SYLLABUS

1. Information about the study program

1.1 Higher education institution	Babeș-Bolyai University
1.2 Faculty	Faculty of Psychology and Educational Sciences
1.3 Department	Department of Psychology
1.4 Field of study	Psychology - Cognitive Sciences
1.5 Study cycle	Bachelor level
1.6 Study program / Qualification	Psychologist

2. Information about the course

2.1 Title of the course	Computational Neuroscience						
2.2 Teacher in charge of the lecture	Lect. Dr. Rusu Vasile Catalin						
2.3 Teacher in charge of the seminar	Lect. Dr. Rusu Vasile Catalin						
2.4 Study year	2	2.5 Semester	4	2.6. Examination type	E	2.7 Course type	O

3. Estimated total time (number of hours of teaching activities per semester)

3.1 Number of hours per week	3	out of which: 3.2 lecture	2	3.3 seminar / laboratory	1
3.4 Total number of hours in the curriculum	42	out of which: 3.5 lecture	28	3.6 seminar / laboratory	14
Distribution of the allocated amount of time:					hours
Individual study (textbook, course support, bibliography, and notes)					28

Supplementary documentation at the library using specialized electronic platforms in the field	14
Preparing for seminars / laboratories, homework, papers, portfolios, and essays	14
Tutoring	
Exams	2
Other activities: research activities	
3.7 Total number of hours of individual study	56
3.8 Total number of hours per semester	100
3.9 Number of credits (ECTS)	4

4. Prerequisites (if applicable)

4.1 Curriculum	- Introduction in Neuroscience
4.2 Competencies	- familiarity with linear algebra and differential equations

5. Requirements (if applicable)

5.1 For the lecture	• Classroom with at least 180 seats, computer and video projector / Online course conducted through the MS Teams platform.
5.2 For the seminar / laboratory	• Room with at least 50 seats, computer and video projector / Online seminar conducted through the MS Teams platform.

6. Specific skills acquired

Professional skills	**Knowledge and understanding** • Description of concepts, theories and models used in computational neuroscience **Explanation and interpretation** • Interpretation of mathematical and computer models **Instrumental - applicative** • Use of mathematical tools and modelling to solve specific problems in computational neuroscience • Data and model analysis **Attitude** • …..
Transversal skills	• Application of efficient and organized work rules, of responsible attitudes towards the didactic-scientific domain, to creatively value one's own potential, with the respect towards the principles and norms of professional etic. • Efficient fulfillment of organized activities in an interdisciplinary group and development of empathic abilities of interpersonal communication, relationship and collaboration with various groups • Use of efficient methods and techniques to learn, inform, research and develop the abilities to value the knowledge, to adapt to requirements of a dynamic society and to communicate in a language of international circulation

7. Objectives of the course (based on the grid of acquired competencies)

7.1 General objective	• basic knowledge of neuroscience and neural computation • enable students to understand, simulate, and analyze the complex behaviors of individual neurons and brain circuits • describe how experimental data is linked to a model and one evaluates computational models

7.2 Specific objectives	• understand the brain anatomy and basic experimental techniques • discuss and model biophysical models of neurons • model neural networks • understand synaptic communication and coding of information in the nervous system • neural implementation of cognitive processes • description of learning and memory in neural terms

8. Content

8.1 Lecture	Teaching strategies	Remarks
I A computational theory of the brain II Single neurons 1. Organization of the nervous system and Neuroanatomy 2. Biophysics of spike generation and action potential propagation 3. Biophysical models of Single neuron 4. Simplified neural models 5. Neural coding and decoding 6. Information theory II Neural circuits 1. Feedforward networks 2. Recurrent networks IV Adaptation and Learning 1. Synaptic plasticity rules	Exposure: description, explanation, examples, discussion of case studies	

2. Reinforcement learning and STDP V Higher level functions 1. Models of human memory		

Mandatory references:

1. Dayan, Peter, and Laurence F. Abbott. "Theoretical neuroscience (Vol. 806)." (2001)
2. Trappenberg, Thomas. *Fundamentals of computational neuroscience.* OUP Oxford, 2009

Optional references:

1. Gerstner, Wulfram, and Werner M. Kistler. *Spiking neuron models: Single neurons, populations, plasticity*. Cambridge university press, 2002
2. Buzsaki, Gyorgy. *Rhythms of the Brain*. Oxford university press, 2006
3. Izhikevich, Eugene M. *Dynamical systems in neuroscience*. MIT press, 2007

8.2 Seminar / laboratory	Teaching strategies	Remarks
A brief introduction to MATLAB	Explanation, dialogue, debate, group work	
Modelling I: the biological neuron and spiking models	Explanation, dialogue, debate, group work	
Neural codes and analysis of single spike trains	Explanation, dialogue, debate, group work	
Modelling II: Conductance-based models	Explanation, dialogue, debate, group work	

Modelling III: Wiring neurons together	Explanation, dialogue, debate, group work	
Learning and synaptic plasticity	Explanation, dialogue, debate, group work	
Modelling IV: Dynamical systems in neuroscience	Explanation, dialogue, debate, group work	

Mandatory references:

1. Dayan, Peter, and Laurence F. Abbott. "Theoretical neuroscience (Vol. 806)." (2001)
2. Trappenberg, Thomas. *Fundamentals of computational neuroscience.* OUP Oxford, 2009

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1. Gerstner, Wulfram, and Werner M. Kistler. *Spiking neuron models: Single neurons, populations, plasticity*. Cambridge university press, 2002
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9. Correlations between the content of the course and the expectations of the representatives of the epistemic community, professional associations and representative employers in the field related to the program

The proposed lecture and seminar offer central topics in fundamental and applied research in the fields of cognitive sciences, and their approach is based on the most recent results found in the literature. The course also offers state of the art research skills that are transferable to any scientific and applied field of knowledge.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final grade
10.4 Lecture	- know the basic principles, theory and models in the domain; - apply and understand course concepts	Written exam	60%
10.5 Seminar / laboratory	- be able to implement course concepts, models and algorithms in Matlab	Research project	40%
10.6 Minimum passing score			
The final grade consists of: a. score obtained in the written exam in proportion of 60% b. research project 40%			

Date 29.11.2021

Signature of the teacher in charge of the lecture.

Lect. Dr. Rusu Vasile Catalin

Signature of the teacher in charge of the seminar.

Lect. Dr. Rusu Vasile Catalin

Approval date in the department

Signature of the Head of the department /director