



Subject card

Subject name and code	, PG_00030018						
Field of study	Mathematics						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2024/2025		
Education level	second-cycle 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		
Semester of study	3	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Katedra Fizyki Teoretycznej i Informatyki Kwantowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Syty					
	Teachers	dr inż. Paweł Syty dr inż. Bartosz Reichel					
Lesson types and methods of instruction	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 Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=7985						
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	0.0	65		
Subject objectives	The aim of the course is to acquaint students with the principles of computer vision.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W12] Knows well at least one symbolic computation software package and one statistical data processing package.	The student is able to implement computer vision methods in Python environment.			[SW2] Assessment of knowledge contained in presentation		
	[K7_U11] Can construct mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution.	The student knows how to build machine learning models.			[SU4] Assessment of ability to use methods and tools		
	[K7_W08] Knows advanced computation techniques, supporting the work of a mathematician and understand their limitations.	The student knows how to use sophisticated machine learning python libraries.			[SW1] Assessment of factual knowledge		

Subject contents	<p>Lecture</p> <ol style="list-style-type: none"> Image formation and filtering. A reminder of optics - lenses, cameras, sensors. Light and colour and their representation. Selected optical filters. Analysis in the frequency domain. Binarisation of images. Image feature detection and matching. Detection of edges, characteristic points and corners. Local image features. Motion detection. Stereography. Recognition of objects in an image. Recognition of faces, instances, scenes, categories in images. Recognition of two-dimensional and three-dimensional objects. Machine learning. Introduction to machine learning. Neural networks - construction and applications: simple perceptron, activation function, learning algorithms, back propagation method, momentum technique. Methods for automatic content categorisation (clustering) of digital images. Algorithms of kmeans and hierarchical clustering. Image classification methods: k-NN algorithms, CART trees, ensemble methods. Classification quality assessment. Content-based image search (CBIR). <p>Laboratory</p> <ol style="list-style-type: none"> Implementation of a selected image filtering function and its use to create hybrid images. Introduction to the OpenCV library. Using the OpenCV library for image recognition. Implementation of a custom artificial neural network and its use for image recognition. Use of libraries: TensorFlow, Keras, Scikit-learn and others for image recognition and classification. 											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="456 696 794 723">Subject passing criteria</th> <th data-bbox="799 696 1137 723">Passing threshold</th> <th data-bbox="1142 696 1481 723">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 730 794 757">Laboratory problems solution</td> <td data-bbox="799 730 1137 757">50.0%</td> <td data-bbox="1142 730 1481 757">60.0%</td> </tr> <tr> <td data-bbox="456 763 794 790">Oral exam</td> <td data-bbox="799 763 1137 790">50.0%</td> <td data-bbox="1142 763 1481 790">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Laboratory problems solution	50.0%	60.0%	Oral exam	50.0%	40.0%
Subject passing criteria	Passing threshold	Percentage of the final grade										
Laboratory problems solution	50.0%	60.0%										
Oral exam	50.0%	40.0%										
Recommended reading	<table border="1"> <tbody> <tr> <td data-bbox="456 804 794 1106">Basic literature</td> <td colspan="2" data-bbox="799 804 1481 1106"> <p>A. Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow 2nd Ed.", O'Reilly, 2019.</p> <p>R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010</p> <p>D.A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002</p> </td> </tr> <tr> <td data-bbox="456 1113 794 1317">Supplementary literature</td> <td colspan="2" data-bbox="799 1113 1481 1317"> <p>R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004</p> <p>R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification (2nd Edition), Wiley-Interscience, 2000</p> </td> </tr> <tr> <td data-bbox="456 1323 794 1406">eResources addresses</td> <td colspan="2" data-bbox="799 1323 1481 1406"> <p>Adresy na platformie eNauczenie:</p> <p>Widzenie komputerowe (2024/2025) - Moodle ID: 41219 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=41219</p> </td> </tr> </tbody> </table>			Basic literature	<p>A. Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow 2nd Ed.", O'Reilly, 2019.</p> <p>R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010</p> <p>D.A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002</p>		Supplementary literature	<p>R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004</p> <p>R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification (2nd Edition), Wiley-Interscience, 2000</p>		eResources addresses	<p>Adresy na platformie eNauczenie:</p> <p>Widzenie komputerowe (2024/2025) - Moodle ID: 41219 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=41219</p>	
Basic literature	<p>A. Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow 2nd Ed.", O'Reilly, 2019.</p> <p>R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010</p> <p>D.A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002</p>											
Supplementary literature	<p>R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004</p> <p>R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification (2nd Edition), Wiley-Interscience, 2000</p>											
eResources addresses	<p>Adresy na platformie eNauczenie:</p> <p>Widzenie komputerowe (2024/2025) - Moodle ID: 41219 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=41219</p>											
Example issues/ example questions/ tasks being completed	<p>Automatic image categorizations based on clustering algorithms.</p> <p>Building CBIR system.</p>											
Work placement	Not applicable											

Document generated electronically. Does not require a seal or signature.