GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Hardware Support of Artificial Intelligence Algorithms, PG_00064019		
Field of study	Electronics and Telecommunications		
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 Microelectronic Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Waldemar Jendernalik	
	Teachers	dr hab. inż. Waldemar Jendernalik	

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	3.0	17.0	50

Subject objectives

The student learns about the design of integrated circuits supporting artificial intelligence algorithms.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	The student knows the methods, techniques and problems related to the design of integrated circuits intended to support artificial intelligence algorithms.	[SW1] Assessment of factual knowledge
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student can correctly select software tools to implement design processes.	[SU4] Assessment of ability to use methods and tools
[K7_W04] knows and understands, to an increased extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or other elements or programmable devices specific to the field of study, and organization of work of systems using computers or such devices	The student has in-depth knowledge of professional computer tools for designing large-scale integrated circuits.	[SW1] Assessment of factual knowledge
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	The student uses knowledge from lectures and laboratories to solve practical problems in the design of large-scale-integrated systems.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents	Course content – lecture 1. Artificial Intelligence (AI) - basic terms and definitions. 2. Problems/limitations related to physical implementation. 3. Integrated circuits for supporting AI - a review of selected solutions. 4. Implementation of operators and functions (addition, multiplication, convolution, etc.) in integrated circuits. 5. Problems of performance, power consumption and area.
Prerequisites and co-requisites	No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Practical exercises	60.0%	100.0%

Recommended reading

Basic literature	1.
Supplementary literature	O. Dreessen. Introduction to Convolutional Neural Networks: What Is Machine Learning?Part 1. Analog Dialogue Magazine, vol. 57, Feb. 2023. https://www.analog.com/en/resources/analog-dialogue/articles/max78000-article-series-part-1.html O. Dreessen.Training Convolutional Neural Networks: What Is Machine Learning?Part 2. Analog Dialogue Magazine, vol. 57, Mar. 2023. https://www.analog.com/en/resources/analog-dialogue/articles/training-convolutional-neural-networks-what-is-machine-learning-part-2.html O. Dreessen. Hardware Conversion of Convolutional Neural Networks: What Is Machine Learning?Part 3. Analog Dialogue Magazine, vol. 57, Apr. 2023. https://www.analog.com/en/resources/analog-dialogue/articles/hardware-conversion-of-cnns-what-is-machine-learning-part-3.html Dudek, P.; Richardson, T.; Bose, L.; Carey, S.; Chen, J.; Greatwood, C.; Liu, Y.; Mayol-Cuevas, W. Sensor-level computer vision with pixel processor arrays for agile robots. Sci. Robot. 2022. DOI: 10.1126/scirobotics.abl7755. W. Shan et al. A 510nW 0.41V Low-Memory Low-Computation Keyword-Spotting Chip Using Serial FFT-Based MFCC and Binarized Depthwise Separable Convolutional Neural Network in 28nm CMOS. ISSCC 2022, USA. DOI: 10.1109/ISSCC19947.2020.9063000. K. Kim et al. A 23W Solar-Powered Keyword-Spotting ASIC with Ring-Oscillator-Based Time-Domain Feature Extraction. ISSCC 2022, USA. DOI: 10.1109/ISSCC42614.2022.9731708. M. Yang et al. Design of an always-on deep neural network-based 1 μW voice activity detector aided with a customized software model for analog feature extraction. IEEE JSSC, 2019. DOI: 10.1109/JSSC.2019.2894360. M. Lefebvre et al. A 0.2-to-3.6TOPS/W Programmable Convolutional Imager SoC with In-Sensor Current-Domain Ternary-Weighted MAC Operations for Feature Extraction and Region-of-Interest Detection. IEEE ISSCC 2021. DOI: 10.1109/ISSCC42613.2021.9365839.
eResources addresses	

Example issues/ example questions/ tasks being completed	
Practical activites within the subject	Not applicable

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