City University of Hong Kong
Course Syllabus

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

Part I Course Overview

Course Title:	AI in Medical Imaging
Course Code:	BME6139
Course Duration:	1 semester
Credit Units:	3 credits
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

AI in medical imaging is experiencing tremendous growth over the world. Biomedical imaging and its analysis are fundamental to understanding, visualizing, and quantifying medical images in clinical applications. With the help of automated and quantitative image analysis techniques, disease diagnosis will be easier/faster and more accurate and leading to significant development in medicine in general. The goal of this course is to help students develop skills in artificial intelligence and machine learning techniques applied to biomedical image analysis. This course will cover the history and the state-of-the-art of the development and deployment of AI in medical imaging. Specifically, the following topics will be covered:

- Basics of radiological image modalities and their clinical use
- Introduction to medical image computing and machine learning
- Medical image registration, segmentation, visualization
- Machine learning/deep learning in medical imaging
- Frontline of AI in medical imaging

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.	**Describe** the basic concepts of Radiological Image Modalities.			✓	
2.	**Describe** the basic concepts and goals of machine learning.			✓	
3.	**Explain** the fundamental mechanism, and applications of representative deep learning in medical imaging.			✓	
4.	**Interpret** the application of AI and deep learning in clinical imaging. **Discuss** the state-of-the-art AI in medical imaging system.		✓	✓	
5.	**Identify** the open challenges and **evaluate** the candidate solutions.		✓	✓	✓
6.	**Apply** the machine learning-level integration and candidate strategies to **propose** a novel clinical AI system to address problems derived from real-world challenges.		✓	✓	✓

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	4	5	6	
Lecture	Explain the concepts, working principles, designs, and analytical methods related with the robotic systems for minimally invasive healthcare, and discuss representative robotic systems.	✓	✓	✓	✓	✓	✓	3 hrs/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	4	5	6		
Continuous Assessment: 50%								
Problem-based learning	✓	✓	✓	✓			10%	
Proposal	✓	✓	✓	✓			10%	
Presentations/projects				✓	✓	✓	30%	Promote teamwork
Examination: 50%								
Examination	✓	✓	✓	✓	✓		50%	Duration: 2 hours
							100%	

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

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)
Problem-based learning	Ability to interpret the basic concepts and methodology of machine learning systems for minimally medical imaging.	High	Significant	Moderate	Basic	Below marginal level
Presentations/projects	Ability to apply the algorithm-level integration of different machine learning to propose novel AI systems to address problems derived from the real-world medical imaging challenges.	High	Significant	Moderate	Basic	Below marginal level
Examination	Ability to understand basic concepts, principles, design methods and analysis skills related with AI in medical imaging.	High	Significant	Moderate	Basic	Below marginal level

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)
Problem-based learning	Ability to interpret the basic concepts and methodology of machine learning systems for minimally medical imaging.	High	Significant	Basic	Below marginal level
Presentations/projects	Ability to apply the algorithm-level integration of different machine learning to propose novel AI systems to address problems derived from the real-world medical imaging challenges.	High	Significant	Basic	Below marginal level
Examination	Ability to understand basic concepts, principles, design methods and analysis skills related with AI in medical imaging.	High	Significant	Basic	Below marginal level

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.)

General keywords

- AI
- Machine learning
- Deep learning

Applications

- Segmentation
- Registration
- Computer aided diagnosis

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	Lia Morra, Silvia Delsanto, and Loredana Correale, Artificial Intelligence in Medical Imaging: From Theory to Clinical Practice. CRC Press, 2020
2	Insight into Images: Principles and Practice for Segmentation, Registration and Image Analysis, Terry S. Yoo (Editor) (FREE)

2.2 Additional Readings

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

1	Image Processing, Analysis, and Machine Vision. M. Sonka, V. Hlavac, R. Boyle. Nelson Engineering, 2014.
2	Visual Computing for Medicine: Theory, Algorithms, and Applications. B. Preim, C. Botha. Morgan Kaufmann, 2013.
3	Medical Image Registration. J. Hajnal, D. Hill, D. Hawkes (eds). CRC Press, 2001.
4	Pattern Recognition and Machine Learning. C. Bishop. Springer, 2007.