City University of Hong Kong
Course Syllabus

offered by Department of Biomedical Sciences
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Artificial Intelligence in Health Science Research and Management
Course Code:	BMS5010
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

This course seamlessly integrates health science and artificial intelligence (AI), offering a dynamic approach to propel both domains forward. Embracing project-based learning, the curriculum ensures students acquire both theoretical knowledge and hands-on experience in cutting-edge AI applications within health science research and management. Topics covered include (1) foundational AI concepts such as machine learning and deep learning, (2) computer vision models, (3) language models, (4) graph models, (5) AI for multi-omics data analysis, (6) drug discovery, and (7) disease diagnosis and prognosis. The emphasis is on cultivating an understanding of AI technologies, enabling biomedical students to apply AI tools effectively to address health science inquiries through curated datasets and practical exercises. This interdisciplinary course is designed to bridge the gap between health science and AI, empowering biomedical students with learned AI skills to contribute meaningfully to advancements in health science research and management.

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 health science and biomedical science.	30	✓	✓	
2.	To understand how AI can be applied to real world questions in health science, and the advantages and disadvantages.	30	✓	✓	✓
3.	To gain practical experience in solving real world questions in health science, with AI-inspired algorithms, including model evaluation and interpretation.	40	✓	✓	✓
		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 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.

3. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.			Hours/week (if applicable)
		1	2	3	
Lectures	Theoretical concepts of the AI algorithms, and introduction to each health science problem and its AI applications.	✓	✓		2 hours/week
Practical labs	Investigate curated datasets for each health science problem, learn the practical ways to optimize the performance, learn how to evaluate and interpret the AI models, compare the pros and cons of different AI algorithms. Practical guide for assignments and final group project.	✓	✓	✓	1 hours/week

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: 100 %					
Assignments	✓	✓	✓	25%	
Mid-term Examination	✓	✓	✓	25%	
Final group project presentation	✓	✓	✓	10%	
Final group project report	✓	✓	✓	40%	
Examination: 0 %					
				100%	

5. Assessment Rubrics

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

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
Assignments	Can run and demonstrate the analysis codes and results successfully in practical labs.	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.	Satisfactory performance on the majority of CILOS possibly with a few weaknesses. Being able to profit from the course experience; understanding of the subject; ability to develop solutions to simple problems in the material.	Barely satisfactory performance on a number of CILOS. Sufficient familiarity with the subject matter to enable the student to progress without repeating the course	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.
Mid-term Examination	Can analyse, state and apply the principles and subject matter learnt in the lectures.					
Final group project presentation	(1) Can clearly present project works in English with well-structured slides and good presentation skills. (2) Can answer to questions comfortably and actively raise questions in others' presentations.					
Final group project report	(1) Can select and state a health science problem, its datasets and current AI applications. (2) Can provide the runnable codes for the selected AI methods on selected datasets. (3) Can benchmark the selected AI methods, and present the benchmark results with interpretable					

	tables/figures. (4) Can make critical thinking on the pros and cons of the AI methods in discussion. (5) Can present the report with a clear, concise, and academic way.					

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
Assignments	Can run and demonstrate the analysis codes and results successfully in practical labs.	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.	Satisfactory performance on the majority of CILOS possibly with a few weaknesses. Being able to profit from the course experience; understanding of the subject; ability to develop solutions to simple problems in the material.	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.
Mid-term Examination	Can analyse, state and apply the principles and subject matter learnt in the lectures.				
Final group project presentation	(1) Can clearly present project works in English with well-structured slides and good presentation skills. (2) Can answer to questions comfortably and actively raise questions in others' presentations.				
Final group project report	(1) Can select and state a health science problem, its datasets and current AI applications. (2) Can provide the runnable				

	codes for the selected AI methods on selected datasets. (3) Can benchmark the selected AI methods, and present the benchmark results with interpretable tables/figures. (4) Can make critical thinking on the pros and cons of the AI methods in discussion. (5) Can present the report with a clear, concise, and academic way.				

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.)

Principles of Artificial Intelligence
Machine Learning
Deep Learning
Model Training, Testing, and Validation
Computer Vision
Convolutional neural networks
Graph neural networks
Language Models
Multi-Omics Data
Drug Discovery
Disease Diagnosis and Prognosis

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.	"Deep Learning for the Life Sciences"; by Bharath Ramsundar, Peter Eastman, Pat Walters, Vijay Pande; O'Reilly Media 2019
3.	"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
4.	"Pattern Recognition and Machine Learning"; by Christopher M. Bishop; Springer 2006