

Evolution of Neural Computation

Alessandro Treves, SISSA office 241, ale@sisssa.it, <http://people.sisssa.it/~ale/>

Rolls and Treves, Neural Networks and Brain Function, Oxford UP, 1998 (*R&T*) can serve as a reference text, even if now 20 years old – the relevant chapters are indicated, together with some of the milestone papers.

Thursday Nov 9: 9:00-11:00

1a: What are we after in the course?

1b: Pyramidal cells (& EUGenIO maybe)

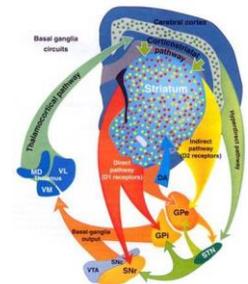


$$\delta = r(t) + \gamma V(t+1) - V(t)$$

Monday Nov 13, 9:00-11:00

2a: Chemical computation – **neuromodulators**. *K Doya (2002)* Simple models of

2b: **reinforcement learning**, then applied to human fMRI experiments. *R&T Ch 5*



Tuesday Nov 14, 9:00-11:00

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 Nov 16, 9:00-11:00

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

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

---- *phase transition into cortical systems*

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

Thursday Nov 23, 9:00-11:00

5a: Cortical ingredients for models of associative learning – the **Hopfield** model. *R&T Ch 1-3*

5b: Simple **associative nets** in olfactory cortex, amygdala and orbitofrontal cortex. *R&T Ch 7*

Tuesday Nov 28, 9:00-11:00

6a: Competitive nets – & EUGenIO – extended to the self-organization of **cortical maps**. *R&T Ch 4*

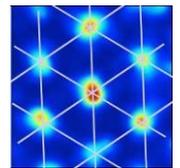
6b: **Lamination** and arealization in sensory cortex. *R&T Ch 8*

Thursday Nov 30, 9:00-11:00

7a: Pure memory in the mammalian **hippocampus** – David Marr and beyond. *R&T Ch 6*

7b: The statistical physics of **spatial maps**, in flat and curved spaces.

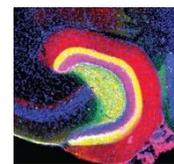
The legacy of David Marr, Oxford University Press (2017)



Tuesday Dec 5, 9:00-11:00

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

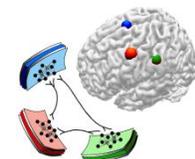
8b: slides by Sophie & Karel – **analyzing charts** and their transitions



Thursday Dec 7, 9:00-11:00

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

9b: Issues at the interface to **higher cognition** – the space of vowels



Wednesday Dec 13, 9:00-11:00

10a: Self-review in the format of an assessment, with multiple choice questions

10b: Collective assessment review and discussion of some controversial issues