**COMPUTATIONAL NEUROSCIENCE**

Computational neuroscience is an expanding field that is proving to be essential in neurosciences. The aim of this short intensive course will be to provide a common background in computational neuroscience. The course, after a brief historical overview of the field, will focus on the description of a few selected modelling and theoretical approaches that are currently developed, including details about their limits and advantages, and that can be applied to different scales of analysis (from the single neuron to the whole brain). In addition we will provide a theoretical and a practical session on artificial neuronal networks of spiking neurons

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Category :

Field :

Language of intervention : English

Number of hours : ~18 hours (session 1=7 + session 2=4 + session 3=7)

Max participants : 15 for the practical sessions (afternoon Day 3), unlimited for theoretical courses

Public priority : PhD students

Public concerned : PhD students, interested M2 students and postdocs

Suggested by :

Location : Institut des Neurosciences de la Timone (INT) / online courses

Keywords : neuronal modelling, neural circuit modelling, information theory, decoding and encoding, artificial networks of spiking-neurons

Beginning of the module : April 21 2021

Registration deadline : ?

Targets : Understanding how computational modelling can be used to formulate and solve neuroscience problems at different spatial and temporal scales; learning the formal notions of information, encoding and decoding and experimenting their use on specific examples

Program : First session (April 21): *Introduction to modeling single neurons (morning); An introduction to* *neural masses: modeling assemblies of neurons up to capturing collective oscillations and resting state dynamics in a mean-field model - presentation of the Virtual Brain software (afternoon)*

Second session (April 22, morning): *An overview on "What is encoding?" "What is decoding?": formalization of the notion of information in neural activity; shared and transferred information; integration, segregation and complexity (morning).*

Third session (April 23): Introduction to the modeling of realistic spiking neural networks by showing how to 1/ use a remote computational facility 2/ follow simple tutorials to model a spiking neural net 3/ apply this knowledge to a real-world use case."

-morning (Alberto) :  Introduction to simulating spiking neuronal networks

-afternoon (Laurent) : a practical application for the replication of a neurophysiological study

Pre-required : Basic knowledge of statistics and probability and calculus is useful, but steps will be explained and complex math avoided as much as possible. Practical exercises are in python, so basic knowledge of this environment is a plus (yet not mandatory).

Pedagogical team:

Timetables :

Session n° 1

Date : April 21, 2021

Schedule : 9:00-12:30; 14h00:17:30

Speaker : Demian Battaglia (INS)

Location : Salle Gastaut (ground floor), INT ?

Title course : Computational modelling: from the neuron, to the neuronal population and the whole brain

Session n° 2

Date : April 22, 2021

Schedule : 9:00-12:30;

Speaker : Demian Battaglia (INS)

Location : Salle Gastaut (ground floor), INT ?

Title course : Encoding and decoding: Shannon, Bayes & co.

Séance n° 3

Date : April 23, 2021

Schedule : 9:00-12:30; 14h00:17:30

Speaker : Alberto Vergani (INT), Laurent Perrinet (INT)

Location : Salle Gastaut (ground floor), INT ?

Title course : Realistic spiking neural networks: Theory and Hands-on practice