

## Evolution of Neural Computation

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Rolls and Treves, Neural Networks and Brain Function, Oxford UP, 1998 (*R&T*) can serve as a reference text. It can be downloaded/photocopied, and the relevant chapters be read in advance of each meeting. At the meeting, I will use and distribute slides and possibly additional written material.

Friday May 22, 9-11:

1a: What are we after in the course?

1b: guest lecturer Sophie Rosay – the **Hopfield** model

$$H = -(1/2N) \sum J_{ij} S_i S_j$$

Tuesday May 26, 11-13:

2a: Chemical computation – neurotransmitters and **neuromodulators**

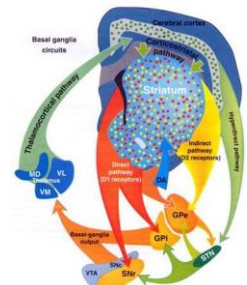
2b: Some slides on simple models of **reinforcement learning**. *R&T Ch 5*

Wednesday May 27, 14:30-16:30

3a: Elements of **information theory**. *R&T App 2*

3b: Geometrical computation – **early vision** in flies, in fish and in mammals

*JJ Atick, ecological theory of sensory processing, Network 3:213 (1992)*



Thursday May 28, 11-13:

4a: Creative geometry in the **basal ganglia** and in the **cerebellum**. *R&T Ch 9*

4b: virtual guest lecturer Elena Marchiori – Perceptrons and **back-propagation**. *R&T Ch 5*

--- phase transition into cortical systems

Wednesday June 10, 11-13:

5a: Cortical ingredients for models of associative learning (incl. review of linear algebra). *R&T Ch 1-3*

5b: Simple **associative nets** – paleocortex and olfaction; amygdala and orbitofrontal cortex. *R&T Ch 7*

Friday June 12, 11-13:

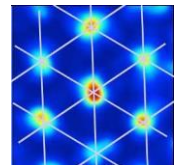
6a: Memory from geometry to combinatorics – self-organization of **cortical maps**. *R&T Ch 4*

6b: **Lamination** and arealization in sensory cortex. *R&T Ch 8*

xxMonday June 15, 11-13:

7a: Pure memory in the mammalian **hippocampus** – its internal differentiation. *R&T Ch 6*

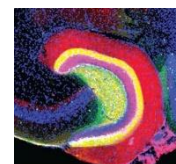
7b: The discovery of **grid cells**. Nobel prize 2014



Tuesday June 16, 9-11:

8a: Random number generators in the **Dentate Gyrus**, and neurogenesis

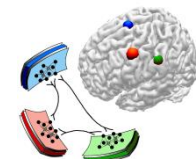
8b: guest lecturer Sophie Rosay – **analyzing charts** and their transitions



Wednesday June 17, 11-13:

9a: Memory from statics to dynamics, **from semantics to grammar**

9b: Issues at the interface to **higher cognition**



Friday June 19, 11-13:

10: Assessment, partially or entirely with multiple choice questions