REQUIREMENTS

Semmelweis University Faculty, Department:

Faculty of Medicine, Department of Anatomy, Histology and Embryology

Name of the course: Systems Neuroscience II. Computational models in systems neuroscience

Type of course: optional course-unit

code: AOSANT560_2A

credit: 2

Name of the responsible person: Dr. Gábor Gerber (Mihály Bányai, PhD)

Academic year: 2018/2019., second semester

Role of the course in the training of the Department:

The purpose of this course is to introduce a mathematical modelling approach to understand brain functionality. We will explore how to build formal theories about the brain with an emphasis on being able to predict measurements. Mathematical tools required to formulate and evaluate hypotheses will be discussed together with interdisciplinary approaches to cognition and cortical computation both on the behavioral and neural levels. We will review state-of-the-art models aiming to predict biophysical quantities in the sensory and decision making systems of the brain. We will elaborate on the strong ties that connect neuroscience to machine learning and artificial intelligence. Recent advancements in the latter fields are discussed.

The program of the course:

1. Lecture: Introduction to systems neuroscience I
2. Lecture: Introduction to systems neuroscience II
3. Lecture: Structure and dynamics of neural networks I
4. Lecture: Structure and dynamics of neural networks II
5. Lecture: Structure and dynamics of neural networks III
6. Lecture: Neurons implementing behavior. Neural coding of the environment I
7. Lecture: Neurons implementing behavior. Neural coding of the environment II
8. Lecture: Neurons implementing behavior. Neural coding of the environment III
9. Lecture: Neurons implementing behavior. Measuring neural activity I
10. Lecture: Neurons implementing behavior. Measuring neural activity II
11. Lecture: How to test predictions of theories? Decoding neural activity I
12. Lecture: How to test predictions of theories? Decoding neural activity II
13. Lecture: How to test predictions of theories? Decoding neural activity III
14. Lecture: How to test predictions of theories? Experimental design and analysis I
15. Lecture: How to test predictions of theories? Experimental design and analysis II
16. Lecture: Successful theories of system-level neural activity The visual cortex and deep learning I
17. Lecture: Successful theories of system-level neural activity The visual cortex and deep learning II
18. Lecture: Successful theories of system-level neural activity The visual cortex and deep learning III
19. Lecture: Successful theories of system-level neural activity Learning strategies in the brain I
20. Lecture: Successful theories of system-level neural activity Learning strategies in the brain II
21. Lecture: Students' presentations, discussion I
22. Lecture: Students' presentations, discussion II
23. Lecture: Students' presentations, discussion III
24. Lecture: Written test

25. Lecture: Written test

Practical courses: 1. Course: Analysis of a publicly available electrophysiological dataset with the aim to answer questions of neural coding. I
2. Course: Analysis of a publicly available electrophysiological dataset with the aim to answer questions of neural coding. II
3. Course: Analysis of a publicly available electrophysiological dataset with the aim to answer questions of neural coding. III

Consultations: personally with the actual course leader

Requirements of course participation and options to recover missed hours:

1. **Total absence allowed: 10% of the course hours**
2. **Recovering missing hours: studying the material provided by the course leaders, consultation**

Eligibility: US grade point average (GPA) of 3.0. Students with a GPA lower than 3.0 should inquire with the Directors on the possibility of a waiver.

Justification of absence from course hours or exams:
Hungarian medical certificate

Number and schedule of the examinations:

1 on the last day of the course

Requirements of the successful completion of the program:

written or oral test in each course material

Marks:

In case of a written test grades are given after obtaining points as follows: 0-50% fail, 51-60% pass, 61-75% fair, 76-90% good, above 90% excellent.

Types of exam: test, essay, verbal

Requirements of the examinations:

Verbal and electronic etc. material provided by the lecturers. Syllabus is available upon opening the program on the web page.

Registration for exams: NEPTUN

Rescheduling the tests:

N/A
Each student has to take an examination in each block of the course.

Justification of absence from the exam:

Hungarian medical certificate (see above).

List of useful literature (books, papers etc):

1. Abbott, LF. 2005. Theoretical Neuroscience. Computational and Mathematical Modeling of

Neural Systems. MIT Press
2. Bialek W, Warland D, van Steveninck RR. 1999. Spikes. Exploring the Neural Code. MIT Press
3. Marr D. 2010. Vision. A Computational Investigation into the Human Representation and Processing of Visual Information. MIT Press