BME6139: AI IN MEDICAL IMAGING

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
AI in Medical Imaging

Subject Code
BME - Biomedical Engineering
Course Number
6139

Academic Unit
Biomedical Engineering (BME)

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
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

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic concepts of Radiological Image Modalities.			x	
2	Describe the basic concepts and goals of machine learning.			x	
3	Explain the fundamental mechanism, and applications of representative deep learning in medical imaging.			x	
4	Interpret the application of AI and deep learning in clinical imaging. Discuss the state-of-the-art AI in medical imaging system.		x	x	
5	Identify the open challenges and evaluate the candidate solutions.		x	x	x
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.		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	Lecture	Explain the concepts, working principles, designs, and analytical methods related with the robotic systems for minimally invasive healthcare, and discuss representative robotic systems.	1, 2, 3, 4, 5, 6	3 hrs/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Problem-based learning	1, 2, 3, 4	10	
2	Proposal	1, 2, 3, 4	10	
3	Presentations/projects	4, 5, 6	30	Promote teamwork

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

Problem-based learning (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Ability to interpret the basic concepts and methodology of machine learning systems for minimally medical imaging.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Assessment Task

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

Criterion

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.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Assessment Task

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

Criterion

Ability to understand basic concepts, principles, design methods and analysis skills related with AI in medical imaging.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Below marginal level

Assessment Task

Problem-based learning (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Ability to interpret the basic concepts and methodology of machine learning systems for minimally medical imaging.

Excellent

(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Below marginal level

Assessment Task
Presentations/projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
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.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

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Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Ability to understand basic concepts, principles, design methods and analysis skills related with AI in medical imaging.

Excellent
(A+, A, A-) High

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Part III Other Information

Keyword Syllabus

General keywords
- AI
- Machine learning
- Deep learning

Applications
- Segmentation
- Registration
- Computer aided diagnosis

Reading List

Compulsory Readings

	Title
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)

Additional Readings

	Title
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.