NS5007: HUMAN AND ARTIFICIAL INTELLIGENCE

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Human and Artificial Intelligence

Subject Code
NS - Neuroscience
Course Number
5007

Academic Unit
Neuroscience (NS)

College/School
College of Biomedicine (BD)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

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 a 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 human intelligence and AI, (2) introduction to machine learning, (3) practical workflows in designing and optimizing machine learning projects, (4) practical demonstration of the state-of-art deep learning models (e.g., convolutional neural network) and correlate with the biological mechanism (e.g., vision and object recognition), and (5) application of AI techniques in neuroscience, including examples in neuroimaging, next-generation sequencing data, in applications of personalized medical cares of disorders such as psychiatric diseases. The course will include curated datasets for each topic and hands-on practice to highlight the power and limitations/pitfalls of adopting AI technologies.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-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

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 real-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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Theoretical concepts of the AI algorithms, and introduction to each selected topic and project	1, 2, 3	
2	Tutorials	Review papers and book chapters in written essays, and oral presentation in one selected topic.	1, 2, 3	

3	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 interpret the AI models.	1, 2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Attendance	1, 2, 3	10	
2	Midterm project	1, 2, 3	40	
3	Final project	1, 2, 3	50	

Continuous Assessment (%)

100

Assessment Rubrics (AR)

Assessment Task

Attendance (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

(1) Attend the lectures, tutorials and computational labs
(2) Participate the discussions

Excellent

(A+, A, A-) 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.

Good

(B+, B, B-) 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.

Fair

(C+, C, C-) Average performance on all CILOS. Some evidence of grasp of subject; some evidence of critical capacity and analytic ability; reasonable understanding of issues; some evidence of familiarity with literature.

Marginal

(D) 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.

Failure

(F) Unsatisfactory performance on all CILOS. Failure to meet specified assessment requirements in the assigned projects; no evidence of familiarity with the subject matter; weakness in critical and analytic skills; irrelevant use of literature.

Assessment Task

Midterm project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

(1) Can execute a machine learning project in solving a practical problem, demonstrating a clear understanding of the critical steps in the standard workflow.

Excellent

(A+, A, A-) 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.

Good

(B+, B, B-) 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.

Fair

(C+, C, C-) Average performance on all CILOS. Some evidence of grasp of subject ; some evidence of critical capacity and analytic ability; reasonable understanding of issues; some evidence of familiarity with literature.

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Failure

(F) Unsatisfactory performance on all CILOS. Failure to meet specified assessment requirements in the assigned projects; no evidence of familiarity with the subject matter; weakness in critical and analytic skills; irrelevant use of literature.

Assessment Task

Final project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

(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 .

Excellent

(A+, A, A-) 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.

Good

(B+, B, B-) 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.

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Assessment Task

Attendance (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

(1) Attend the lectures, tutorials and computational labs
(2) Participate the discussions

Excellent

(A+, A, A-) 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.

Good

(B+, B) 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.

Marginal

(B-, C+, C) 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.

Failure

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Assessment Task

Midterm project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

(1) Can execute a machine learning project in solving a practical problem, demonstrating a clear understanding of the critical steps in the standard workflow.

Excellent

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Assessment Task

Final project (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Part III Other Information

Keyword Syllabus

Human intelligence, Artificial intelligence, Machine learning, Supervised and unsupervised learning, Model training benchmarking, and optimization, Convolutional neural network (CNN), Recurrent neural network (RNN), Graph neural network (GNN), Transformer, Reinforcement learning (RL), Genomics and next - generation sequencing, Disease diagnostics

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	"Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow: Con cepts, 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