GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00066267		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Specialty 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
Semester of study	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Bartosz Reichel	
	Teachers	dr inż. Bartosz Reichel	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	45.0	0.0	0.0	60
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	60	5.0	35.0	100

Subject objectives

The aim of the course is to familiarize students with the methods, techniques and algorithms of computer vision.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U09] constructs mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution,constructs mathematical models used in specific advanced applications of mathematics, uses stochastic processes as a tool for modeling phenomena and analyzing their evolution, recognizes mathematical structures in physical theories	Can model a phenomenon using functions available in computer vision packages.	[SU1] Assessment of task fulfilment
[K7_U10] understands the mathematical foundations of the analysis of algorithms and computational processes, constructs algorithms with good numerical properties, used to solve typical and unusual mathematical problems	Can use the functionalities of the OpenCV package to create their own solutions.	[SU1] Assessment of task fulfilment
[K7_W07] describes well symbolic computation software package and statistical data processing package.	Can use machine learning packages.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W03] demonstrates knowledge advanced computation techniques, supporting the work of a mathematician and understand their limitations.	Can use the functionalities of the OpenCV package to create their own solutions.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents	Course content – lecture Image Creation and Filtering. Review of concepts in optics: lenses, cameras, and sensors. Light and color and their representation. Selected optical filters. Frequency domain analysis. Image binarization. Image feature detection and matching. Detection of edges, characteristic points, and corners. Local image features. Motion detection. Stereography. Image object recognition. Recognition of faces, instances, scenes, and categories in images. Recognition of two-dimensional and three-dimensional objects. Machine Learning. Introduction to Machine Learning. Neural Networks: Structure and Applications: Simple Perceptron, Activation Function, Learning Algorithms, Backpropagation Method, Momentum Technique. Methods for Automatic Content Categorization (Clustering) of Digital Images. Kmeans and Hierarchical Clustering Algorithms. Image Classification Methods: K-NN, CART Trees, Ensemble Methods. Classification Quality Assessment. Content-Based Image Search (CBIR). Course content – laboratory Lab (sample topics) Implementing a selected image filtering function and using it to create hybrid images. Introduction to the OpenCV library. Using the OpenCV library for image recognition. Implementing your own artificial neural network and using it for image recognition. Using libraries: TensorFlow, Keras, Scikit-learn, and others for image recognition and classification. Augmented Reality (AR)
Prerequisites and co-requisites	Knowledge of programming in any popular programming language
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Pytania (ustne)	50.0%	50.0%
Projekt	50.0%	50.0%

Recommended reading	Basic literature	A. Géron, Hands-On Machine Learning with Scikit-Learn and PyTorch: Concepts, Tools, and Techniques to Build Intelligent Systems 1st Edition
	Supplementary literature	Joseph Howse, Joe Minichino, Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, 3rd Edition 3rd ed. Edition
	eResources addresses	
Example issues/ example questions/ tasks being completed	What methods do you know for detecting edges in an image?	
Practical activites within the subject	Not applicable	

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