GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Machine Learning in Earth Research, PG_00064486		
Field of study	Informatics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Optional 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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Geoinformatics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Zbigniew Łubniewski	
	Teachers	dr hab. inż. Tomasz Berezowski dr hab. inż. Zbigniew Łubniewski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

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	30	4.0	16.0	50

Subject objectives

The aim of the course is to familiarize students with the tools that enable the correct acquisition and processing of data on the earth's surface, in particular with the use of machine learning. The course will mainly use data from satellite remote sensing and sonar. Students will learn examples of how to apply classification and regression with different levels of complexity and for different purposes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	Student is ready to critically evaluate the learned contents and to recognise the importance of knowledge in solving problems with respect to machine learning methods applied in Earth research.	[SK2] Assessment of progress of work [SK5] Assessment of ability to solve problems that arise in practice
[K7_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of advanced technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	Student is able to analyse critically possible machine learning solutions and to select the appropriate one from them for a given issue in Earth observation and research.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K7_U10] can individually plan and pursuit their own lifelong education and influence others in this aspect, also by means of advanced information and communication technologies (ICT), and communicate on specialist issues with diverse recipients, appropriately justify points of view, hold debates, present, assess and discuss different opinions and points of view, as well as use specialist terminology related to the field of study in communication	Student is prepared for continuous updating and extending his knowledge and skills in the area of machine learning methods applied in Earth research.	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents

Course content – lecture
Remote sensing methods in Earth research. Satellite imaging, sonar sounding

Examples of artificial intelligence and machine learning applications in Earth research. Image segmentation, image classification

AI and ML methods used in Earth research

Characteristics of remote sensing imagery data

Sources of satellite remote sensing data

Methodology of model development for classification and regresion of remote sensing data

Verification of remote sensing data models

Current best practices in machine learning for remote sensing

Sonar data characteristics. Stages and methods of sonar data pre-processing

Machine learning in marine ecosystems research

Prerequisites and co-requisites

Knowledge of the R or Python scripting language

Basic knowledge of machine learning methods

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture final test	50.0%	50.0%
Practical exerices - lab	50.0%	50.0%

Recommended reading	Basic literature	SCHOWENGERDT, R. A. Remote sensing: models and methods for image processing. 3rd ed. [s. l.]: Elsevier, 2011. ISBN 0123694078. JENSEN, J. R. Remote sensing of the environment: an earth resource perspective. 2nd ed. [s. l.]: Pearson Education, 2014. ISBN 9781292021706. R. Cresson, "A Framework for Remote Sensing Images Processing Using Deep Learning Techniques," in *IEEE Geoscience and Remote Sensing Letters*, vol. 16, no. 1, pp. 25-29, Jan. 2019, doi: 10.1109/LGRS.2018.2867949.
	Supplementary literature	Lei Ma, Yu Liu, Xueliang Zhang, Yuanxin Ye, Gaofel Yind, Brian Alan Johnson, Deep learning in remote sensing applications: A meta-analysis and review. ISPRS Journal of Photogrammetry and Remote Sensing, 152, 166-177, 2019
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Practical activites within the subject	Not applicable	

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