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## Memory

Memory is not unitary.

1. Weights (long-lasting, requires re-activation) versus activations (short-term, already active, can influence processing).
2. Specialized neural systems: computational tradeoffs. Cortex shows priming, but suffers catastrophic interference. Abandon neural network models?

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## Or, Hippocampus To the Rescue!

Two specialized, complementary systems resolve fundamental tradeoff:

The hippocampus can learn rapidly without interference by using sparse, pattern-separated representations!

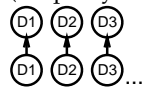
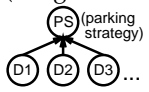
Meanwhile, cortex slowly learns overlapping representations of similarity structure & regularities.

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## Complementary Learning Systems

Goals:	Remember <b>Specifics</b>	Extract <b>Generalities</b>
Example:	Where is car parked?	Best parking strategy?
Need to:	Avoid <b>interference</b>	<b>Accumulate</b> experience

*Solution:*

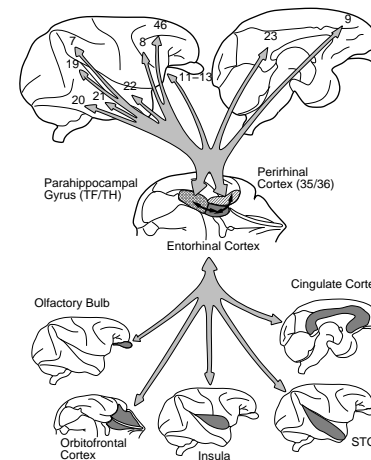
1.	<b>Separate</b> reps (keep days separate)	<b>Overlapping</b> reps (integrate over days)
		
2.	<b>Fast</b> learning (encode immediately)	<b>Slow</b> learning (integrate over days)
3.	Learn <b>automatically</b> (encode everything)	<b>Task-driven</b> learning (extract relevant stuff)

*These are incompatible, need two different systems:*

System:	<b>Hippocampus</b>	<b>Neocortex</b>
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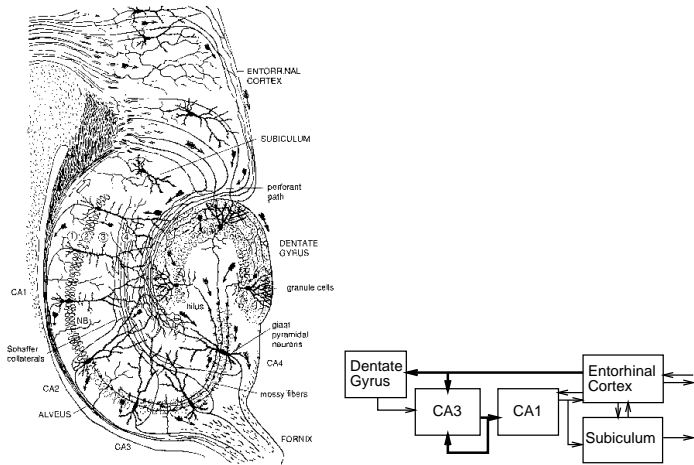
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## Hippo = King-of-the-Cortex



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### Hippocampal Anatomy



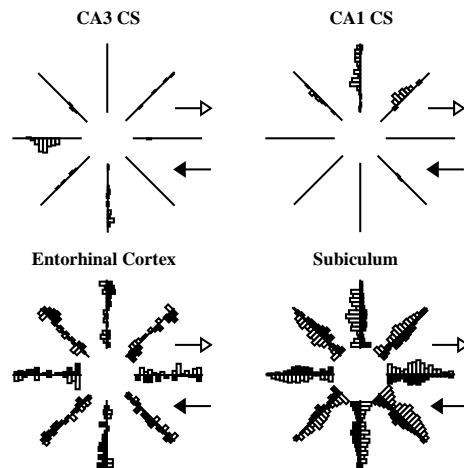
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### Sparse Activity

Area	Rat		Model	
	Neurons	Pct Act	Units	Pct Act
EC	200,000	7.0	144	25.0
DG	1,000,00	0.5	625	1.0
CA3	160,000	2.5	240	5.0
CA1	250,000	2.5	384	9.4

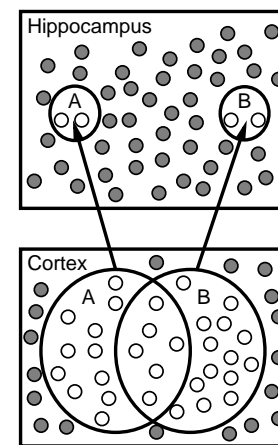
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### Sparse Activity



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### Pattern Separation & Conjunctions

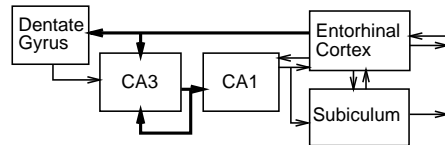


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## The Flip Side of Separation: Pattern Completion

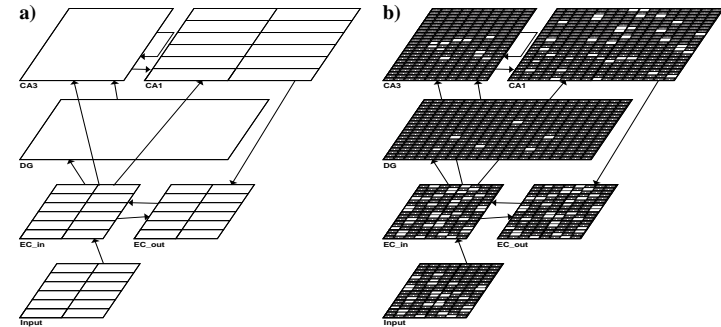
College friend example: "This one time, at this one party..."

Pattern completion in CA3 activates corresponding CA1 rep, which reinstates original EC pattern.



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## The Model



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2. Specialized neural systems: computational tradeoffs. Cortex shows priming, but suffers catastrophic interference. Abandon neural network models? *No, hippocampus can learn rapidly without interference using sparse, pattern-separated representations.*
3. Next time: Activation-based memory and activation-weight-based interactions.