

。 GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optimization methods, PG_00021010								
Field of study	Technical Physics								
Date of commencement of studies	October 2022		Academic year of realisation of subject			2024/2025			
Education level	first-cycle studies		Subject group						
Mode of study	Full-time studies		Mode of delivery			at the university			
Year of study	3		Language of instruction			Polish			
Semester of study	6		ECTS credits			5.0			
Learning profile	general academic profile		Assessment form			assessment			
Conducting unit	Katedra Fizyki Teoretycznej i Informatyki Kwantowej -> Faculty of Applied Physics and Mathematic					atics			
Name and surname	Subject supervisor		dr Maciej Kuna						
of lecturer (lecturers)	Teachers		dr Maciej Kuna						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	t	Seminar	SUM	
	Number of study hours	30.0	0.0	30.0 0.0			0.0	60	
	E-learning hours included: 0.0								
Learning activity and number of study hours	Learning activity	Participation in classes includ plan	n didactic ed in study	Participation in consultation hours		Self-study		SUM	
	Number of study hours	60		0.0		0.0		60	
	The aim of the lecture is to present classical and machine learning inspired optimization methods to allow quick implementation them in the form of appropriate algorithms. There are discussed in the lecture modern optimizing algorithms with an emphasis on their inspiration in physics and biology.						ls to allow ure modern		
Learning outcomes Course		come	Subject outcome		Method of verification				
	K6_U08		The student has the ability to prepare an oral presentation, presenting modern optimization algorithms used in physics.			[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task			
	K6_W02		The student has ordered knowledge related to the use of optimization methods in the field of physics.			[SW3] Assessment of knowledge contained in written work and projects			
	K6_U07		The student is able to present the areas of application of optimization methods in physical sciences.			[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task			
Subject contents	Mathematical foundations of optimization. Numerical linear algebra. Vector norms, operations on vectors and matrices. Mathematical analysis. Conditions of existence of extremes of functions of one and many variables and methods of their checking. Methods of finding derivatives. Classic optimization methods. Algorithms for optimizing functions of one variable: dividing the interval into half, golden ratio, Fibonacci, Newton-Raphson and secant method. Algorithms for optimization of multivariable functions: cubic interpolation, Nelder-Mead, conjugate directions, Cauchy, Newton. Optimization issues in machine learning: Linear regression, simple gradient regression, polynomial regression, regularized linear models, logistic regression, linear and non-linear SVM regression, decision trees, team learning, including random forests, dimensionality reduction, deep neural network training.								
Prerequisites and co-requisites									
Assessment methods and criteria	Subject passing criteria		Passing threshold			Percentage of the final grade			
	Written exam		50.0%			20.0%			
	Positive completion of laboratories		50.0%		60.0%				
	Test		50.0%			20.0%			

Recommended reading	Basic literature	 A. Geron - Uczenie maszynowe z użyciem Scikit-Learn i TensorFlow, 2 wydanie Helion, 2020 Singiresu S.Rao Engineering Optymalization - Theory and Practie, Wiley 2009. Findestein. Metody obliczeniowe optymalizacji, PWN, 1977 R.Wieczorkowski, Z, Zieliński, Komputerowe generatory liczb losowych, WNT, 1997 X. Yang. Engineering Optimization - An Introduction With Metaheuristic Applications, Wiley, 2010 		
	Supplementary literature	 K.Kukuła, Badania Operacyjne w przykładach i zadaniach, PWN 2011 M. Wahde, Biologically Inspired Optimization Methods - An Introduction (WIT, 2008) S. Luke, Essentials of Metaheuristics, Lulu, second edition, available at http://cs.gmu.edu/sean/book/metaheuristics/ G. Rozenberg, Handbook of Natural Computing, Springer 2012 T.Weise Global Optimization Algorithms Theory and Application , http://www.it-weise.de/, 2013 		
	eResources addresses Adresy na platformie eNauczanie:			
Example issues/ example questions/ tasks being completed	Application of linear regression to data optimization. Regularization of linear models. Linear and nonlinear SVM regression. Learning deep neural networks.			
Work placement	Not applicable			

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