System architecture approach to cortical information primitives

- Practical considerations acting through natural selection constrain but do not precisely specify cortical information primitives
- Cognitive processes can be modelled as combinations and sequences of these theoretical information primitives
- Physiological and anatomical results appear consistent with these information primitives
- Precise definition of primitives within the theoretical constraints requires furitehr anatomical and physiological investigation



Investigators

Research School of Computer Science L. Andrew Coward Tamas D. Gedeon John Curtin School of Medical Research Jason Potas

Contact

L. Andrew Coward Associate Professor Australian National University andrew.coward@anu.edu.au http://cs.anu.edu.au/~Andrew.Coward/

Architectural constraints on the brain imposed by practical considerations through natural selection





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- Form of cortex constrained by practical considerations
- Form of cortex constrained by use of cortical outputs in other structures

Cortex resource organization into modular hierarchy

Cortical modules define and detect conditions on different levels of complexity up to complex receptive fields

Modules do not correspond with behaviours or cognitive categories

Modules specified on the basis of *more information exchange within a module than between peer modules*



Synapses



Terminal branches

Neurons



Areas



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Cortical receptive field change management

The problem with changes

Cortical neuron and column receptive fields do not correspond with specific behaviours

One receptive field has many behavioural meanings

Change to a receptive field jeopardizes existing behavioural meanings

Changes must be tightly managed

Only change if more receptive field detections needed

Safest change is simple addition to set of circumstances in which field is detected

Only change a field if a small change is sufficient

Columns are the units managing receptive field changes

A. At least a minimum number of column receptive field detections needed for high integrity behaviour



B. Layer II/III column activity indicates appropriateness for receptive field change



C. Columns reciprocally connected to hippocampal change manager to identify most appropriate columns for change





Processing multiple sources of information in the same cortical neuron without confusion



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Generating a pseudovisual image from a word



Generating a recollection of a novel past event



System Architecture Approach

- Information models for cortical structures
- Modelling cognitive processes
- Physiological investigation of information coding and processing
- Simulation of wide range of learning mechanisms

