



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA  
CAMPUS DI CESENA

# Cognition and Neuroscience

Academic year 2024/2025

**Francesca Starita**

francesca.starita2@unibo.it

# Course timetable

Module 1 – tot. 32 hours

Lesson period Feb 18, 2025 – April 02, 2025

Francesca Starita, [francesca.starita2@unibo.it](mailto:francesca.starita2@unibo.it)

Office hours: contact me via email to arrange a time

Module 2 –tot. 16 hours

Lesson period to be defined

Giuseppe di Pellegrino, [g.dipellegrino@unibo.it](mailto:g.dipellegrino@unibo.it)

Office hours: contact him via email to arrange a time



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Office hours: contact me via email to arrange a time

**Tuesdays 16.00-18.30**

**Wednesdays 12.00-15.00**

Module 2 –tot. 16 hours

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# Nice to meet you



## Who am I?



# What's my background?



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# What's my background?



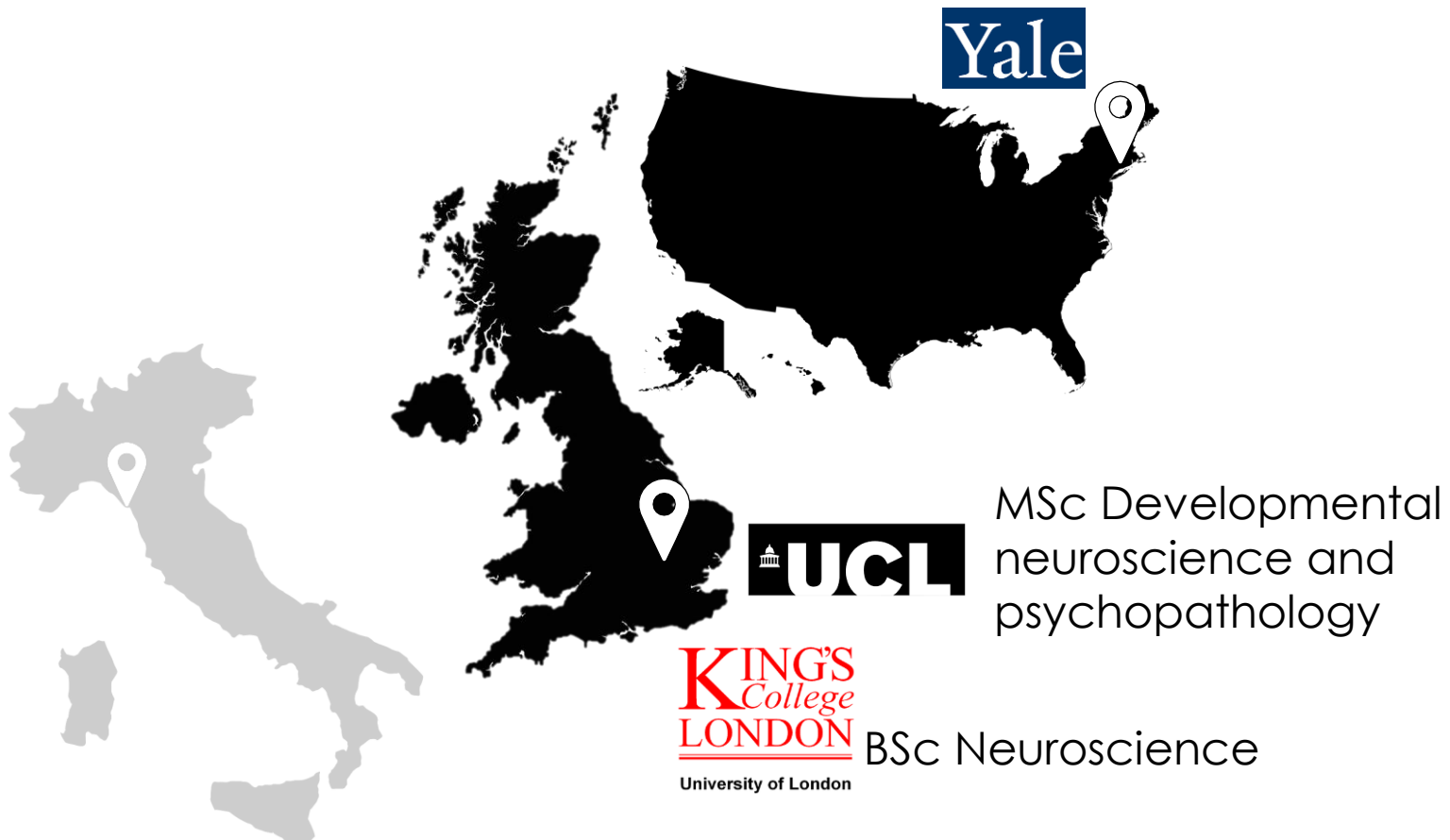
**KING'S**  
*College*  
**LONDON**  
University of London

BSc Neuroscience



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# What's my background?





# What's my background?

PhD Cognitive Neuroscience



Yale

MSc Developmental  
neuroscience and  
psychopathology



BSc Neuroscience



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# What's my background?

PhD Cognitive Neuroscience



Yale

Junior Assistant Professor

*Centre for Studies and Research  
in Cognitive Neuroscience*

*Department of Psychology,  
University of Bologna*

MSc Developmental  
neuroscience and  
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BSc Neuroscience



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## What do I do?

I am a **Junior Assistant Professor** at the **Psychology Department** of the University of Bologna and member of the **Neuroscience of Motivation, Decision and Learning Group** located at the Center for Studies and Research in Cognitive Neuroscience, directed by Prof. di Pellegrino.

My research concerns the psychophysiological and neural bases of **human motivation, reinforcement learning** and **affective processing**, with a particular focus on **fear** and **pain**.

I use a multimodal approach to conduct my research, combining **behavioral, psychophysiological** (e.g. skin conductance, electromyography, eye tracking) measures, **neuroimaging** (EEG) and **neuromodulation** (TMS), both in healthy participants and in patients with brain injury.



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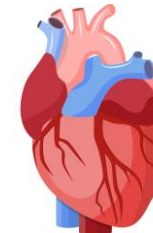
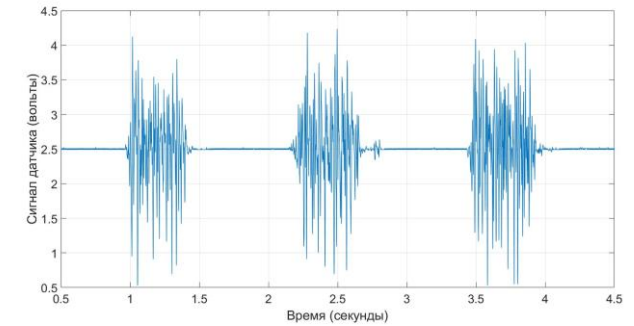
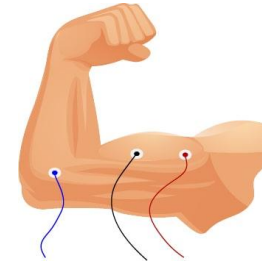
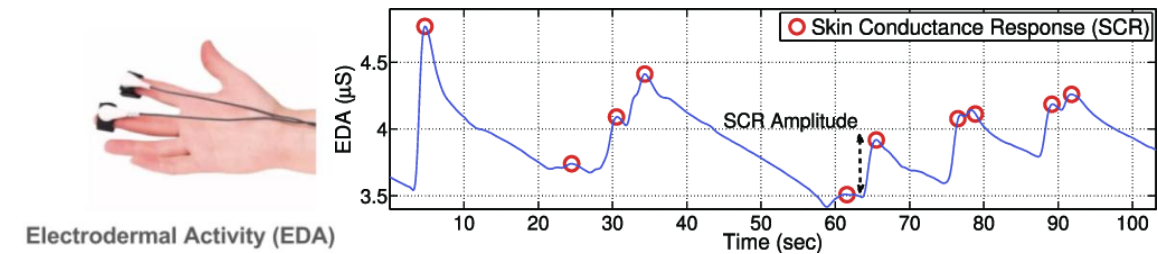


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EEG & TMS



# What about you?



# The course



# Learning outcomes

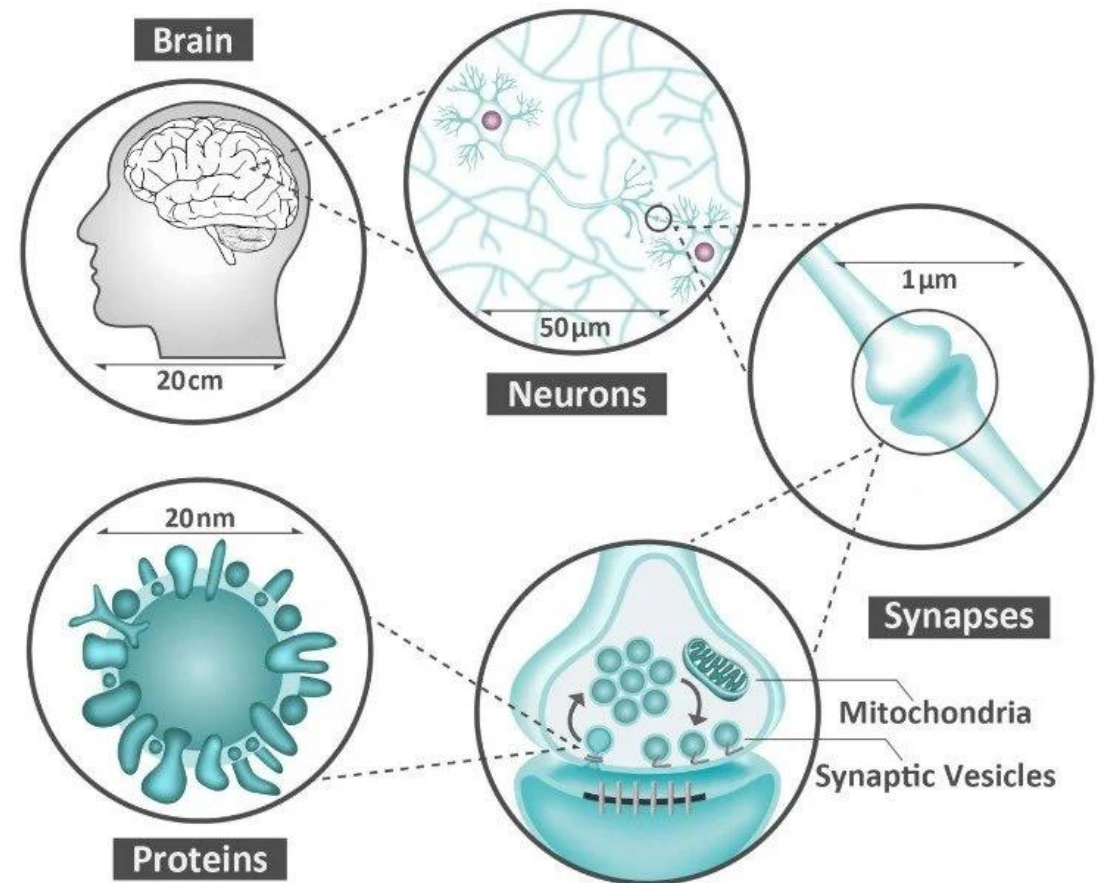
- The student knows state-of-art human and animal research that uses neuroscience techniques to understand the cognitive and emotional aspects of the human mind and behavior
- Being able to:
  - critically read experimental and theoretical studies of cognitive neuroscience
  - evaluate their methods and results
  - explain their significance
  - apply such notions in the study and development of artificial intelligence systems





# Course contents: Module 1 - Francesca Starita

1. What is cognitive neuroscience?
2. From single neurons to neural networks and systems
3. Signal transmission within and between neurons



# Course contents: Module 1 - Francesca Starita

1. Introduction to animal reinforcement learning (RL):
  - Pavlovian/prediction learning
  - Instrumental/control learning
2. Mechanisms of RL 1: contiguity, contingency & surprise
3. Mechanisms of RL 2: the reward prediction error hypothesis of dopamine neurons
4. From reinforcement learning to decision-making



Dopamine		<i>Reward</i>
		<i>Reward prediction error</i>

## Course contents: Module 2 - Giuseppe di Pellegrino

1. Reinforcement learning (RL): from cognitive neuroscience to artificial intelligence



# Course material

## Resources on Virtuale

- Lecture slides [I aim to publish them before class]
- List of recommended readings
  - Scientific articles (they will be uploaded on Virtuale)
  - Book chapters from:
    - Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2014). Cognitive Neuroscience, The biology of the mind.
    - Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S., Hudspeth, A. J., & Mack, S. (Eds.). (2000). Principles of neural science. New York: McGraw-hill.
    - Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction. MIT press.



## Teaching methods

What **I** provide to the course  
→ lecturing through

- Talking
- Lecture slides
- Videos
- Recommended readings

What **YOU** provide to the course  
→ participation to

- In-class interactions, discussion
- Real-time polls, and quizzes to make sure we are all on the same page
  - Wooclap

# The exam



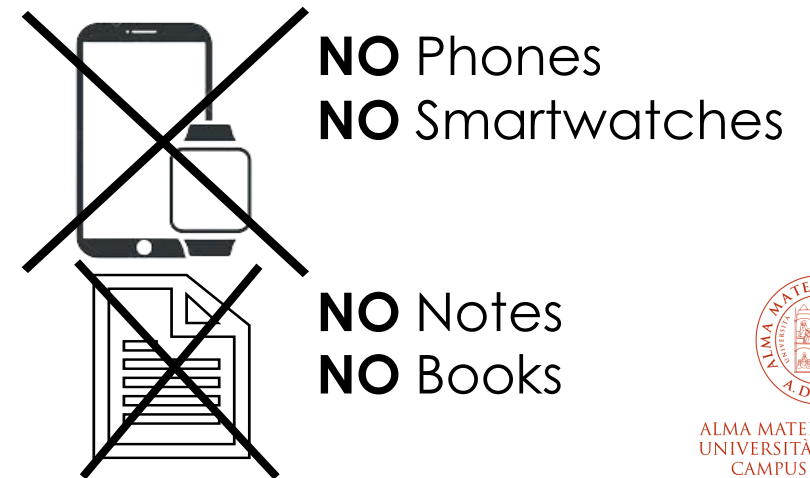
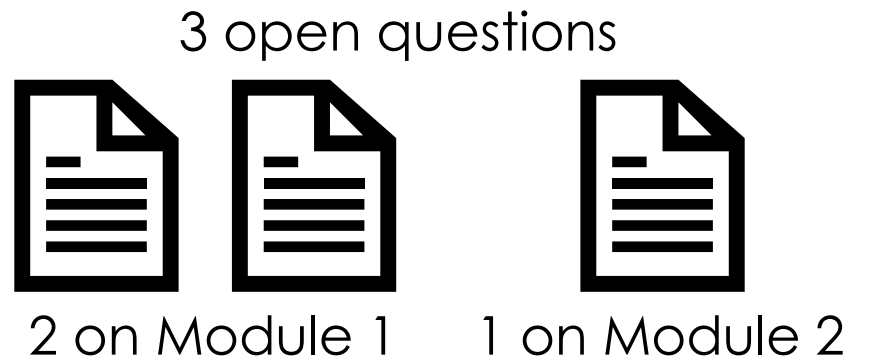
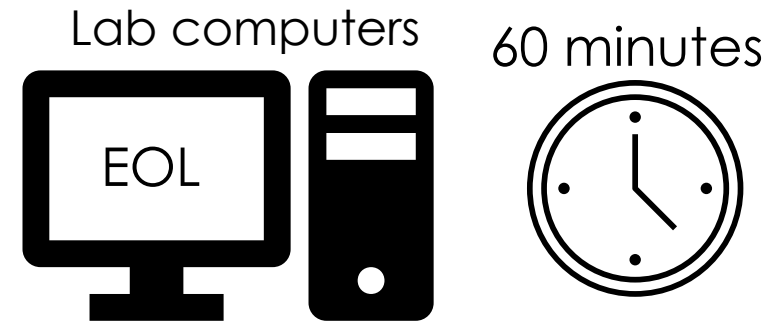
# Assessment method

- Student must **enroll** in the exam using the **Almaesami** application, strictly **by the deadline**.
  - Those who fail to enroll for technical issues by the due date are required to report the problem to the “segreteria didattica” (and in any case before the deadline) and send an email to Prof. Starita, who will ultimately decide whether to admit the student to take the exam.



## Assessment method

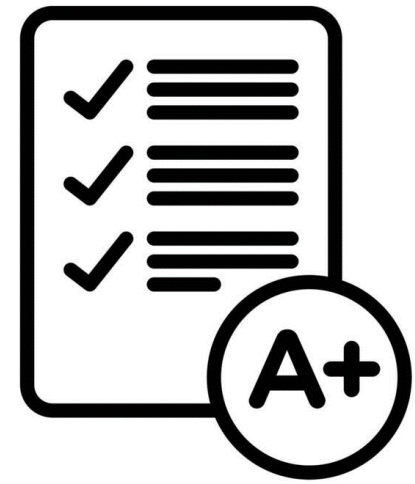
- The exam tests the knowledge of the topics discussed during the course.
- The exam will be taken on the lab computers through EOL.
- A total time of 60 minutes is allowed for the exam.
- The exam consists of a written exam including 3 open questions
  - 2 open questions on the topics covered in Module 1 (Prof. Starita).
  - 1 open question on the topics covered in Module 2 (Prof. di Pellegrino)
- During the exam, students are not allowed to use any lecture material nor books, scientific articles, personal notes, or electronic media.



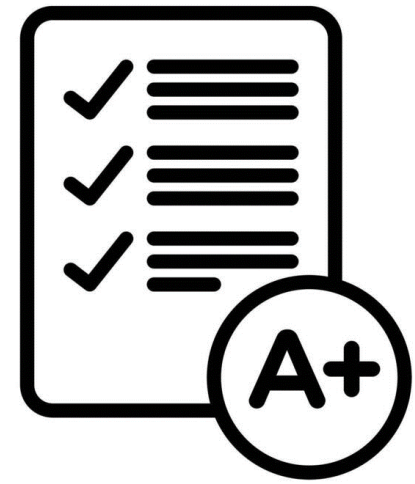


## Assessment method

- Up to 30 points are assigned for each open question, and the final score (out of 30) is given by the average of the points obtained on each question.
- Answers must be provided in English.



# Assessment method



## Evaluation criteria

The following areas will be considered to evaluate each answer:

### **Analysis/critical thinking**

- Ability to select, consider, evaluate, the course material relevant to answering the question.
- Use of appropriate definitions for the concepts prompted by the exam questions.
- Understanding of relevant concepts, through proper analysis of the course material.
- Ability to synthesize and employ in an original way ideas from across the course.
- Discussion of relevant evidence to support assertions (e.g. discussion of experimental evidence, use of citations/references).

### **Structure**

- Clarity of introduction, body, and conclusion
- Clear, logical and well-organized flow of information.

### **Style**

- Precision of vocabulary and use of academic tone.
- Clarity and conciseness of sentences, with minimal verbosity.
- Use of appropriate grammar, sentence construction, paragraph structure.



## Assessment method

- The **exam grade** will be **registered on the 5th working day** following the date of publication of the results.
- Students who want to **refuse their grade** need to write an **email to Prof. Starita** stating the wish to refuse, otherwise their grade will be registered.
- You can **refuse the grade** as many times as you want, but you must do it **within the 5 working days** following the date of publication of the results, otherwise your grade will be registered.

