Virtual Exchange Program

BIO-465 Biological modelling of neural networks

Start date: 17/02/2020, **End date:** 29/05/2020
Platform: courseware.epfl.ch

Ecole Polytechnique Fédérale de Lausanne

COURSE SYNOPSIS

Domain: Life sciences

Title(s) of the course(s) as it appears on the platform: Neuronal Dynamics and Computational Neuroscience: Neuronal Dynamics of Cognition

Language (ISO-639-1 code): en

Short description of the course: In this course we study mathematical models of neurons and neuronal networks in the context of biology and establish links to models of cognition.

Instructor(s): Wulfram Gerstner

Level: MA all years

ECTS: 4.0

Workload in student hours: 120

Semester: 1: jan-june

Full course description: I. Models of single neurons 1. Introduction: brain vs computer and a first simple neuron model 2. Models on the level of ion current (Hodgkin-Huxley model) 3./4. Two-dimensional models and phase space analysis II. Neuronal Dynamics of Cognition 5./6. Associative Memory and Attractor Dynamics (Hopfield Model) 7. Neuronal Populations and networks 8. Continuum models and perception 9. Competition and models of Decision making III. Noise and the neural code 10. Noise and variability of spike trains (point processes, renewal process, interval distribution) 11: Variance of membrane potentials and Spike Response Models IV. Plasticity and Learning 12. Synaptic Plasticity and Long-term potentiation and Learning (Hebb rule, mathematical formulation) 13. Summary: Fitting Neural Models to Data

Prerequisites: Required courses undergraduate math at the level of electrical engineering or physics majors undergraduate physics. Recommended courses Analysis I-III, linear algebra, probability and statistics For SSV students: Dynamical Systems Theory for Engineers or "Mathematical and Computational Models in Biology" Important concepts to start the course Differential equations, stochastic processes.

Link to course on platform: https://courseware.epfl.ch/courses/course-v1:EPFL+BIO_465.a+2019_1/course/, https://courseware.epfl.ch/courses/course-v1:EPFL+BIO462.b+2019_1/course/

Link to course in University studyplan: http://isa.epfl.ch/imoniteur_ISAP/!GEDPUBLICREPORTS.pdf?ww_i_reportModel=1696552884&ww_i_reportModelXsl=1696552963&ww_i_itemplan=2372843310&ww_c_langue=fr

Course registration opening date: 01/02/2020

Course registration deadline: 17/02/2020

Course withdraw date: 04/05/2020

Midterm: Yes

Midterm details: Mini-Project

Exam period start: 14/06/2020

Exam period end: 04/07/2020

Exam date: -

Exam timing: Synchronous (exam needs to take place at the same date and time everywhere)

Exam start time: -

Exam end time: -

Time zone (at the time of the exam, DST): UTC+2

Exam registration date: 04/05/2020

Exam resit available: No

Exam resit period start: -

Exam resit period end: -

Exam resit date: -

Exam resit time start: -

Exam resit time end: -

Time zone (at the time of the resit of the exam, DST): -

Final exam type: Written

Final exam details: Exam can be on a Saturday. Exam rules: Allowed material: • Bring writing material (Pen, etc.). • Paper will be provided. • You can bring a single A5 (half the size of A4) sheet, handwritten, on which you are allowed write (recto-verso) whatever you think might be useful. • Nothing else. (In particular no books, lecture notes, mobile phones, laptops, calculators, etc.)

Exam requirements for home university (computer, VOIP, recording materials): Exam can be on a Saturday. Proctored room necessary

Cap (maximum number of exchange students): 10

Offered to which partenrs: -, All partners of the Alliance(s) selected above

Link to course image: https://drive.google.com/open?id=1i4C-RNaHuuZMj5bEvhU0AtJ0wFQT04Uh