Introduction to Machine Learning with Python
- COURSE SYLLABUS

1.	**Course title:**	
	Introduction to Machine Learning with Python	
2.	**Lecturer:**	
	dr inż. Piotr Klejment	
3.	**Field, type and level of studies, year of study:**	
	all years of study, IT tools for scientists	
4.	**Course character:**	
	monographic lecture	
5.	**Teaching method:**	
	traditional or traditional + on-line	
6.	**Language:**	*English*
7.	**Course type and number of hours:**	
	Lecture, 24 h	
8.	**Estimated load of student's independent work:**	*36 h*
9.	**Total workload and number of ECTS points:**	*60 h, 2 ECTS*
10.	**Short description and main focus of the course:**	
	GENERAL DESCRIPTION *Machine learning offers great opportunities for data analysis and dependency search. In this branch of artificial intelligence, algorithms are trained to learn patterns from massive amounts of data in order to make decisions and predictions on new data sets. Today, examples of machine learning are all around us, and machine learning methods are also widely used in science and engineering problems. The same is happening in the Earth Sciences, from geophysics to oceanography. This course aims to develop practical skills in using machine learning algorithms, primarily working with Python packages.* *COURSE OUTLINE* *Python: basic syntax and Python packages - NumPy, Matplotlib, SciPy, Pandas, and Scikit-learn.* *Supervised learning: workflow for creating machine learning models, data preparation for the model - training, validation, and test data sets. Regression and classification problem: basic metrics, model selection - cross validation, underfitting and overfitting problem, working with various algorithms (Multiple Linear Regression, Decision Tree, Random*	

	Forest, Support Vector Machine, K-nearest, Naive Bayes and others...). Feature importance and SHAP values. *Unsupervised learning: clustering, cluster analysis, Minkowski's metric, K-means algorithm, hierarchical clustering algorithm, dimensionality reduction methods, association rules.* *Elements of Deep Lerning: TensorFlow and Keras, principles of artificial neural networks, example of image processing with Convolution Neural Network, predictions with Artificial Recurrent Neural Network, outline of Reinforcement Learning.* *Examples of machine learning applications in scientific articles in the field of geosciences. Preparing own small scientific article using machine learning.*	
11.	**References:**	
	books, on-line resources	
12.	**Prerequisites:**	
	The course is from scratch, but basic programming knowledge would be an asset.	
13.	**Educational outcomes:**	**PQF level 8 codes:**
	Knowledge: *Student knows and understands:* *(P8S_WG) the world's achievements relating to:* *theoretical foundations, general and selected specific issues of applying machine learning models to scientific problems at a level enabling the revision of existing paradigms;* *the main scientific developments in the academic or artistic disciplines essential to the study programme;* *the methodology of scientific research (with computer programming language Python)* *rules for dissemination of scientific results (from machine learning methods)*	*P8S_WG*
	Practical Skills: *Student is able to:* *(P8U_U) analyse and creatively synthesise scientific and creative achievements to identify and solve (machine learning) research problems as well as those related to innovative and creative activities;* *contribute new elements to these achievements;* *independently plan one's own development as well as inspire the development of others;* *participate in the exchange of experiences and ideas, also in the international community* *(P8S_UW) take advantage of programming skills to creatively identify, formulate and innovatively solve complex problems or perform research activities, especially:* *to define the aim and subject of the research, formulate a research hypothesis, develop research methods, techniques and tools and use them creatively to draw conclusions on the basis of research results;* *perform critical analysis and evaluation of the results of*	*P8U_U, P8S_UW*

	scientific research, expert activities and other works of a creative nature and their contribution to knowledge; *transfer the results of research studies to the other spheres*	
	Social Skills: *Student is ready to:* *(P8U_K) conduct independent research (application of machine learning models) which contributes to existing scientific and creative achievements;* *assume professional and public challenges taking into consideration: their ethical dimension, responsibility for their results and develop models of good practice in such situations* *(P8S_KK) critically evaluate the achievements in scientific programming and development of machine learning;* *critically evaluate one's contributions to the development of that field;* *recognize the value of knowledge in solving cognitive and practical problems*	*P8U_K, P8S_KK*
14.	**Evaluation of the educational outcomes:**	
	lecture activities + tests + project (homework assignment)	
15.	**Criteria to complete the course:**	
	achieving the appropriate threshold of points from all tests and activities + attendance	
16.	**Contact with the lecturer:**	
	email (pklejment@igf.edu.pl), possible personal consultations	