Course title:	AI-Driven Modeling of Environmental Processes
Course title in Polish:	Modelowanie procesów środowiskowych z wykorzystaniem sztucznej inteligencji
Course for discipline:	Environmental Engineering, Mining and Energy

Semester:	6	**Status of course:**	faculty	**Language:**	english
Academic year:		**Catalog number:**			

Coordinator of course:	Sylwia Szporak-Wasilewska, PhD Eng.
Lecturer od course:	Sylwia Szporak-Wasilewska, PhD Eng.; Mohammadreza Einikarimkandi, PhD
Executing unit:	Institute of Environmental Engineering, Department of Hydrology, Meteorology and Water Management
Ordering unit:	Doctoral School SGGW
Assumptions, goals and description of the course:	The course focuses on the applications of artificial intelligence, including machine learning methods and generative AI, in the analysis, modeling, and prediction of environmental processes. It covers both theoretical foundations and the practical implementation of AI tools for processing and integrating large-scale spatial datasets, including remote sensing, hydrological, and climatic data, as well as modeling environmental processes. Additionally, the course will address issues related to model interpretability, reliability, and the ethical challenges associated with the application of AI in environmental engineering and protection.
Didactic form, number of hours:	Computer lab exercises, 10 hours
Teaching methods:	Computational exercises, individual student project, consultations
Limit of people in the group:	15

Learning outcomes

KNOWLEDGE - the graduate knows and understands:	**SKILLS - the graduate is able to:**	**COMPETENCES - the graduate is ready to:**
To the extent enabling to revise the existing pradigms in the field/discipline - the world achievments, gathering theoretical background as well as general and selected detailed issues	Carry out critical assessment of the scientific research findings and expert activities and their contribution to the knowledge development in the field/discipline	Critically evaluate the achievments in the field/discipline represented
Major general development trends in the field/discipline		Recognise knowledge in solving cognitive and practical problems characteristic for the area of research (field/discipline) and in an interdisciplinary aspect
		Support the ethos of scientific circles and conduct independent research

The method of verification of learning outcomes:	Evaluation of partial projects completed as part of small-group computational exercises. Evaluation of the individual project.
Form of documentation of achieved learning outcomes:	Reports on completed computational exercises, including files. Report on the individual project, including files.
Elements and weights of the final grade:	Final grade: assessment of partial reports from small-group computational exercises (60% of the final grade), assessment of the individual project (40% of the final grade).
Place of the course:	Computer laboratory.

Basic and supplementary literature

Basic literature:
1. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An introduction to statistical learning with applications in R. Springer Nature.
2. Dormann, C. (2020). Environmental Data Analysis. An Introduction with Examples in R. Springer Nature.
3. Hastie, T. (2009). The elements of statistical learning: data mining, inference, and prediction. Springer Nature.
4. Cerulli, G. (2023). Fundamentals of Supervised Machine Learning: With Applications in Python, R, and Stata. Springer Nature.
Supplementary literature:
1. Li, Y., & Zhang, S. (2022). Applied Research Methods in Urban and Regional Planning. Springer Nature.
2. Lokers, R., Knapen, R., Janssen, S., van Randen, Y., & Jansen, J. (2016). Analysis of Big Data technologies for use in agro-environmental science. Environmental Modelling & Software, 84, 494-504.
3. McGovern A, Ebert-Uphoff I, Gagne DJ, Bostrom A. (2022). Why we need to focus on developing ethical, responsible, and trustworthy artificial intelligence approaches for environmental science. Environmental Data Science.
4. Konya, A.& Nematzadeh, P. (2024). Recent applications of AI to environmental disciplines: A review. Science of the Total Environment 906.

Comments:	

Estimated number of hours of work of the doctoral student necessary to achieve the assumed learning outcomes:	

Leraning outcomes reference to the second degree characteristics of the National Qualification Framework (level 8) covering doctoral competences:

Symbol:	**Learning outcomes:**	**8 level NQF**
SD1_KW01	To the extent enabling to revise the existing pradigms in the field/discipline - the world achievments, gathering theoretical background as well as general and selected detailed issues	P8S_WG
SD1_KW02	Major general development trends in the field/discipline	P8S_WG
SD1_KU05	Carry out critical assessment of the scientific research findings and expert activities and their contribution to the knowledge development in the field/discipline	P8S_UW
SD1_KK01	Critically evaluate the achievments in the field/discipline represented	P8S_KK

SD1_KK03	Recognise knowledge in solving cognitive and practical problems characteristic for the area of research (field/discipline) and in an interdisciplinary aspect	P8S_KK
SD1_KK08	Support the ethos of scientific circles and conduct independent research	P8S_KR