

Neural networks and the evolution of neural computation

This year my course, in response to student suggestions, will follow closely the presentation in Rolls and Treves, *Neural Networks and Brain Function*, Oxford UP, 1998, covering roughly one chapter or appendix per meeting. Students are advised to photocopy the whole book, and read the relevant chapters in advance of each meeting. After the meeting, they can read the additional material or review the slides I will use and distribute.

We shall meet twice a week, on Monday and Thursday, over 8 weeks, Nov 8 to Dec 17 and Jan 10-20, for 90 minutes, ideally at 9am (but initially at 1pm to avoid overlap with Prof Nicholls' classes). Updated calendar on <http://www.sissa.it/cns/courses.html>

The scheme to be followed will be

Day 1 (60 min): Introduction, and overview of research directions in LIMBO, in one slide and loosely based on Ch. 1 of the book

Day 2: App. 1 – Introduction to linear algebra

Day 3: App. 2 (partial) – Elements of information theory

Day 4: (no Chapter or Appendix) – Geometry based computation: redundancy reduction à la Atick, from *JJ Atick, ecological theory of sensory processing, Network 3:213 (1992)*.

Day 5: Ch. 2 & App. 3 – Pattern associators

Day 6: Ch. 3 – Autoassociators

Day 7: App. 4 – analysing the Hopfield model and the connection with physics

Day 8: Ch. 4 – Competitive nets and self-organizing maps

Day 9: Ch. 5 (partial) – Reinforcement learning

Day 10: Ch. 5 (partial) – Perceptrons and back-propagation connectionist models

Day 11: Ch.6 – The hippocampus

Day 12: Ch 7 – Amygdala and orbitofrontal cortex

Day 13: Ch. 8 – Invariant sensory representations in cortical streams

Day 14: Ch. 9 – Motor systems: Cerebellum and basal ganglia

Day 15: Ch. 10 – The overall structure of neocortex, and thoughts on language

Day 16+: 30min presentations by surviving students

App. 5 and several other topics will be left for potential integration in the form of seminars, from February 2011, together with internal LIMBO seminars.

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