WSB University					
Field of study: Computer science					
Course: Advanced AI Methods					
Educational profile: *practical*					
Education level: II -cycle studies					
Number of hours per semester	1		2		
	I	II	III	IV	
Full -time studies (L/C/lab/pr/e)					
Part-time studies (L/C/lab/pr/e)					
CLASS LANGUAGE	English				
LECTURER	Rafał Deja				
FORM	Computer-based laboratory				
COURSE OBJECTIVES	To provide knowledge and develop practical skills in creating modern solutions based on neural networks.				

Reference to learning outcomes		**Description of learning outcomes**	**Verification of learning outcomes**
Field-related learning outcome	**PQF**		
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.	Graded pass 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 (report/notebook).
Skills			
INF2_U01 INF2_U06	P7U_U	Using available programming tools, the student can design, implement and train deep learning models for regression, forecasting and image classification tasks, and then correctly select metrics and evaluate model quality (validation/test).	Graded pass 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 can prepare brief documentation/a report from the completed exercises (description of data, model, parameters, results and conclusions).	report/notebook evaluation + reproducibility
Social competences			

INF_K01	P7U_K	The student is ready to critically assess results and limitations of deep learning models, understands risks and "pitfalls" (e.g., overfitting, incorrect interpretation of metrics), and can consult conclusions with experts when needed.	Graded pass based on independently completed tasks.

Students' own workload (in didactic hours 1h=45 minutes)**

Full- time	**Part-time**
Participation in lectures =	Participation in lectures =
Participation in classes =	Participation in classes =
Preparation to classes =	Preparation to classes =
Preparation to lectures =	Preparation to lectures =
Preparation to an examination =	Preparation to an examination =
Project tasks =	Project tasks =
e-learning =	e-learning =
Credit/examination =	Credit/examination =
others (indicate which) =	others (indicate which) =
TOTAL:	**TOTAL:**
ECTS points:	**ECTS points:**
Including practical classes:	**Including practical classes:**

PREREQUISITES	• Basic Python programming (functions, classes, working with libraries), • Basic linear algebra and calculus (derivatives, gradient), • Basic machine learning (regression/classification, data partitioning, metrics), • Ability to work in a notebook environment (Jupyter/Colab) and with a repository (e.g., Git) – preferred.
COURSE CONTENT (Division into contact hours and e-learning)	**Contact hours:** Neural Network Fundamentals: Perceptron and Multilayer Networks, Network Training, Error Function, Stochastic Gradient Descent, Backpropagation, Over- and Underfitting, Validation, and Testing. Neural Network Creation Tools, Tensors, Computational Graph, and Automatic Differentiation. Deep Convolutional Networks: Convolutions (Convolutions), Modern Activation Functions, Pooling, Regularization, Batch Normalization, and Dropout. Limitations and Challenges in Image Recognition. Defining and Teaching Deep Convolutional Network Models. **E-learning:** • Laboratory Instructions, Task Requirements, • Supplementary Materials: Presentation of Theoretical Foundations, Sample Implementation, • Consultation/Assistance on Teams.
LITERATURE (compulsory reading)	Dive into Deep Learning. Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola https://d2l.ai [online], 2020 Chollet, F. (2021) *Deep Learning with Python*. 2nd edn. Manning. ISBN 9781617296864.
OPTIONAL LITERATURE (including at least two items in English, either books or articles)	Goodfellow, I., Bengio, Y. and Courville, A. (2016) *Deep Learning*. Cambridge, MA: The MIT Press. ISBN 9780262035613.

SCHOLARLY PUBLICATIONS BY PERSONS WHO CONDUCT CLASSES, WHICH ARE RELATED TO THE MODULE SUBJECT	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 (Division into contact hours and e-learning)	**Contact hours:** • Theoretical introduction to the subject (45 min), • live-coding / demonstration of the solution using an example, • independent completion of exercises with consultations, • analysis of results (metrics, learning curves) and discussion of conclusions. **E-learning:** • instructional materials for laboratories, • exemplar notebooks.
TEACHING AIDS	
PROJECT (if implemented in the framework of a classes module)	Project goal: Topic of the project: Project form:
FORM AND CONDITIONS OF ASSESSMENT (Division into contact hours and e-learning)	Grade based on independently completed tasks and delivered report

** L-lecture, C- classes lab- laboratory, pro- project, e- e-learning*