Modelling ocular dominance plasticity

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One of the most intriguing aspects of the brain is the fact that it is plastic: it learns and develops in response to input that it receives. One of the paradigms of neuroscience to study plasticity is ocular dominance plasticity. In the young brain neurons in the visual cortex are responsive to both eyes but normally some neurons develop selectivity for the right eye and others for the left eye. During the so called critical period it is possible to shift this selectivity by for instance closing an eye with a patch. But both before and after this period, plasticity is strongly reduced. Although a number of models explain some aspects of the paradigm and despite its long history, no satisfactory explanation of this phenomenon exists.

The project is a theory and simulation project and will follow a two-pronged approach.
First we will develop a top-down theory that seeks to explain the conditions for ocular dominance plasticity and use dynamical systems theory to describe the onset and end of the critical period.

Second, we will incorporate the wealth of new experimental data about this phenomenon that is currently being produced and highlights the role of inhibitory plasticity, spine plasticity, and homoeostasis to create a bottom-up model of the system.

The balance between the two approaches will be mainly set by the candidate. The project requires strong physics/mathematical skills. Programming skills are somewhat less important as they can be picked up during the project.

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