

NS5009: ETHICAL APPLICATION OF ARTIFICIAL INTELLIGENCE IN BIOLOGICAL SCIENCES AND HEALTHCARE

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Ethical Application of Artificial Intelligence in Biological Sciences and Healthcare

Subject Code

NS - Neuroscience

Course Number

5009

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

The implementation of deep learning techniques developed in the field of artificial intelligence (AI) is expected to bring revolutionary advancement in biological research and healthcare. This course uses a project-based learning approach to introduce the students to AI techniques, including fundamental concepts such as supervised and unsupervised learning, practical workflows such as model training and benchmarking, and state-of-the-art neural network architectures such as convolutional neural networks and transformer learning. The students will gain practical knowledge when learning to apply AI tools to real-world problems in the field of biology and healthcare, spanning topics including (1) mining the biological big data such as biological sequences, structures, and images, (2) AI-guided clinical decision-making processes such as triage and diagnosis, and (3) AI-guided drug screening. For each project, the course will provide simple explanations of the logic behind the analytic workflow and hands-on instructions to optimize and interpret the AI models. Ethical considerations and challenges when applying AI tools will also be discussed.

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, classification and assumptions.	25	x	x	
2	To understand a list of suitable problems in the biological sciences and healthcare that are suitable for AI applications: the advantages and caveats.	25	x	x	
3	To gain practical experience in solving real world questions, with AI-inspired algorithms, including model optimization and interpretation.	40	x	x	x
4	Evaluate ethical implications and challenges of AI applications in healthcare	10	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, 4

2	Tutorials	Review case studies of AI applications through paper discussions, or oral presentations in selected topics.	1, 2, 3, 4	
3	Practical labs and assignments	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.	1, 2, 3	
4	Group projects	Collaborative work on designing and implementing AI solutions for biological or healthcare problems	1, 2, 3, 4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Attendance	1, 2, 3, 4	10	-	No
2	Practical Assignments	1, 2, 3, 4	40	Four computational projects, selected for each of the four chosen topics	Yes
3	Final group project	1, 2, 3, 4	50	Collaborative projects involving data collection, analysis, report and presentation.	Yes

Continuous Assessment (%)

100

Assessment Rubrics (AR)**Assessment Task**

1. 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

2. Practical Assignments (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.

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Failure
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Assessment Task

3. 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.

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(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

1. 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.

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(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.

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Part III Other Information

Keyword Syllabus

Artificial intelligence
Machine learning
Supervised and unsupervised learning
Model training, benchmarking, and optimization
Neural Network
Genomics
Medical imaging
3D protein structure
Drug discovery
Disease diagnostics
Healthcare triage
AI ethics

Reading List**Compulsory Readings**

Title	
1	Nil

Additional Readings

Title	
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	Fundamentals of Machine Learning, Machine Learning for Healthcare: Handling and Managing Data by Rashmi Agrawal and Neha Sharma (2021)
3	Artificial Intelligence in Medical Imaging: Opportunities, Applications and Risks by Erik R. Ranschaert, Sergey Morozov, and Paul R. Algra (2019)