City University of Hong Kong
Course Syllabus

offered by Department of Neuroscience
with effect from Semester A 2023/24

Part I Course Overview

Course Title:	Human and Artificial Intelligence
Course Code:	NS5007
Course Duration:	One semester
Credit Units:	3
Level:	P5
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

Bridging neuroscience and artificial intelligence (AI) can provide novel insights to drive both fields forward. This course aims at using a project based learning approach, to engage the students with both theoretical understanding as well as practical experience for cutting edge applications in neuroscience and AI. The projects focus on the following topics: (1) basic concepts and principles in AI, including machine learning and deep learning; (2) neuroscience-inspired artificial working memory; (3) biological vision and computer vision; (4) application of deep learning in neuroimaging; (5) AI applications in processing next generation sequencing data from genomic neuroscience; (6) applying AI in psychiatric disorders for diagnosis and personalized care; and (7) AI in processing brain waves and brain-machine interface. The course will include curated datasets for each topic and hands on practice, to highlight the power and limitations/pitfalls in adopting the AI technologies.

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.	To understand the basic principles of AI algorithms, including the basic theory and the inspiration from human brain and neuroscience.	25	x	x	
2.	To understand how AI can be applied to study questions in neuroscience as well as other fields, and the advantages and disadvantages.	25	x	x	
3.	To gain practical experience in solving real world questions, with AI-inspired algorithms, including model optimization and interpretation.	50	x	x	x
** 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	4			
Lectures	Theoretical concepts of the AI algorithms, and introduction to each selected topic and project	x	x	x				
Tutorials	Review papers and book chapters in written essays, and oral presentation in one selected topic.	x	x	x				
Practical labs	Investigate curated datasets for each project, learn the pros and cons of different algorithms, learn the practical ways to optimize the performance, and learn how to interpretate the AI models.	x	x	x				

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	4				
Continuous Assessment: 100%								
Oral presentation	x	x	x				30	
Written essays	x	x	x				20	
Final project	x	x	x				50	
Examination: ____% (duration: , if applicable)								
** 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. Oral presentation	(1) Can clearly present their ideas in English with well-structured slides. (2) Can answer to questions comfortably and actively raise questions in others' presentations.	Outstanding performance on all CILOs. Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.	Substantial performance on all CILOS. Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with literature.	Unsatisfactory performance on a number of CILOS. Failure to meet specified assessment requirements, little evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited or irrelevant use of literature.	Unsatisfactory performance on a number of CILOS. Failure to meet specified assessment requirements, little evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited or irrelevant use of literature.
2. Written essays	(1) Can summarize the essential concepts from the assigned reading materials, (2) Can make critiques on the pros and cons of the method in discussion.				
3. Final project	(1) Can select and apply the proper AI models to the data. (2) Can optimize the selected AI models, and interpret the model to address the biological question.				

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

1. Keyword Syllabus

Recurrent neural network (RNN)
Convolutional neural network (CNN)
Feature engineering
Model training and testing
Artificial working memory
Computer vision
Genomics and next generation sequencing
Disease diagnostics
Brain waves
Brain-machine interface

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.)

Nil

2.2 Additional Readings

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

1.	"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems"; 2nd edition; by Aurélien Géron; O'Reilly Media 2019
2.	"Data Mining: Practical Machine Learning Tools and Techniques"; 4th Edition; by Ian H. Witten, Eibe Frank, Mark A. Hall and Christopher Pal; Morgan Kaufmann 2016
3.	"Pattern Recognition and Machine Learning"; by Christopher M. Bishop; Springer 2006