

Hierarchical Temporal Memory

A Theoretical Framework for the Neocortex

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LessWrong Community Weekend 2019

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The Human Brain in Numbers

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Neurons in cerebellum	69 billion (80%)
Rel. size of cerebellum	10% of brain
Neurons in cerebral cortex	16 billion (19%)
Rel. size of cerebral cortex	82% of brain
Neurons in brain stem	1 billion (1%)

Data from [1].

The Human Brain

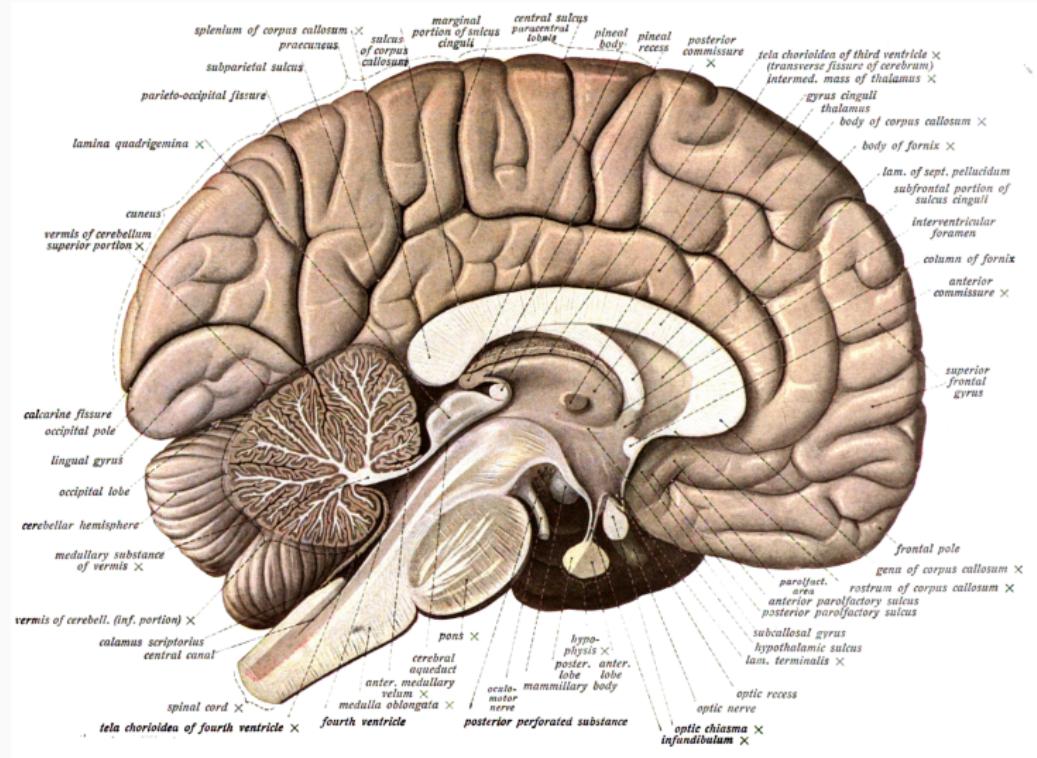
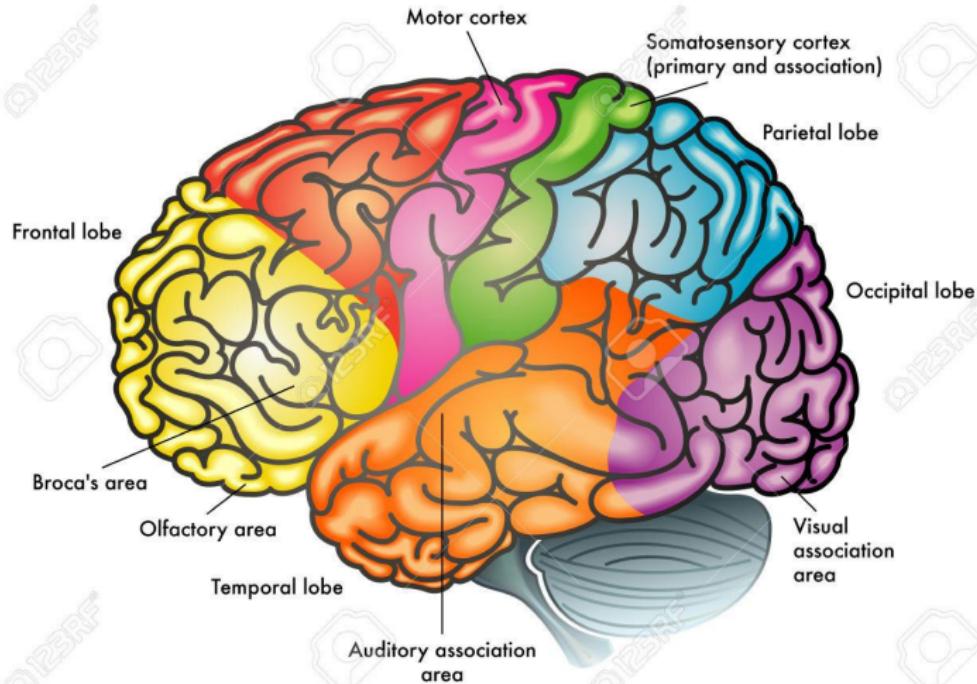


Image from [2].

The Human Brain - Different Areas



Cortical Column

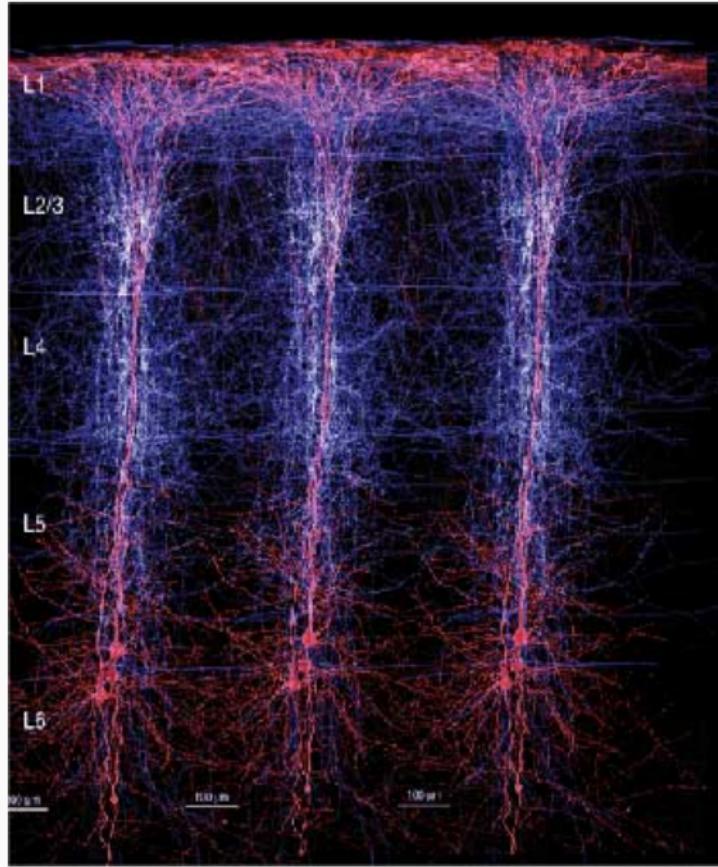


Image from [3].

Cortical Column

- Everywhere in the Brain

Cortical Column

- Everywhere in the Brain
- 80-120 up to 200-400 Neurons

Cortical Column

- Everywhere in the Brain
- 80-120 up to 200-400 Neurons
- smallest symbol unit

Neuron - Number of Connections

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Min. n. of connections	1'000
Avg. n. of connections	7'000
Max. n. of connections	10'000

Neuron - Number of Connections

Min. n. of connections	1'000
Avg. n. of connections	7'000
Max. n. of connections	10'000
Firing Rate	20-250 Hz (453 Hz [4])

Connection data from [1] and firing rate from [5].

Neuron - Spike Frequencies

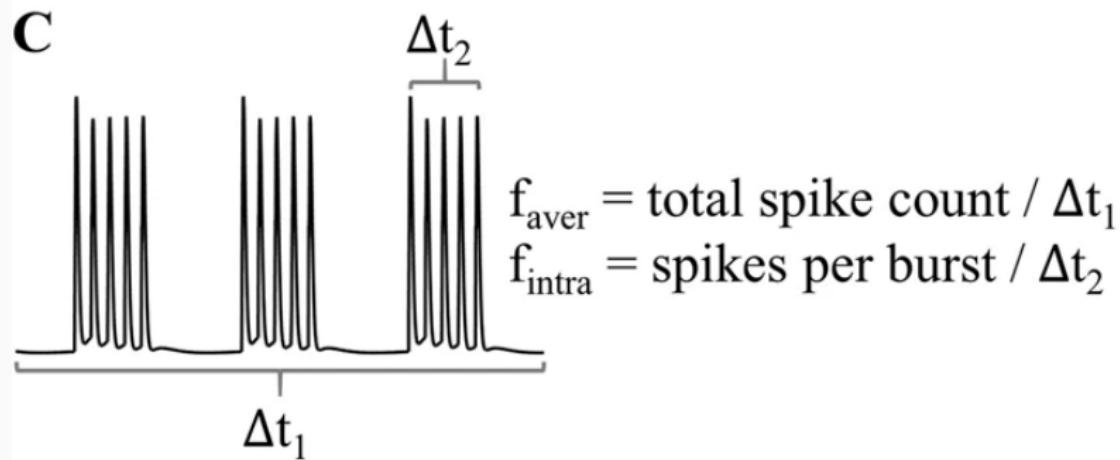


Image adapted from [6].

Neuron - Overview

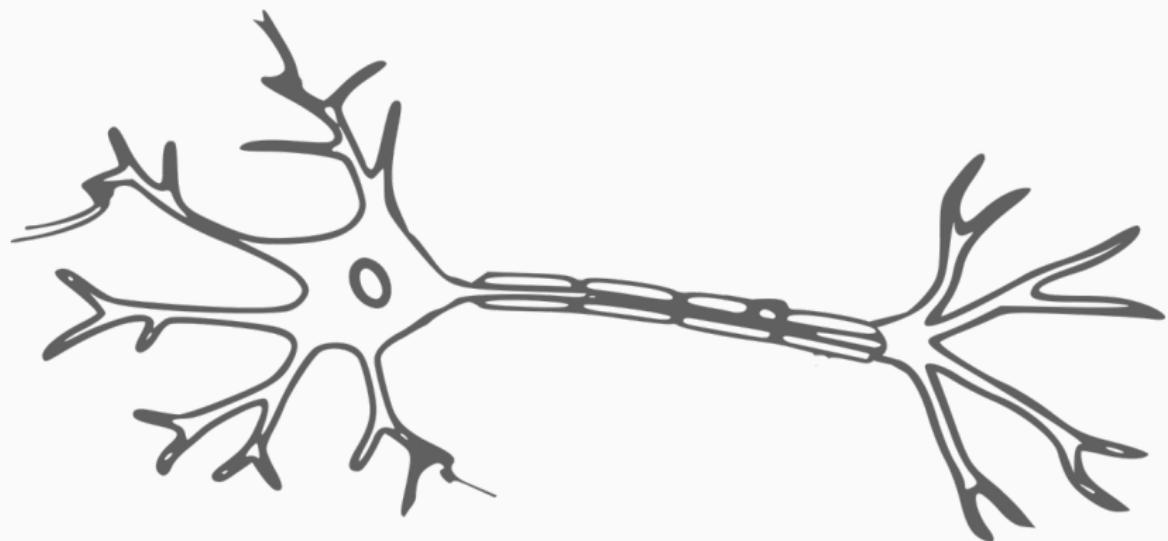


Image from [7].

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- Learning is purely statistical

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- Looking for Spatial and Temporal Patterns

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Learning

- Learning is purely statistical
- Looking for Spatial and Temporal Patterns
- Regions themselves are limited
- Automatically adjusts to size of allocated Memory
- Automatic On-Line learning
- takes longer to learn high-level concepts with lower levels missing
- only a precursor for inference and prediction

Inference

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- Matching previously learned sequences

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- Example: recognizing a Melody

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- There are only novel experiences

Inference

- Matching previously learned sequences
- Example: recognizing a Melody
- There are only novel experiences
- Partial SDR matches

Prediction

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- Can be thought of to be similar to a markov chain

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- Takes up a considerable amount of memory

Prediction

- Matching stored sequences
- Can be thought of to be similar to a markov chain
- Takes up a considerable amount of memory
- Integral to how the brain works

Prediction - Key Properties

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- Continuity

Prediction - Key Properties

- Continuity
-

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Sources i

The slides are online: <https://github.com/fkarg/things-to-talk-about/blob/master/htm/main.pdf>

Drop me a mail: fkarg10@gmail.com

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