UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Computational Modelling

**2627-1-F5109P009**

## Learning area

Research methods in experimental psychological sciences

## Learning objectives

*Knowledge and understanding*

- Methodological and epistemological foundations in cognitive modelling
- Development of computational models: techniques and approaches
- Methods for the validation and assessment of the models

*Applying knowledge and understanding*

- Development of simple models in different domains of human cognition
- Application of toolkits to existing datasets
- Validation of computational models through behavioral data
- Critical analysis and interpretation of the model and its predictions

*Making judgments*

- Choosing the most apt computational approach for a given question
- Activities: hands-on practice with a number of models from different computational traditions

*Communication skills*

- Explaining inner workings and capabilities of computational models
- Activities: brief essays discussing outputs and predictions of different models

*Learning skills*

- Exploring current developments in the field of computational psychology
- Activities: analysis of classical and contemporary reference papers, online apps and tutorials

## Contents

The course aims to provide an introduction to the use of computational modeling in cognitive sciences. The theoretical and epistemological bases of the approach will be described, as well as the main methods of developing and validating a model, with examples from different domains of human cognition. The lectures will be accompanied by hands-on practice with the techniques and methodologies introduced.

## Detailed program

Introduction to computational modelling and Artificial Intelligence

Epistemological foundations of cognitive modeling

Levels of description and representation

Methods for developing models in different domains of cognition

Tuning, setting, and interpreting parameters

Training and validation of learning models

Simulation of behavioral data

Model evaluation: quantitative performance and theoretical criteria

Example: implementing an exemplar-based model for categorization

Example: implementing a model for the phonological loop

Example: training models based on the Rescorla-Wagner equations

Example: training and testing neural networks

## Prerequisites

Familiarity with R. General knowledge in the field of cognitive psychology

## Teaching methods

This is a laboratory.

Initial classes (6 hours) are dedicated to an introduction to computational psychology (Didactic Delivery)
The remaining classes (26 hours) focus on interactive lab activities, including discussions about the role of computational methods in psychology, hands-on experience with specific toolkits, implementation of simple models, and setup of simulations in the R environment (Didactic Interaction).

All classes will be held in-presence.

## Assessment methods

The course will be assessed on a pass/fail basis only. There is no final exam; evaluation will be based on active participation and any assignments or activities carried out during the course.
Attendance is mandatory for at least 70% of the course. Failure to meet this minimum attendance requirement will result in not passing the course.

Individual assignments will require students to replicate the scripts developed in class, and to produce short essays concerning their views on cognitive modelling and AI.

Moreover, further assignments will require the students to apply the practical knowledge acquired during the course. These will include modifying simple scripts, evaluating the impact of different parameters on model performances, testing model predictions against human-generated data, and comparing simulations from different models.

## Textbooks and Reading Materials

Reference materials:

Lewandowsky, S., & Farrell, S. (2010). Computational modeling in cognition: Principles and practice. Sage Publications.

Sun, R. (Ed.). (2008). The Cambridge handbook of computational psychology. Cambridge University Press.

## Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE