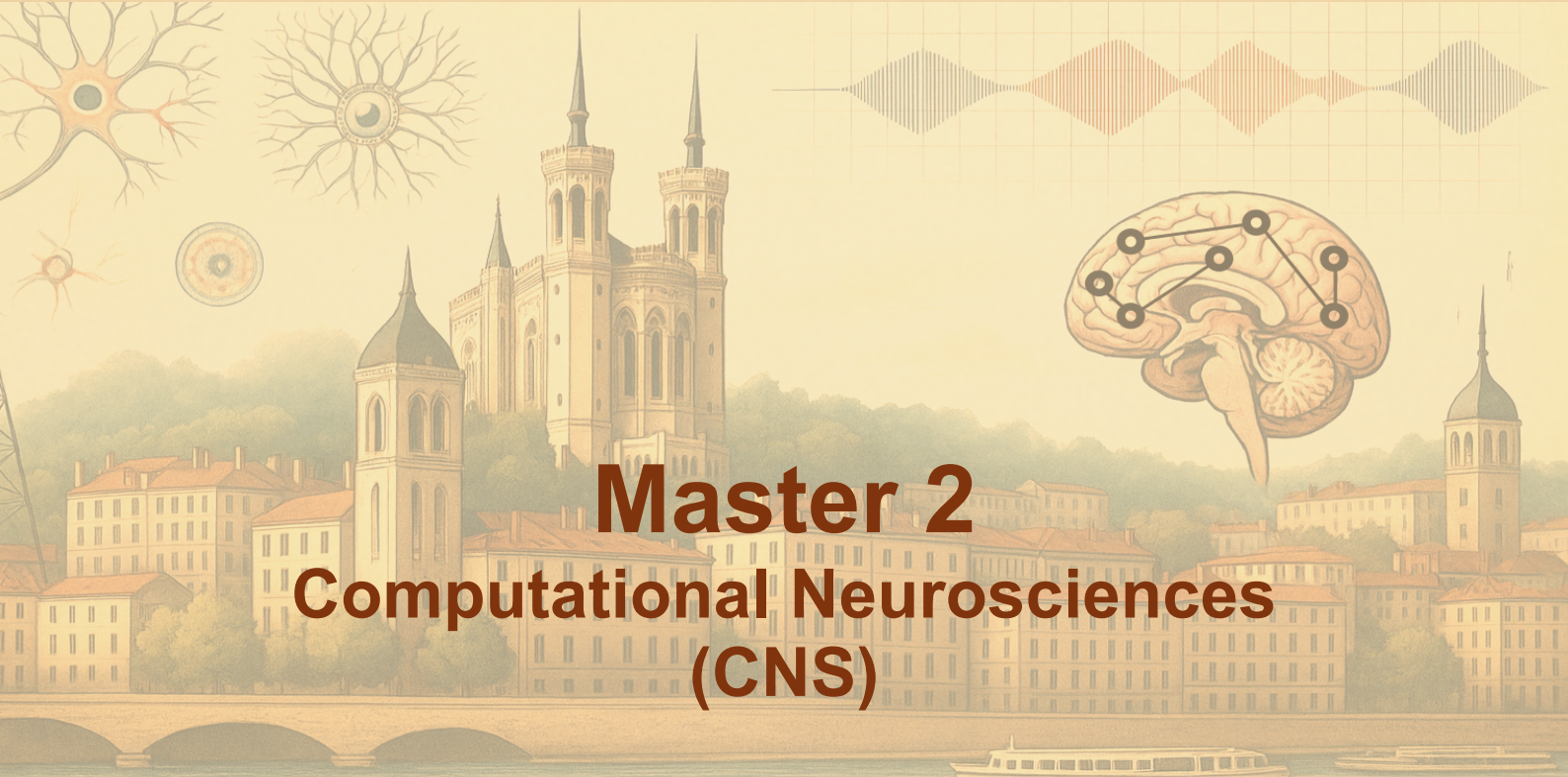




Master 2 Computational Neurosciences (CNS)

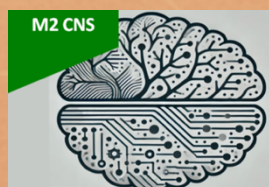
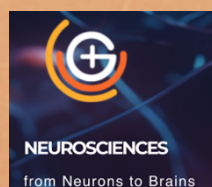
General info

Duration: 1 year (60 ECTS), full-time
Start month: September
Language of instruction: English
Class hours: 15–20 hours per week
Target students: Graduates in Engineering, Mathematics, Physics, Biology, Psychology
Internship / project: 6-month research internship (January-June)
Laboratories : CRNL , ISC , SBRI , INMG
Location: Lyon (France)

Master's objectives

This program trains students in modern computational and analytical methods to study the brain: from the electrical activity of single neurons to neural networks, interacting brain regions, and animal behavior. Students learn the principles of brain function by applying statistics, signal processing, and computational modeling to real neuroscientific datasets, gaining extensive hands-on experience through practical Python-based work.

The **M2 CNS** prepares students for research careers in neuroscience, neuroengineering, and data analysis. The main objective of CNS is to equip students with the skills and critical perspective needed to design, conduct, and interpret analyses of electrophysiological and behavioral data from a mechanistic viewpoint.



The program also exposes students to state-of-the-art research in computational neuroscience through lectures and seminars given by leading scientists, providing an up-to-date overview of the questions, challenges, and discoveries shaping modern neuroscience.

Job opportunities

The CNS Master allows students to follow an academic path, leading to PhD programs in Neuroscience and potentially careers as researchers or lecturers at universities (see our doctoral school in Lyon at [this link](#)). At the same time, the strong computational skills developed in the program open opportunities in industry, where neuroscientists with expertise in data analysis are increasingly in demand. Graduates can work in companies specializing in EEG-based neurotechnology, therapeutic brain-computer interfaces, robotics, or neuroengineering, as well as in R&D departments focusing on data science and cognitive technologies in France and abroad.

General view on the program

The Master is organized into two semesters: the first semester focuses on **courses**, while the second semester is dedicated to a **six-month internship**.

First semester - structured into three blocks

Block 1 –Tools <i>September to mid-October</i>	Students take courses on statistics, elements of neuroscience, mathematics, and Python programming. These courses are designed for students coming from both psychology/biology and mathematics/engineering backgrounds. A large part of the training is hands-on, using practical exercises in Python. An English course for neuroscientists, focusing on article writing and scientific presentations, is also included in this block
Block 2 – Specialized Courses <i>mid-October- November</i>	This block includes three main courses. <i>Neuroconferences</i> is a series of talks on recent advances in neuroscience given by experts (topics vary each year). The second course <i>PhysioMod</i> covers methods to model and analyze brain electrical activity across multiple scales, from single neurons to neural network up to whole-brain signals such as EEG and MEG. The third course, <i>CogMod</i> , focuses on methods to model and analyze behavioral data and learning processes in the brain.
Block 3 – Computational Neuroscience Seminars <i>December</i>	This block consists of talks by leading experts on recent advances in computational neuroscience, providing students with exposure to cutting-edge research in the field.
Optional Unit	Students can choose one optional course to specialize their path among the following ones : AI and Cognition, Human-Machine Interfaces, and Advanced Clinical Neurosciences.

Second semester – research internship

The six-month research internship involves projects centered on modeling and computational data analysis in neuroscience. Students will develop new tools or implement and adapt existing ones to analyze and interpret data ranging from electrophysiological recordings to behavioral measures. Internships may be carried out in research laboratories (CNRS, INRIA, INSERM, etc.) or in private companies, provided the project meets the pedagogical requirements described above. A list of internship proposals is available on the Master's website. Our master also provides scholarship for internships abroad through the [Graduate + Neurosciences initiative](#).

Course Prerequisites

The program is open to students from diverse backgrounds, including life sciences, computer science, mathematics, physics, and engineering. Applicants should hold a degree equivalent to a **Master 1** or **Master 2 level**, or an **engineering diploma**, and demonstrate **English proficiency** at least equivalent to level B2.

- Details on the admission procedures can be found here: <https://masterneuro.univ-lyon1.fr/admission/>
- Details on scholarships and opportunities here: <https://neurograduate.univ-lyon1.fr/opportunities/>

Research environment

The CNS Master is embedded in a vibrant neuroscience ecosystem in Lyon, supported by several leading research institutes, including the **Centre de Recherche en Neurosciences de Lyon (CRNL)**, the **Institut des Sciences Cognitives Marc Jeannerod (ISC)**, the **Stem-cell & Brain Research Institute (SBRI)**, and the **Institut NeuroMyoGène (INMG)**. Together, these institutes cover a wide range of expertise and provide students with unique opportunities to work on state of the art topics in computational neuroscience. Students can work on topics such as cognitive modeling (N. Kolling, J. Schol, J.-L. Dreher), brain-machine interfaces (J. Mattout), oscillations and computational principles in sensory areas (M. Bonnefond, M. Di Volo), computational modeling of epilepsy and large-scale brain networks (V. Magloire, Elif Koksall), decision-making and electrophysiology in monkey prefrontal cortex (E. Procyk, C. Wilson), learning and adaptive control (R. Quentin, R. Ligneul), sensorimotor integration and cortical dynamics (J. Bonaiuto), AI applications in neuroscience (G. Bondanelli / NeuroAI) etc.... Other research topics and projects can be found on the websites of CRNL, ISC MJ, SBRI, and INMG.

This diverse research environment allows students to gain hands-on experience in analyzing neural and behavioral data, modeling brain dynamics, and implementing computational tools. The strong integration of experimental and computational neuroscience provides a **distinctive training** that equips students with the skills and perspective needed to tackle **current challenges in brain research and neurotechnology**.

Detailed program and Teaching Units

TEACHING UNIT (UE)	ECTS
Stats – Statistics	3
NMI – Elements of Neurosciences, Mathematics & Informatics	3
English	3
PhyMod – Computational models of neurophysiological phenomena	3
CogMod – Computational Models of Behavior & Cognition	3
NeuroConf – Neuroconferences	6
NeuroComp – Computational Neurosciences	6
AI & Cognition (Optional Unit)	3
Advanced Clinical Neurosciences (Optional Unit)	3
Human-Computer Interaction & Robotic Interfaces (Optional Unit)	3
Internship (2nd Semester)	30

UE: Stats – Statistics

- **Coordinators:** Matteo di Volo
- **Pedagogical Team:** M. di Volo and C. Bardel
- **Content:**
 - This unit teaches advanced statistical methods used in biology and neuroscience: non-parametric tests, ANOVA (multiple factors), linear/logistic/mixed regressions, PCA/CFA, classification methods (decision tree etc..).
 - Practical works with hands on in R.

UE: NMI – Elements of Neurosciences, Mathematics and Informatics

- **Coordinator:** Matteo di Volo
- **Pedagogical Team:** M. Di Volo, F. Lecaigard, G. Bondanelli, C. Amat, J. Sallet, I. Cristofori
- **Content:**
 - Foundational knowledge in neuroscience: Neuroanatomy (J. Sallet), Multiscale electrophysiology (C. Amat) and Neuropsychology (I. Cristofori).
 - Foundational knowledge in mathematics: Linear algebra and Dynamical systems theory, Ordinary Differential Equations ODE (M. Di Volo)
 - Probability theory and Bayesian approach (F. Lecaigard).
 - Foundational knowledge in python programming for neurosciences through practical works. Machine learning (linear decoder, logistic regression, ...) applied to experimental datasets of neural recordings (M. Di Volo and G. Bondanelli)
 - Numerical simulation of ODE for neuronal dynamics in python - Integrate and Fire, Izhikevich, Hodgkin-Huxley (Matteo Di Volo).

UE: English

- **Coordinator:** Nathalie Dourlot (nathalie.dourlot@univ-lyon1.fr)
- **Content:** English language training specific to scientific communication: writing scientific articles, preparing poster presentations, job interviews, editorial correspondence.

UE: PhyMod – Computational models of neurophysiological phenomena

- **Coordinator:** Matteo di Volo
- **Pedagogical Team:** M. di Volo, E. Koksai, G. Bondanelli, J. Bonaiuto
- **Content:**
 - Computational models of neural networks, including neural dynamics, spiking neural networks and models of interacting neural populations (M. di Volo).
 - Computational models of the whole brain and large scale signals – EEG and MEG (E. Koksai).
 - Advanced methods in electrophysiological data analyses: dynamics of neural population activity through spike-based analyses, emphasizing manifold and geometrical approaches to characterize population dynamics. The course includes extensive hands-on sessions using real electrophysiological datasets (Z. Unagvsski & G. Bondanelli).
 - Advanced methods in data analyses of neural oscillations in electrophysiological signals, LFP and MEG (J. Bonaiuto)

UE: CogMod – Computational Models of Behavior and Cognition

- **Coordinators:** Jérémie Mattout (jeremie.mattout@inserm.fr) & Matteo di Volo (matteo.di-volo@univ-lyon1.fr)
- **Pedagogical Team:** Jean Daunizeau, Mateus Joffily, Françoise Lecaigard, Romain Ligneul, Jérémie Mattout, Romain Quentin, Emmanuel Reynaud, Jacqueline Scholl, David Thura
- **Content:**
 - Bayesian models of perception, action and cognition (J. Daunizeau, F. Lecaigard, M. Joffily)
 - Reinforcement learning models and tasks – practical session (R. Ligneul, J. Scholl)
 - Decoding approaches – practical session (R. Quentin)
 - Modeling decision making, trading speed and accuracy (D. Thura)
 - Deep learning models and cognitive neurosciences (E. Reynaud)
 - Brain-Computer Interfaces & Neurofeedback training (J. Mattout)

UE: NeuroConf – Neuroconferences

- **Coordinator:** Marion Richard (marion.richard@univ-lyon1.fr)

- **Content:** A series of scientific conferences given by nationally and internationally recognised experts on current hot topics across neuroscience levels. Emphasis on discussion between students and speakers to foster scientific reasoning and networking. Topics treated in 2025/2026: [link1](#) and [link 2](#)

UE: NeuroComp – Computational Neurosciences

- **Coordinators:** Matteo di Volo & Jérémie Mattout
- **Content:** A series of scientific conferences given by nationally and internationally recognised experts on current topics in the field of computational neurosciences. Emphasis on duo talks by an experimentalist and a computational model expert. See here the program for 2025/2026

Optional Units

1. **AI Cog – Artificial Intelligence and Cognition**
Coordinator: Marie Lefevre
Content: Introduction to different AI approaches (symbolic, digital, computational, strong AI), their relationship with cognition, and focus on developmental AI. More info [here](#)
2. **Adv Clinical – Advanced Clinical Neurosciences**
Coordinators: Irene Cristofori & Frédéric Haesebaert
Content: Conference series by national and international experts on clinical neuroscience. Focus on cutting-edge methods to study the neural basis of neurological and psychiatric disorders; emphasis on discussion and networking. Program of previous year [here](#)
3. **HCI – Human-Computer Interaction: Robotic Interfaces**
Coordinator: Emanuelle Reynaud (emanuelle.reynaud@univ-lyon2.fr)
Content: Study of digital interfaces and brain–machine interface design. Students will work in small groups to design an interface of their choice using current methods.