University of Gdańsk

Subject card

Subject name and code	Introduction to Digital Medical Image Processing, PG_00210201		
Field of study	Medical Physics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	Bachelor's studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish pl
Semester of study	3	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Krzysztof Dorywalski	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	45.0	0.0	0.0	45
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	45	0.0	30.0	75

Subject objectives	The course focuses on fundamental methods of acquisition, processing, and analysis of images generated in medical diagnostics. Students acquire skills in digital image enhancement, filtering, and automatic segmentation of anatomical structures.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_U05] Can program and use specialised software for calculations and data analysis, including in the field of imaging diagnostics, radiotherapy and biomedical signal analysis.	Is able to independently implement Python scripts for loading, filtering, morphological operations, and segmentation of medical images, as well as use specialized libraries to extract and analyze clinical metadata contained in diagnostic files.	[SU2] presentation/project/paper/ report [SU5] implementation of a problem task [SU6] demonstration of practical skills
[FIZMEDL3_W05] Knows and understands the most important computational and programming techniques used to solve physical and medical problems, present results, and analyse data.	Knows and understands key computational techniques used in digital medical image processing, including filtering algorithms, morphological operations, and segmentation, as well as principles of software-based presentation of graphical data and metadata for proper visualization and interpretation of results.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report [SW5] implementation of a problem task
[FIZMEDL3_U04] He can independently search for information in Polish and English professional and popular science literature, databases, and on the Internet, as well as from other sources. He can integrate and interpret this information, draw conclusions, and formulate opinions.	Is able to search Polish and English literature as well as technical databases for standards and documentation of specific medical imaging formats, and to integrate and interpret the contained metadata in order to correctly assess the physical parameters of diagnostic examinations.	[SU2] presentation/project/paper/ report [SU5] implementation of a problem task [SU6] demonstration of practical skills
[FIZMEDL3_W03] Knows and understands at an advanced level the most important topics of higher mathematics, including statistics, to the extent necessary for the quantitative description, understanding and modelling of physical and medical processes.	Knows and understands the mathematical and statistical foundations of point operations, filtering, and segmentation of digital images, including the application of transformation matrices, discrete convolution, and intensity distributions (histograms) for the quantitative description and modeling of medical structures.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report [SW5] implementation of a problem task
[FIZMEDL3_K01] He is ready for a critical evaluation of his own knowledge and the information he receives, and understands the need for further education and for improving professional and personal competencies.	Is prepared to critically evaluate the results of image processing and segmentation algorithms, being aware of technological limitations and the need for continuous monitoring of the development of medical software in order to ensure the highest diagnostic safety.	[SK2] presentation/project/paper/ report [SK5] implementation of a problem task [SK6] demonstration of practical skills

Subject contents

1. Fundamentals of digital image processing: loading and displaying images in a Python environment
2. Point operations and image enhancement
3. Image filtering
4. Morphological operations
5. Image segmentation
6. Analysis of medical image formats and metadata

Prerequisites and co-requisites

- Basics of programming in Python
- Basic knowledge of higher mathematics (matrices, vector operations, fundamentals of analysis)

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Mini-projects during classes	51.0%	20.0%
Knowledge test	51.0%	20.0%
Final project	51.0%	60.0%

Recommended reading	Basic literature	1. R. C. Gonzalez, R. E. Woods, *Digital Image Processing*, Pearson 2. R. C. Gonzalez, R. E. Woods, S. L. Eddins, *Digital Image Processing Using MATLAB, Python, and Gates*, Gatesmark Publishing 3. G. Dougherty, *Digital Image Processing for Medical Applications*, Cambridge University Press 4. K. M. Soomro et al., *Digital Image Processing using Python: A Practical Approach*, Springer
	Supplementary literature	1. Official documentation of the scikit-image and OpenCV-Python libraries (online resources) 2. Specification of the DICOM standard (PS3.3: DICOM PS3.3 202X – Information Object Definitions) – dicomstandard.org.
	eResources addresses	Supplementary https://github.com/KrzysztofDorywalski - Materials for students
Example issues/ example questions/ tasks being completed	**Final project:** Implementation of a simple processing pipeline for a selected medical image (e.g., vessel segmentation in an X-ray image or detection of lesions in CT scans).	
Work placement	Not applicable	

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