Course Directors:
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Course Manager:
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BRIEF COURSE DESCRIPTION

The aim of the course is to demonstrate that some basic principles of decision making can provide a unifying framework for constructing intelligently behaving artefacts on one hand, and for explaining human and animal cognition both in simple as well as in the most complex domains of behaviour on the other hand. To achieve this, lectures will progress via domains of gradually increasing abstraction that machine learning algorithms and humans deal with starting from representing uncertainty, beliefs about unobserved quantities, through learning internal models of the environment, to making adaptive and successful decisions.

The course will be organised around the following three key modules:

1. *Representations of uncertainty.* Why is it useful to represent uncertainty? How is uncertainty represented in machine learning algorithms, what are the main advantages and challenges in practical applications? Does human and animal behaviour reflect the representation of uncertainty? How can networks of neurons represent uncertainty? What are the main sources of evidence for probabilistic computations in neural activity recorded in the brain?

2. *Learning.* How can we make intelligent algorithms that learn without direct supervision? How does learning benefit from probabilistic representations of beliefs? How can principles of learning be formalised mathematically, and how can such formal theories be tested in human or animal behaviour?   How do we learn to adjust our movements to our environment, and how does our visual processing become to be adapted to it?

3. *Decision making.* How does uncertainty and learning influence decision making? How can rewards be taken into account in constructing machine learning applications? How do rewards affect human and animal behaviour? What happens if rewards are delayed rather than immediate, what new challenges does this pose to artificial as well as biological cognitive systems? How can we track the process by which a decision is born in the brain?

The principal format of the course will be seminars given by the core faculty. There will be a discussion session after each module where participants will be encouraged to formulate a coherent view based on the lectures. Participants will be expected to critically evaluate competing views represented by a series of papers. In addition, when possible, there will be computer demonstrations of the relevant concepts.

The scope of the course will be broadened by organising round table discussions with representatives of disciplines that are in secondary connection with the main topic of the course. These guest discussants will come from areas such as economics, business, and arts, and they will present their views on how everyday decisions and notions of uncertainty reflect the principles discussed in the main lectures of the course. Students will also carry out project work in small groups for which supervision will be provided by the faculty. Each group will need to lay out a detailed project proposal addressing a relevant question in a topic offered by one of the faculty members.

Central European University's summer school (CEU SUN), established in 1996, is a program in English for graduate students, junior or post-doctoral researchers, teachers and professionals. It offers high-level, research-oriented, interdisciplinary academic courses as well as workshops on policy issues for professional development, taught by internationally renowned scholars and policy experts (including CEU faculty). Application from all over the world is encouraged. Financial aid is available.