Reading List

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This page contains a list of reading materials for further self-education on neuroscience and HTM.

For those interested there is also a very useful [in-depth annotated bibliography being maintained in nupic.research](https://github.com/numenta/nupic.research/tree/master/docs/bibliography). If you are a Mendeley user, you can [go to this link](http://www.mendeley.com/groups/4799871/htm-neuroscience-papers/) and click on the "follow" button to get updates to the list of papers.

**Neuroscience Books**

**Introductory Books**

* Neuroscience Online, an online electronic textbook, can be found here: [http://neuroscience.uth.tmc.edu](http://neuroscience.uth.tmc.edu/), provided by the Department of Neurobiology and Anatomy at The University of Texas Medical School at Houston.

*Notes: This is a nice free online introduction to Neuroscience. It covers basic cellular biology of neurons, as well as a detailed tour of sensory systems, and motor systems, and higher brain functions.*

* Kandel, Eric. *Principles of Neural Science.* 2013. ISBN-10: 0071390111 | ISBN-13:978-0071390118

*Notes: General neuroscience reference book. It's a classic text book and contains a ton of material.*

* Montcastle, Vernon B. *Perceptual Neuroscience: The Cerebral Cortex.* 1998. ISBN-10: 0674661885 | ISBN-13: 978-0674661882.

*Notes: As suggested by Jeff Hawkins on the* [*mailing list*](http://nupic.markmail.org/message/pc6h2k2jgcl5qel3) *- "It is a beautiful book and well written. It will give you a good overview of the cortex but not a clue as to how it works."*

**More specific books**

* Sherman, S. Murray, and Rainer W. Guillery. *Functional Connections of Cortical Areas: A New View from the Thalamus*. MIT Press, 2013. ISBN-10: 0262019302 | ISBN-13: 978-0262019309.

*Notes: For those interested in going deeper into the role of the thalamus, this is an excellent book. Suggested by Jeff, it is a well written summary of a modern view of cortico-thalamic connections. It describes, for example, the connections between every cortical region and the thalamus including the role of sub-cortical motor centers. It does require some neuroscience background but is much easier to read than many of the really dense neuroscience papers. The diagrams are also very clear.*

* O'Regan, J. Kevin. *Why Red Doesn't Sound Like a Bell.* 2011. ISBN-10: 0199775222 | ISBN-13: 978-0199775224

*Notes: A book about consciousness. His 2001 paper "A sensorimotor account of vision and visual consciousness" focuses on perception and is a harder read.*

**Neuroscience Papers**

**Laminar and Columnar Structure**

* Thomson, Alex M., and A. Peter Bannister. *Interlaminar connections in the neocortex.* Cerebral cortex 13.1 (2003): 5-14.
* Thomson, Alex M., and Christophe Lamy. *Functional maps of neocortical local circuitry.* Frontiers in neuroscience 1 (2007): 2.

*Notes: These papers by Thomson are dense but contain a lot of detailed information about the connections into, out of, and within the various cortical layers.*

* Buxhoeveden and Casanova. *The minicolumn hypothesis in neuroscience.* Brain (2002)

*Note from Jeff: this is the best review article I know about mini-columns. Start here.*

* Raizada, R D., Grossberg S. Towards a Theory of the Laminar Architecture of Cerebral Cortex: Computational Clues from the Visual System (2003).

*Notes: This paper reviews a laminar theory of visual cortex. It proposes a computational model for the visual system based on a lot of experimental details of laminar circuitry.*

* Constantinople CM. and Bruno RM. Deep Cortical Layers Are Activated Directly by Thalamus. Science (2013) 340:1591. DOI: 10.1126/science.1236425

*Notes: This paper showed evidence supporting the idea that superficial layers (L4->L2/3) and deeper layers (L5/6) act as parallel systems. It challenges the classical belief of sensory processing pathway along L4->L2/3->L5/6 among cortical layers.*

* Harris Kenneth D, and Mrsic-Flogel Thomas D. (2013) Cortical connectivity and sensory coding. Nature (2013) 503:51 doi:10.1038/nature12654 *Notes: This is a recent review paper on cortical connectivity and its relationship with sensory coding.*

**Sparse Coding**

* Olshausen, Bruno A., and David J. Field. *Sparse coding with an overcomplete basis set: A strategy employed by V1?.* Vision research 37.23 (1997): 3311-3325.
* Olshausen, Bruno A., and David J. Field. *Sparse coding of sensory inputs.* Current opinion in neurobiology 14.4 (2004): 481-487.

*Notes: The 1997 paper is one of the first papers on sparse representations in the cortex. Their work has been very influential in the machine learning and neuroscience. The 2004 paper is shorter and easier to read, more of a review.*

* Wixted, John T., Squire, Larry R., Jang, Yoonhee, Papesh, Megan H., et al., *Sparse and distributed coding of episodic memory in neurons of the human hippocampus* PNAS, (2014): doi: 10.1073/pnas.1408365111

*Notes: This papers demonstrate sparse distributed neural code are used for human hippocampus episodic memory.*

**Sensorimotor Inference**

* Sommer, Marc A., and Wurtz, Robert H. Brain Circuits for the Internal Monitoring of Movements Annu Rev Neurosci (2008) 31:317–38

*Notes: This review paper summarizes a series of studies that established a pathway for corollary discharge signal (the motor command copy to sensory cortex), explains how predictive shifting of receptive field is constructed with CD signal, and how visual stability is achieved despite eye-movements.*

* Miall RC and Wolpert DM, Forward models for physiological motor control. Neural Networks (1996) 9:8,1265-1279

*Notes: This paper discussed sensorimotor integration from a computational perspective. The forward model concept in this paper is widely used in motor control and sensorimotor inference.*

* Keller GB, Bonhoeffer B and Hubener Mark, Sensorimotor Mismatch Signals in Primary Visual Cortex of the Behaving Mouse. Neuron (2012) 74:809–815

*Notes: This research paper demonstrated that the primary visual cortex are strongly driven by locomotion and by mismatch between actual and expected visual input.*

**Attention**

* Knudsen EI, Fundamental Components of Attention. Annu. Rev. Neurosci. (2007) 30:57–78

*Notes: This review paper discussed a framework to understand attention and identifies four processes fundamental to attention: working memory, top-down control, competitive selection, and bottom-up filtering.*

**Referenced in On Intelligence**

* Mountcastle, Vernon B. *An Organizing Principle for Cerebral Function: The Unit Model and the Distributed System,* in Gerald M. Edelman and Vernon B. Mountcastle, eds., The Mindful Brain (Cambridge, Mass.: MIT Press, 1978).
* Creutzfeldt, Otto D. *Generality of the Functional Structure of the Neocortex,* Naturwissenschaften, vol. 64 (1977): pp. 507-517.
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*Notes: Papers mentioned in the back of Jeff's book, "On Intelligence"*

**Other**

* Bartlett Mel has written the most important papers on the local dendritic properties we use in the CLA. These are technical.

**Free Courses (not specific to HTM/CLA)**

* Coursera: [Computational Neuroscience](https://class.coursera.org/compneuro-002) by Rajesh P. N. Rao, Adrienne Fairhall (University of Washington)

*Excellent introduction to neuroscience from a computational point of view.*

* Coursera: [Neural Networks for Machine Learning](https://www.coursera.org/course/neuralnets) by Geoffrey Hinton (University of Toronto)

*Geoffrey Hinton is one of the leading experts on Deep Learning Networks.*