Computational Models in Cognition

The course will examine introduce a variety of methods for computational modelling, which will be applied to several domains of cognition. The models will be used to account for existent data and make further predictions. The course will also address controversies that involve competing models and theories.

Required background:

i) cognitive psychology, including memory, visual attention.
ii) Some computational background (basic maths, or programming, Matlab, etc).

Textbooks:
1. Computational Explorations in Cognitive Neuroscience: Understanding the Mind by Simulating the Brain (O'Reilly & Munakata, MIT Press, 2000).
2. Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. Peter Dayan & LF Abbott.
http://www.gatsby.ucl.ac.uk/~dayan/book/index.html

Structure:

- weakly lecture
- 7 Practicals (TIRGUL), about once every two weeks (see dates in Moodle); the practicals will help students to implement models, and will give exercises to carry out.

Marking:

Course work which includes a computational project (84) + 2 points for each exercise (6 in total).

Lecture provisorry time-table:

1. Introduction to modelling: rationale, domains and examples. Neurons and networks. Firing-rates and spikes (synchronisation). Integrate-and-fire model. The neural code; Cell assemblies, the Hebbian-framework.

2. Connectionism (PDD framework); Localistic vs distributed representations; Learning and in neural networks. Semantic knowledge; Generalisation;

3. Models of choice-RT-1: From Signal-detection to sequential sampling models race and diffusion.

4. Models of choice-RT-2: Leaky-Competing-Accumulators; psychophysical data and optimality.

5. Models of choice-RT-3. Models of choice-RT-3: contrasting the models and

neurophysiological data.

6. Models of Attention-1: salience, pop-out and Visual Search; Figure-ground.

7. Models of Attention-2: Parallel and serial models (Guided Search) of VS.

8. Models of Attentional-3. Cueing, Stroop, the flanker test; Biased competition; attentional control.

9. Models of Memory-1: Activation memory; the activation buffer, modelling dissociations between STM/LTM. Temporal-context-model vs dual memory.

10.Models of Memory-2: Episodic LTM and amnesia; semantic memory.

11. Models of memory-3. Memory recognition. Remember know

12.Motivation based (multi-attribute) decision-making: accounting for preference reversal.

13. Modelling decision confidence, sequential control; psychiatric disorders: the gain-context hypothesis.

Some reading to start with:

Introduction to Connectionsism:
Chapter-1 from the PDP book, Rumelhat & McClellend (1986). On Moddle.

Integrate and Fire models
http://icwww.epfl.ch/~gerstner//SPNM/node26.html
http://www.inf.ed.ac.uk/teaching/courses/nc/lF.pdf
http://icwww.epfl.ch/~gerstner/SPNM/node5.html