City University of Hong Kong
Course Syllabus

offered by Department of Neuroscience
with effect from Semester A 2023/2024

Part I Course Overview

Course Title:	Advanced Computational Neuroscience
Course Code:	NS6002
Course Duration:	One semester
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

(A 150-word description about the course)

How the brain computes is a long-lasting question to understand various brain functions and phenomena. Thanks to the development of different numerical techniques, computational models, and experimental discoveries, the investigation of computational aspects in Neuroscience has become possible. This course aims to promote the awareness of computational aspects in Neuroscience. Prior experience in computer languages is not necessary to do well in this course. Topics covered in this course include computational models for ion channels, models for synapses, models for neurons, descriptive models, neural coding, information theory, and analysis of neural data. In addition, implementations of computational models and analytic techniques will be exercised.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Promote the awareness of the computational aspects of Neuroscience	25%	✓		
2.	Gain fundamental knowledge of computational models for neural systems	50%	✓	✓	✓
3.	Able to apply modern machine learning techniques to analyze neural data.	25%	✓	✓	✓
…					
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.			Hours/week (if applicable)
		1	2	3	
Lecture	The primary form of teaching; Systematic presentation of class content	✓	✓	✓	
Projects	Learning and practicing computing tools for computational models and data analysis; Initiating discussion among students and encouraging explorations in computational studies; Report the results in a journal-article format	✓	✓	✓	
Presentation	Give presentations of the project results; The presentation session will be conference-like	✓	✓	✓	
Hand-in Assignment	Helping the students to check their understanding of class content continuously		✓	✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.			Weighting*	Remarks
	1	2	3		
Continuous Assessment: _65_%					
Hand-in Assignments		✓	✓	10%	
Computational Projects	✓	✓	✓	25%	
Presentation	✓	✓	✓	5%	
Midterm Examination		✓	✓	25%	
Final Examination: _35_% (duration: 3 hours)					
** The weightings should add up to 100%.*				100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Hand-in Assignments	Based on the submitted written assignment, evaluate whether the students can understand the concepts of the models and skills they learned in lessons.	The student submits the clearly written assignment without any error.	The student submits the clearly written assignment with minor errors.	The student submits the written assignment with some errors.	The student fails to submit the assignment. Or the student submits a partially finished assignment with significant errors.
2. Computational Projects	Based on the submitted programming codes and project reports to evaluate whether the students can apply the knowledge and skills to address the computational problems.	The student is able to finish the numerical assignment without any assistance and submit a clearly written and grammatically correct project report without error.	The student is able to finish the numerical assignment with little assistance and submit a clearly written and grammatically correct project report with only minor errors.	The student is able to finish the numerical assignment with moderate assistance and submit a clearly written and grammatically correct project report without significant errors.	The student fails to finish the numerical assignment and is unable to produce a project report.
3. Presentation	Able to show the origination of the knowledge and concept involved in the computational project.	The student gives a systematic presentation of the results and responds appropriately to queries from audience classmates.	The student gives a moderate presentation of the results and responds acceptably to queries from audience classmates.	The student gives a basic presentation of the results and responds partly to queries from audience classmates.	The student fails to give a presentation of the results and fails to respond to queries from audience classmates.
4. Midterm and Final Examinations	Able to show the understanding of concepts and applications of numerical methods and models.	Students achieve a 86% or greater on the examination.	Students achieve a 65% or greater on the examination.	Students achieve a 50% or greater on the examination.	Students achieve less than 50% on the examination.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Neuronal Models; Synaptic Models; Neuronal Network; Neural Coding, Information Theory; Analysis of Neural Data.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1. Dayan, P., & Abbott, L. (2014). Theoretical neuroscience: Computational and mathematical modeling of neural systems. MIT Press.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1. James V Stone. (2018). Principles of Neural Information Theory. Sebtel Press.