WSB ACADEMY				
Field of study: Computer Science				
Subject: Advanced artificial intelligence methods				
Educational profile: practical				
Level of education: second-cycle studies				
Number of hours per semester	1		2	
	I	II	III	IV
Full-time studies (lecture/exam/lab/prep/e)				
Part-time studies (lecture/exam/lab/prep/e)				
LANGUAGE OF SUBMISSION SUBJECT	Polish			
LECTURER	Rafaÿ Deja			
FORM OF CLASSES	Computer-based laboratory			
SUBJECT OBJECTIVES	Transfer of knowledge and acquisition of practical skills in creating modern solutions based on neural networks			

Reference to learning outcomes		**Description of learning outcomes**	**Method of verifying the learning outcome**
Directional effect	By-election		
KNOWLEDGE			
INF2_W01, INF2_W07 P7S_WG		The student knows and understands the principles of operation and training of deep neural networks (optimization, error functions, backpropagation, regularization) and their application to classification, regression and forecasting.	Grading based on independently completed tasks
INF2_W03, INF2_W07		The student knows the architectures and mechanisms of deep convolutional networks and understands the typical limitations and challenges of image recognition.	practical tasks + analysis of results (report/ notebook)
SKILLS			
INF2_U01 INF2_U06	P7U_U	The student is able to use available programming tools to design, implement and train deep learning models for regression, forecasting and image classification tasks, and then correctly select metrics and assess the model quality (validation/test).	Grading based on independently completed tasks
INF2_U02, INF2_U09		The student is able to plan and conduct a learning experiment, including comparing architecture/hyperparameter variants, interpreting results and drawing conclusions.	experiment report/ notebook + conclusions
INF2_U14		The student is able to prepare a short documentation/report of the exercises performed (description of data, model, parameters, results and conclusions)	report evaluation / notebook + reproducibility
SOCIAL COMPETENCES			
INF_K01	P7U_K	The student is ready to critically evaluate the results and limitations of deep learning models, understands the risks and pitfalls (e.g., overfitting, misinterpretation of metrics), and is able to consult conclusions with experts if necessary.	Grading based on independently completed tasks

Student workload (during teaching hours 1 hour = 45 minutes)**	
Stationary participation in lectures = participation in exercises = preparation for exercises = preparation for the lecture = preparation for the exam = implementation of project tasks = e-learning = pass/exam = other (specify what) = **TOGETHER:** **Number of ECTS points:** **including as part of practical classes:**	**Part-time** participation in lectures = participation in exercises = preparation for exercises = preparation for the lecture = preparation for the exam = implementation of project tasks = e-learning = pass/exam = other (specify what) = **TOGETHER:** **Number of ECTS points:** **including as part of practical classes:**

PREREQUISITES	• Basics of programming in Python (functions, classes, working with libraries), • Basics of linear algebra and differential calculus (derivatives, gradient), • Basics of machine learning (regression/ classification, data partitioning, metrics), ability to work in a notebook environment (Jupyter/Colab) and with a repository (e.g. Git) – welcome.
SUBJECT CONTENT (divided into face-to-face and e-learning classes)	Contents covered in a direct format: • Fundamentals of neural networks: perceptron and multilayer networks, network training, error function, stochastic gradient descent, backpropagation, over- and underfitting, validation and testing. • Tool for creating neural networks, tensors, graph calculations and automatic differentiation • Deep Convolutional Networks: Convolutions, Modern Activation Functions, Pooling, Regularization, Batch Normalization, and Dropout. • Limitations and Challenges in Image Recognition. Defining and Training Models. convolutional deep networks. Content provided in the form of e-learning • laboratory instructions, task requirements, supplementary • materials: presentation of theoretical foundations, sample implementation • consultation/assistance on Teams.
LITERATURE MANDATORY	Deep Learning: Contemporary Solutions for Machine Learning. Ian Goodfellow, Yoshua Bengio, Aaron Courville. PWN Scientific Publishers 2017.
LITERATURE SUPPLEMENTARY (including at least 2 items in English; book publications or articles)	Dive into Deep Learning. Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola https://d2l.ai [online], 2020
SCIENTIFIC PUBLICATIONS OF PERSONS TEACHING CLASSES RELATED TO THE TOPICS OF THE MODULE	Froelich W, Deja R. Selection a group of features based on machine learning algorithms to simplify psycho-technical examination. Procedia Computer Science. 2022 Jan 1;207:319-26. Deja R, Froelich W. Forecasting basal insulin for the clinical therapy of juvenile diabetes at onset. Procedia Computer Science. 2022 Jan 1;207:138-44. Deja R. Applying rough set theory to the system of type 1 diabetes prediction. In Internet–Technical Development and Applications 2009 (pp. 119-127). Berlin, Heidelberg: Springer Berlin Heidelberg.

TEACHING METHODS (divided into face-to-face and e-learning classes)	In direct form: • theoretical introduction to the task (45 min), • live-coding / demonstration of the solution using an example, • independent implementation of exercises with consultations, • analysis of results (metrics, learning graphs) and discussion of conclusions. In the form of e-learning: • instructional materials for laboratories, • sample notebooks.
LEARNING AIDS	
PROJECT **(if it is implemented as part of the course module)**	Project goal: Project topic: Form project:
FORM AND CONDITIONS ASSESSMENTS (divided into face-to-face and e-learning classes)	Assessment based on independently completed tasks

* *W-lecture, cl-exercises, lab-laboratory, pro-project, e-e-learning*