School of Engineering and Natural Sciences / Electrical and Electronics Engineering (English)

2024 - 2025 Academic Year

MEDICAL IMAGE ANALYSIS

Syllabus

Course Description					
Name	**Code**	**Semester**	**T+A Hour**	**Credit**	**ECTS**
MEDICAL IMAGE ANALYSIS	EEE4213125	Spring Semester	3+0	3	6

Prerequisites Courses	BİLGİSAYARLA GÖRMEYE GİRİŞ
Recommended Elective Courses	
Language of Instruction	English
Course Level	First Cycle (Bachelor's Degree)
Course Type	Elective
Course Coordinator	Assist.Prof. Cihan Bilge KAYASANDIK
Name of Lecturer(s)	Assist.Prof. Cihan Bilge KAYASANDIK
Assistant(s)	
Aim	The course aims to show how to identify the problems in medical sciences and how to approach them. We will introduce mathematical techniques to extract information from medical images. We will show how to analyze medical images according to different purposes and help diagnose diseases. Medical image analysis is a highly interdisciplinary field involving medicine, computer science, mathematics, biology, statistics, probability, psychology, and other fields. The course includes topics in medical image acquisitions: basics of Xray CT, Ultrasound, MRI and fMRI; image preprocessing: image denoising, image filtering, and basic filter design, image enhancement, feature extraction; image segmentation: local and adaptive thresholding, active contour and level set methods, edge detection, basic texture analysis; image registration, tracking; machine learning and deep learning for the feature extraction and segmentation purposes in medical images. This course will be application-oriented. Assignments will be based on a literature review, paper presentation, and computer implementations. □□□
Course Content	This course contains; Course Introduction ,Medical Data Acquisition, ,Introduction to Computer vision and signal processing ,Data Preprocessing ,Convolution and special filters , Image Segmentation with Conventional Methods ,Student Paper presentations ,Machine Learning basics ,Machine Learning methods on image analysis ,Validation methods for small data analysis ,Artificial neural networks/ Autoencoders I ,Artificial neural networks/ Autoencoders II ,Deep learning applications for medical data ,Deep learning applications for medical data II .

Course Learning Outcomes	**Teaching Methods**	**Assessment Methods**
1. Ability to identify problems and deficiencies in medical data analysis and create solution routes for existing problems	10, 14, 16, 18, 19, 2, 3, 9	A, D, F
2. Ability to identify and apply filters and filtering methods appropriate to the features to be extracted from an image. □□□□□□□	10, 14, 16, 18, 19, 2, 3, 9	A, D, F
3. Being able to use a mathematical perspective and put it into practice in order to obtain the necessary information in medical data analysis.	10, 14, 16, 18, 19, 2, 3, 9	A, D, F
4. Ability to use deep learning methods from machine learning and artificial neural networks in medical data analysis □□□□□□□	10, 14, 16, 18, 19, 2, 3, 9	A, D, F

Teaching Methods	10: Discussion Method, 14: Self Study Method, 16: Question - Answer Technique, 18: Micro Teaching Technique, 19: Brainstorming Technique, 2: Project Based Learning Model, 3: Problem Baded Learning Model, 9: Lecture Method
Assessment Methods	A: Traditional Written Exam, D: Oral Exam, F: Project Task

Lecture Schedule

Sequence	**Topics**	**Preliminary Preparation**
1	Course Introduction □□	Lecture slides, reading assigned papers
2	Medical Data Acquisition, □□□	Lecture slides, reading assigned papers
3	Introduction to Computer vision and signal processing □□□□□	Lecture slides, reading assigned papers
4	Data Preprocessing □□	Lecture slides, reading assigned papers
5	Convolution and special filters □□□	Lecture slides, reading assigned papers
6	Image Segmentation with Conventional Methods □□□□	Lecture slides, reading assigned papers
7	Student Paper presentations □□□	Lecture slides, reading assigned papers
8	Machine Learning basics □□	Lecture slides, reading assigned papers
9	Machine Learning methods on image analysis □□□□	Lecture slides, reading assigned papers
10	Validation methods for small data analysis □□□□	Lecture slides, reading assigned papers
11	Artificial neural networks/ Autoencoders I □□□□	Lecture slides, reading assigned papers
12	Artificial neural networks/ Autoencoders II □□□□	Lecture slides, reading assigned papers

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Sequence	**Topics**	**Preliminary Preparation**
13	Deep learning applications for medical data □□□□	Lecture slides, reading assigned papers
14	Deep learning applications for medical data II □□□□	Lecture slides, reading assigned papers

Evaluation Methods	Weight(%)
Midterm Exam	30
General Exam	70

Resources
1. Fundamentals of Medical Imaging, Suetens, P., Cambridge University Press, 2. Insight into Images: Principles and Practice for Segmentation, Registration and Image Analysis, Yoo, Terry S., CRC Pressö 3. Duda, R. O., & Hart, P. E. (2006). Pattern classification. John Wiley & Sons. □□□□