

Syllabus of the course "**Cognitive Computing**"

№	Name of the field	Content, comments
1.	Level of higher education	Second cycle (master`s degree)
2.	Subject area	122 Computer science
3.	Type and the title of the study programme	Academic professional programme Systems of Artificial Intelligence
4.	Type of the course	Compulsory
5.	Language of instruction	English
6.	Number of ECTS credits	3
7.	Structure of the course (distribution of the types and the hours of the study)	Lectures – 18 hours, seminars/practical classes – 12 hours, consultations – 6 hours, independent study – 54 hours
8.	Form of the final evaluation	Test
9.	Year of study/semester when the course is delivered	2 year/ 3 semester
10.	Course objectives	Provide knowledge and skills needed for building computerized cognitive models to simulate the human thought process in complex ambiguous situations and performing underlying big data (Web) mining and knowledge extraction.
11.	Learning outcomes	<ul style="list-style-type: none"> • identify the concepts, algorithms and data structures needed to describe the domain of development or research; to perform decomposition of a given problem in order to apply known methods and technologies for its solving; • choose the appropriate means for development or research (e.g., development environment, programming language, software, and software packages) that allow finding the correct and effective solution; • model the object of development or research in terms of functional components (subsystems) in such a way that facilitates and optimizes the work on the project • identify, evaluate and compare different technologies (methods, languages, algorithms, work schedules) in order to set priorities in accordance with different performance and quality criteria defined by the task. • detect, identify, classify hybrid threats and respond to them effectively in transsectoral collaboration; • apply intelligent security technologies to protect vulnerable methods of artificial intelligence, e.g., deep learning, from cyber threats.
12.	Course annotation (content)	Module 1. Main Concepts of the Cognitive Computing Domain: trends in IT; Big Data challenge; Computational Science; Computational Intelligence; Cognitive Science; Cognitive Computing; Machine Learning. Cognitive Computing for Cyber Security in Hybrid Warfares.

		<p>Module 2. Origin of the Deep Learning: before Deep Learning; gentle introduction to Neural Networks.</p> <p>Module 3. Fuzzy logic and Deep Learning: basics of fuzzy logic; fuzzy sets; membership function; linguistic variables; neuro-fuzzy networks; fuzzy logic controller.</p> <p>Module 4. Deep Learning advantages and problems: modeling deep architectures with TensorFlow and trying demos with ConvnetJS; deep vs. shallow neural net architectures; other than NN deep architectures; self-configurable NN architectures; limitations of Neural Networks and Deep Learning.</p> <p>Module 5. Deep Learning architectures and their training: Deep Neural Networks; Recurrent Neural Networks; Convolutional Neural Networks; Generative Adversarial Networks; Deep Reinforcement Learning.</p> <p>Module 6. Cognitive Computing Services online: Cognitive Computing Services from IBM Watson; Cognitive Computing Services from Microsoft. Cognitive Computing Services from Google. Other Service Providers.</p> <p>Module 7. Cognitive Computing and the Internet of Things: Industry 4.0; Cyber-Physical Systems; Self-Driving Cars; Smart spaces, homes and cities; Role of deep learning and cognitive computing.</p> <p>Module 8. Cognitive Computing and Cybersecurity: AI vulnerabilities. Hybrid threats exploiting the vulnerabilities of AI systems. Adversarial Machine Learning. Cognitive Hacking. Cognitive Security. Data poisoning attacks. Evasion attacks. AI protection (AI for cybersecurity vs. cybersecurity for AI). Immune system and vaccination for AI.</p>
13.	Students performance evaluation	<p>Accumulating grades for the course:</p> <ul style="list-style-type: none"> • Experimenting with cognitive services, demos, cloud and APIs (4 topics for practical work) – 80 points, • Design of own Cognitive Profile (1 topic for self-study) – 20 points. <p>Maximum – 100 points (60 and more – pass, 59 and less – fail)</p>
14.	Quality assurance of the educational process	<p>Academic integrity is fundamental for the educational process. The principles of academic integrity are described in the Regulations on fight against academic plagiarism in NURE and the Regulations on the organization of the educational process in NURE, p. 5.8.</p>

		<p>Evaluation of students performance is a tool to control the quality and to measure the achievement of the intended learning outcomes. Grades are based upon in-class (online) participation, learning activities, and assignments. The point values associated with each activity are delineated in the student evaluation section of this document. The criteria used in grading each assignment are discussed in class and are specified and provided in written form at the beginning of the course. Grades are assigned on the basis of accumulated points.</p> <p>At the end of the course, anonymous feedbacks regarding the usefulness of the proposed material and the complexity of the work are obtained from the students</p>
15.	Link to the course on Moodle	https://dl.nure.ua/
16.	Recommended or required reading and other learning resources/tools	<p>Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning, MIT Press, 787 pp. (http://www.deeplearningbook.org)</p> <p>Nielsen, M. (2017). Neural Networks and Deep Learning. (http://neuralnetworksanddeeplearning.com/)</p> <p>Manual to self-study IBM Watson services: http://computing.derby.ac.uk/bigdatares/?page_id=241</p> <p>Documentation on Google Cloud Platform: https://cloud.google.com/docs/ ;</p> <p>- Documentation on Microsoft Cognitive Services: https://www.microsoft.com/cognitive-services/en-us/documentation</p> <p>Glossary of hybrid threats https://warn-erasmus.eu/ua/glossary/</p>
17.	Specific equipment, hardware and software for the course	<p>The specialized educational AI laboratory is a component of the interfaculty NURE hub on countering hybrid threats, and also is a part of the trans sectoral academic environment countering hybrid threats.</p> <p>In 2021, AI Lab was equipped with powerful computer hardware totally for more than 420 thousand UAH, funded by a grant of the Erasmus+ project "Academic Response to Hybrid Threats – WARN" (610133-EPP-1-2019-1-FI-EPPKA2-CBHE-JP)</p>
18.	Department	<p>Department of Artificial Intelligence (AI), of. 245, 255-258 Tel. +38(057)7021337, http://ai.nure.ua, d_ai@nure.ua</p>
19.	Teacher(s) – syllabus designer(s)	<p>Prof. Vagan Terziyan, Dr. (Habil) Tech. vagan.terziyan@nure.ua</p>

