



# Pernambuco State University

## Polytechnic School of Engineering

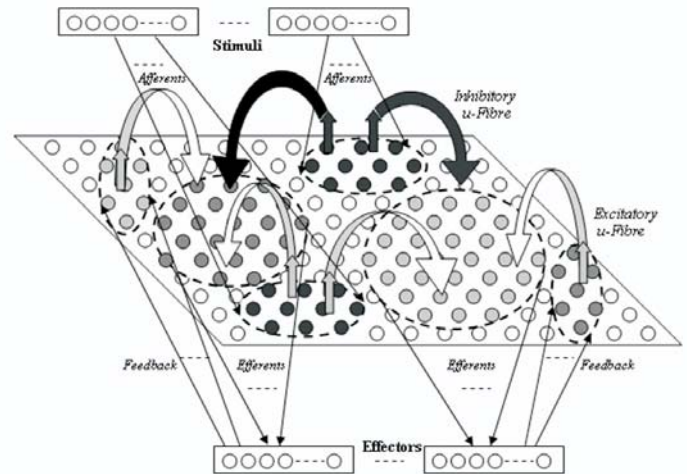
### Department of Computing Systems

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## Why include more Processing Layers in Venn networks?

**Background:** Venn Network is a new architecture of artificial neural networks that is able to produce localized activations on a 2D map while executing simple cognitive tasks. These activations resemble the ones observed in patches of the cerebral cortex (in fMRI style). Four distinct and independent concepts are present in this biologically inspired type of neural network: (i) cyto-architectonic regions; (ii) localization of functional activations; (iii) complex pattern of intra/interregional connectivity; and (iv) definable damage to neurons and axons. The dynamics of Venn networks is greatly influenced by these four concepts. Venn network architecture incorporates both unsupervised and supervised learning paradigms that are implemented in either open or closed loops. The modeler can freely make use of the four kinds of fibers available, that is afferent, efferent, feedback and u-fiber type of connections. Venn networks were devised to integrate in a single model the topographical representation of neural activations and also functional results evoked by these activations.



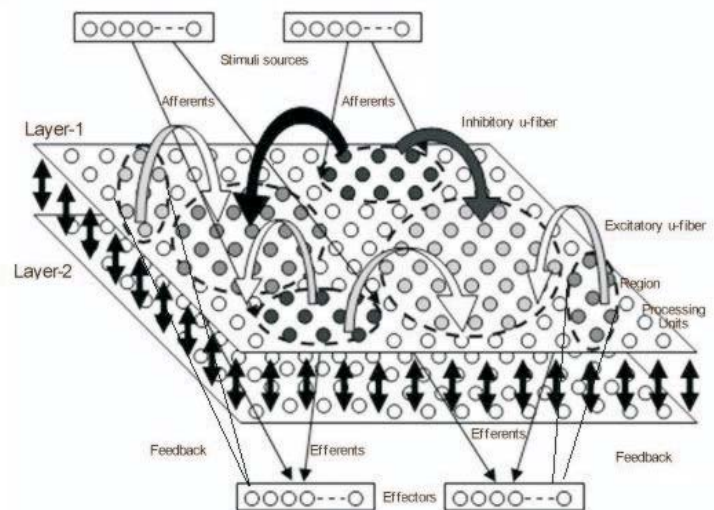
Schematic view of Venn-network

**Hypothesis:** Previous work by Treves and Raizada suggests that throughout animal evolution, substantial (cognitive) processing abilities were obtained following the increase of lamination in the cortex.

**Objective:** Buarque and De Wilde have demonstrated that Venn networks are successful in controlling single (and simple) cognitive functions such as movements of virtual fingers while evoking observable voxel-like activations, very similar to the ones obtained by fMRI brain scans. In this research we aim to increase the lamination (layeredness) of the model to investigate how powerful the (computer) system becomes.

**Current work:** For producing the new *ML-Venn network* (i.e. *multi-layer Venn*) we have already identified the necessary changes in functions and data structures in the current implementation of the Venn-network simulator. We are now carrying out the software upgrade. Problems we currently face are: (i) what type of learning algorithm should be incorporated, and (ii) how to train the new architecture. Next, we will compare results of the new architecture with the ones obtained by single-layer Venn.

**Expected results:** As the original implementation of Venn-network presents only one processing layer we expect that this *work-in-progress* by means of adding more layers *in silico* will lead to the increase in processing power observed *in vivo*. Ultimately, the new artificial neural network produced may help to reduce the gap between *micro-macro* features found in current brain studies, that is, the disconnection between the already known neural physiology and what is observed in localization



Schematic view of (new) ML-Venn network

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