Syllabus
Course Program

Artificial intelligence systems

Specialty
121 – Software Engineering

Institute
Institute of Computer Science and Information Technology

Educational program
Software Engineering

Department
Software Engineering and Management Intelligent Technologies (321)

Level of education
Bachelor's level

Course type
Special (professional), Mandatory

Semester
8

Language of instruction
English, Ukrainian

Lecturers and course developers

Svitlana Yershova
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Senior Lecturer of Department of Software Engineering Management Intelligent technologies, National Technical University "Kharkiv Polytechnic Institute"
Prepared and published more than 20 publications.
Developed and taught more than 15 different training courses
Google Scholar: https://scholar.google.com.tw/;
ORCID: https://orcid.org/0000-0003-3893-117X
Scopus (Web of Science): https://ceur-ws.org/Vol-2753/paper25.pdf https://www.scopus.com/record/display.uri?eid=2-s2.0-85134395161&origin=resultslist&sort=plf-f&retries=1, https://ceur-ws.org/Vol-3403/paper37.pdf

More about the lecturer on the department's website

General information

Summary

The discipline program focuses on the consideration of basic concepts, principles of construction and development technologies, trends and prospects for the development of artificial intelligence systems, as well as major achievements in this area (expert systems, pattern recognition systems, etc.). The basic principles of construction and functioning of intelligent systems, methods and algorithms for solving typical intellectual problems are highlighted. The discipline pays attention to the ability to use pattern recognition systems to solve applied problems in various subject areas, the design of expert systems. The methods of metric classification, clear and fuzzy cluster analysis are considered. The acquisition of practical skills in the design and application of artificial intelligence systems is based on Python, Clips, MatLab. The knowledge and skills obtained in the process of studying the discipline "Artificial Intelligence Systems" are an integral part of the formation of professional competence and an important aspect of the professional training of students.

Course objectives and goals

The task of the discipline is to get acquainted with the range of tasks solved in artificial intelligence systems. Providing the future specialist with a clear understanding of models and methods and software for solving intelligent problems using artificial intelligence systems. Mastering theoretical and practical issues of creating and applying artificial intelligence systems.

Format of classes

The discipline "Artificial Intelligence Systems" is an academic discipline from the cycle of special (professional) training in specialty 121 "Software Engineering". Lectures, laboratory works, independent work, consultations. Final
Final control – standings.

Competencies

К01. Ability to think abstractly, analyze and synthesize.
К05. Ability to learn and master modern knowledge.
К06. Ability to search, process and analyze information from various sources.
К08. Ability to act on the basis of ethical considerations.
К19. Knowledge of data information models, ability to create software for storing, extracting and processing data.
К20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems.
К26. Ability to think algorithmically and logically.

Learning outcomes

PLO01. Analyze, purposefully search and select information and reference resources and knowledge necessary for solving professional problems, taking into account modern achievements of science and technology.
PLO02. To know the code of professional ethics, to understand the social significance and cultural aspects of software engineering and to adhere to them in professional activities.
PLO08. Be able to develop a human-machine interface.
PLO11. Select input data for design, guided by formal methods of requirements description and modeling.
PLO13. Know and apply methods of developing algorithms, designing software and data structures and knowledge.
PLO18. To know and be able to apply information technologies for data processing, storage and transmission.

Student workload

The total volume of the course is 90 hours (3 ECTS credits): lectures – 20 hours, laboratory classes – 20 hours, independent work– 50 hours.

Course prerequisites

The course "Artificial Intelligence Systems" is based on the disciplines "Computer Mathematics", "Probability Theory and Mathematical Statistics", "Fundamentals of Programming"

Features of the course, teaching and learning methods, and technologies

Teaching and learning methods:
interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback, problem-based learning.

Forms of assessment:
written individual assignments for laboratory work (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS).

Program of the course

Topics of the lectures

Topic 1. "Basic concepts about artificial intelligence systems. "
The history of the development of artificial intelligence. The main directions of research in the field of artificial intelligence. Problems. Prospects. The concept and properties of intelligent systems. Intelligent system architecture Expert systems. Architecture of expert systems. Components of expert systems. Knowledge base. The structure of knowledge in the knowledge base. Logical inference machine. Tools for the development of expert systems. Composition and interaction of participants in the creation and operation of expert systems. Mechanisms for training expert systems based on well-known precedents. Agent-based approach to intelligent systems.
Topic 2. Pattern recognition.
The problem of pattern recognition. Basic concepts of pattern recognition theory. The problem of selection and criteria for evaluating the informativeness of features on the basis of heuristic, informational, statistical and probabilistic approaches. Learning with a teacher. Methods of metric classification.
Topic 3. Clear cluster analysis.
Clear cluster analysis. Data mining technologies. Learning without a teacher.
Topic 4. Neuro-fuzzy systems.
Basic concepts of fuzzy logic. Fuzzy cluster analysis. Neuro-fuzzy networks. Development of neuro-fuzzy network. A new class of fuzzy neural networks – cascading neo-fuzzies – neural networks, their architecture, properties, learning algorithms.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Topic 1.
Development of diagnostic expert system
Topic 2.
Pattern recognition based on metric classification.
Topic 3.
Cluster analysis.
Topic 4.
Development of neuro-fuzzy network.

Self-study

Students are recommended additional materials (videos, articles) for self-study and processing.

Course materials and recommended reading

Key literature

1. Булгакова О. С. Методи та системи штучного інтелекту: теорія та практика: навч. посібник / О. С. Булгакова, В. В. Зосімов, В. О. Поздєєв, – Херсон: «ОЛДІ-ПЛЮС», 2020, 356 с.
2. Методи та системи штучного інтелекту: навч. посіб. / укл. Д.В. Лубко, С.В. Шаров, - Мелітополь: ФОП Однорог Т.В., 2019, 264 с.
3. Системи штучного інтелекту. Навчальний посібник / Н. Б. Шаховська, Р. М. Камінський, О. Б. Вовк, -Львів: Видавництво Львівської політехніки, 2018, 392 с.
4. Artasaches A., Joshi P. Artificial Intelligence with Python (Second Edition)/A. Artasaches, P. Joshi, – Packt Publishing, 2020, 448 p.
5. Rothma D. Artificial Intelligence By Example: Acquire advanced AI, machine learning, and deep learning design skills (Second Edition) / D. Rothma, - Packt Publishing, 2020, 578p.

Additional literature

1. Берри Пол Head First Python. Легкий для сприйняття довідник/ Пол Берри, - Видавництво Фабула, 2021, 624 с
2. Auffarth B. Artificial Intelligence with Python Cookbook/ B. Auffarth, - Packt Publishing, 2020, 468p.
3. Burgess Matthew Artificial Intelligence: How Machine Learning Will Shape the Next Decade/ Matthew Burgess, - Random House Business, 2021 год, 208 p.
4. Hogan R, A Practical Guide to Database Design/ R. Hogan, – CRC Press, 2018, 414p.
5. Kassambara Alboukadel Practical Guide To Cluster Analysis in R. Unsupervised Machine Learning (First ed.) / Alboukadel Kassambara, - STHDA, 2017. - 187p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of the results of the assessment in the form of an exam (40%) and current assessment (60%):
- 4 laboratory works (5% each);
- 2 tests (10% each);
- independent work (30%).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	11.04.2023	Head of the department Ihor HAMAIUN
	08.06.2023	Guarantor of the educational program Uliya LITVINOVA