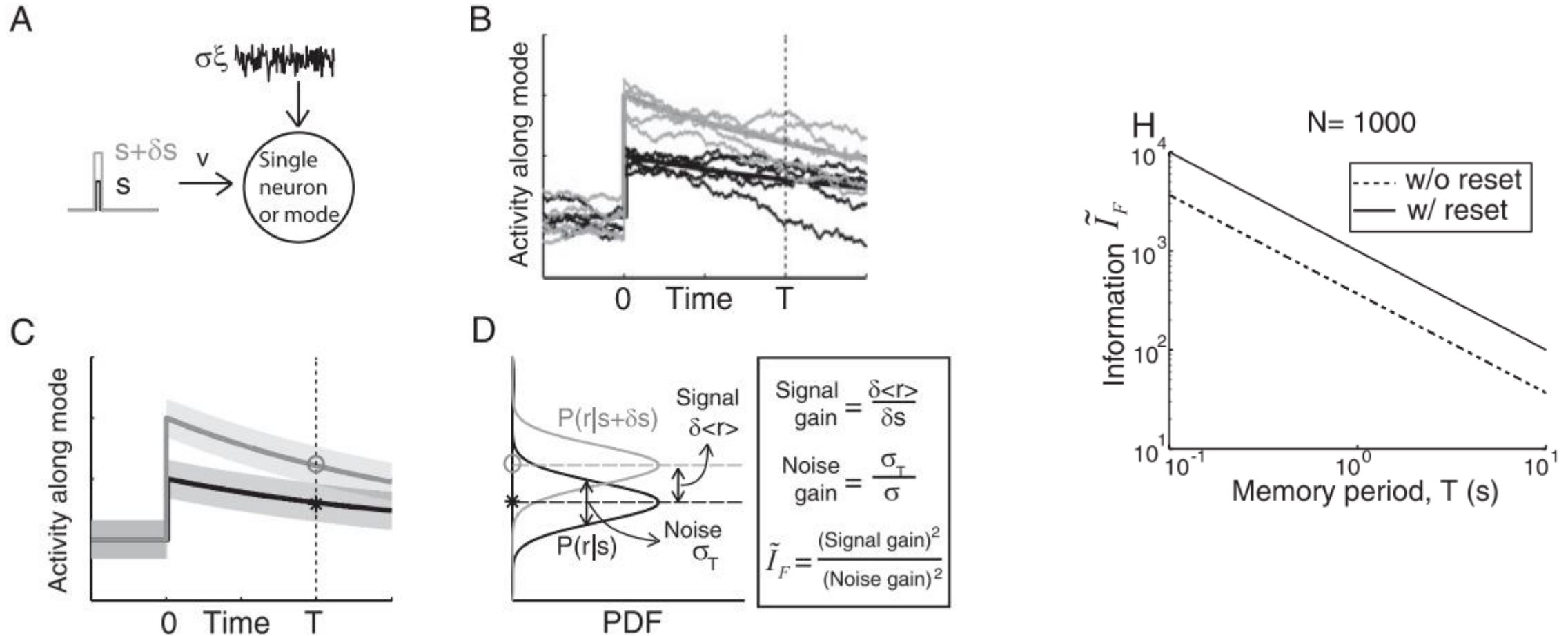
Properties: Robustness to noise



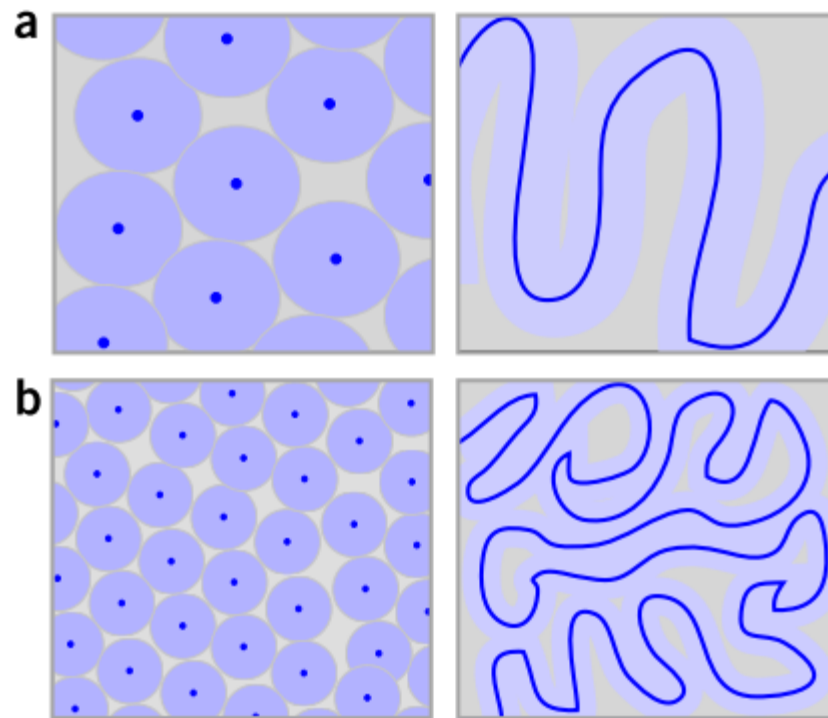
Intrinsic Decay of information

Not robust

Properties: Fisher Information

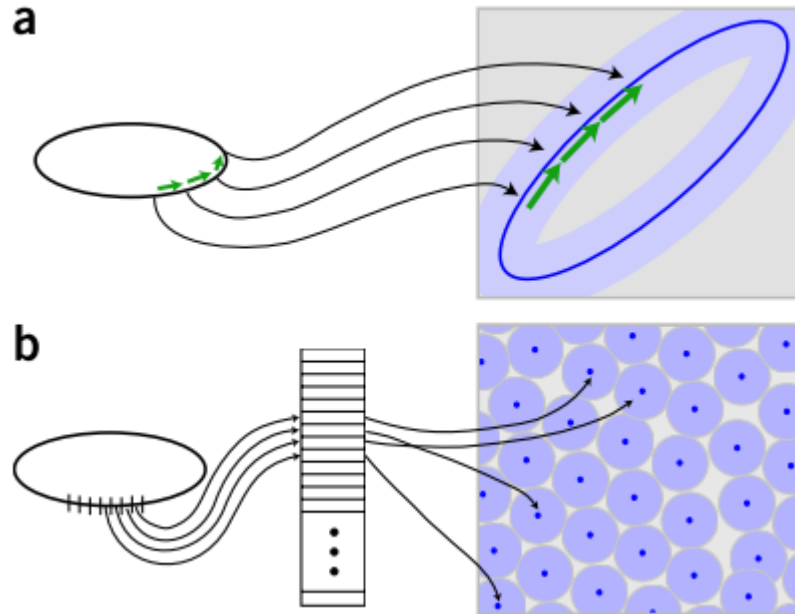


Properties: Capacity



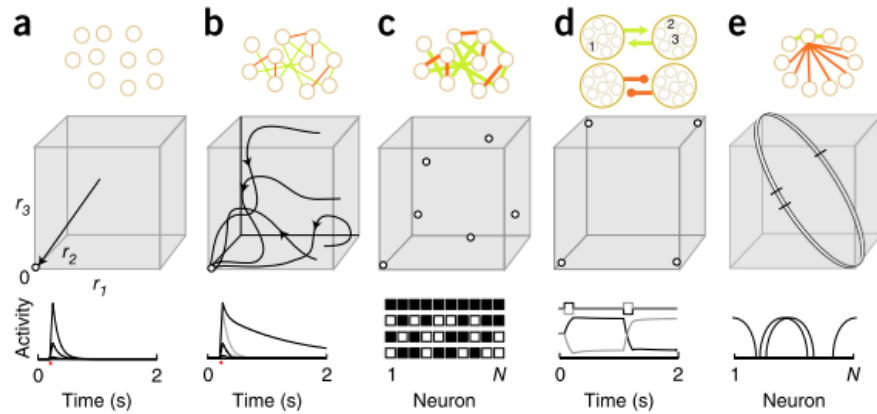
Properties: Capacity

Attractor model show better in both robustness and capacity
Then why long transient or continuous attractor?



Conclusion

1. Neural circuit models



2. Properties of those models

