Syllabus
Course Program

Data collection and preparation

Specialty
121 – Software Engineering
122 – Computer Science

Institute
Institute of Computer Science and Information Technology

Educational program
Software Engineering
Computer Science and Intelligent Systems

Department
Software Engineering and Management Intelligent Technologies (321)

Level of education
Bachelor's level

Course type
Special (professional), Elective

Semester
3

Language of instruction
English, Ukrainian

Lecturers and course developers

Oleh Hutsa

Oleh.Hutsa@khpi.edu.ua
Doctor of Philosophy (Ph.D.), Associate Professor, Associate Professor of Software Engineering and Management Intelligent Technologies Department

Google Scholar: https://scholar.google.com.ua/citations?user=Zhn_myMAAAAJ&hl=uk
ORCID: https://orcid.org/my-orcid?orcid=0000-0002-0194-0315
Scopus: https://www.scopus.com/authid/detail.uri?authorId=57196298121
More about the lecturer on the department's website

General information

Summary

The objective of the discipline is to acquire the knowledge and skills necessary for the collecting and preparing data in the IT sphere, including in the form of: Semantic network model, Production model, Frame model, Logical model, a model of knowledge in Verbal methods, Process model, data for Fuzzy systems and knowledge models in Neural networks.

Course objectives and goals

Developing students' theoretical and practical knowledge necessary for the collecting and preparing data in the IT sphere in solving problems related to the development, maintenance, and quality assurance of software.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control in the form of a credit.

Competencies

121 – Software Engineering:
К01. Ability to think abstractly, analyze and synthesize.

К02. Ability to apply knowledge in practical situations.
К05. Ability to learn and master modern knowledge.
К06. Ability to search, process and analyze information from various sources.
К19. Knowledge of data information models, ability to create software for storing, extracting and processing data.
К22. Ability to accumulate, process and systematize professional knowledge of software development and maintenance and recognize the importance of lifelong learning.
К26. Ability to think algorithmically and logically.

122 – Computer Science:
GC1. Ability to think abstractly, analyze and synthesize.
GC2. Ability to apply knowledge in practical situations.
GC6. Ability to learn and master modern knowledge.
GC7. Ability to search, process and analyze information from various sources.
PC1. Ability to mathematically formulate and study continuous and discrete mathematical models, justify the choice of methods and approaches for solving theoretical and applied problems in the field of computer science, analysis and interpretation.
PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic computing, design, develop and analyze algorithms, evaluate their effectiveness and complexity, solvability and intractability of algorithmic problems for adequate modeling of subject areas and creation of software and information systems.
PC15. Ability to analyze and functional modeling of business processes, construction and practical application of functional models of organizational, economic, production and technical systems, methods of risk assessment of their design.

Learning outcomes

121 – Software Engineering:
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.
PLO10. Conduct a pre-project survey of the subject area, system analysis of the design object.
PLO18. To know and be able to apply information technologies for data processing, storage and transmission.

122 – Computer Science:
PLO1. To apply knowledge of the basic forms and laws of abstract and logical thinking, the basics of the methodology of scientific knowledge, forms and methods of extracting, analyzing, processing and synthesizing information in the subject area of computer science.
PLO2. To use the modern mathematical apparatus of continuous and discrete analysis, linear algebra, analytical geometry in professional activities to solve theoretical and applied problems in the design and implementation of information objects.

Student workload

The total volume of the course is 120 hours (4 ECTS credits): lectures - 32 hours, laboratory classes - 32 hours, self-study - 56 hours.

Course prerequisites

121 – Software Engineering:
The study of this discipline is directly based on: "Fundamentals of Programming", "Computer Architecture and Operating Systems", "Theory of algorithms", "Introductory practice at the "Innovation Campus".

122 – Computer Science:
The study of this discipline is directly based on: "Algorithmization and programming", "Operating systems", "Algorithms and data structures", "Introductory practice at the "Innovation Campus".

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

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

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

Program of the course

Topics of the lectures

Topic 1. Introduction
Basic concepts. Information. Data. Subject area. Knowledge. Classification of knowledge. Basics of knowledge engineering. Declarative knowledge. Procedural knowledge. Data acquisition strategies. Data-bases and Knowledge-bases. Knowledge representation models.
Topic 2. Production model
Produce. Facts and rules. Inference machine. Chain of inference. Systems with reverse conclusions. Advantages and disadvantages.
Topic 3. Semantic network model
Semantic network. The main types of relations in Semantic networks. Types of Semantic networks. Relationships in Semantic networks. Classification of Semantic networks. Basic properties of Semantic networks.
Topic 4. Frame model
Frame. Frame structure. Slot. A network of frames. Methods of obtaining slot values. Demand. Types of frames. Procedure IF-ADDED. Procedure IF-REMOVED. Procedure IF-NEEDED. Inheritance of properties. Static and dynamic frame systems. Representation of frames in databases. Relationship.
Topic 5. Logical model
Calculation of statements. Predicates of the first order. Atomic predicate. Quanter. Logical conclusion. Direct chain of reasoning. Reverse chain of reasoning. Advantages and disadvantages.
Topic 6. Verbal model
Decision making process. Features of the human information processing system. Memory model. Alternatives: independent; dependent; group dependence; availability of alternatives at the time of decision-making; number of alternatives. Criteria: quantitative; qualitative; criteria scales; independent; dependent; number. Edgeworth-Pareto set.
Topic 7. Process models
Process model. Defining the Goal and Viewpoint. Selection of Process display type. Information collecting and interviewing. The "top-down" principle. The method of "black boxes". Functional decomposition method. Hierarchy method. BPMN. Basic graphic elements of Business Process diagrams.
Topic 8. Fuzzy systems
Fuzzy set theory. Function and degree of belonging. Operations on fuzzy sets. Fuzzy logic. Fuzzy variable. Linguistic variable. Algorithm of logical conclusion. Advantages and disadvantages.
Topic 9. Model of knowledge in Neural networks
Neural networks. The structure of a biological neuron. The structure of an artificial neuron. Activation functions. Incompletely connected neural networks. Formulation of a problem suitable for solving with the help of a neural network. Selection of an artificial neural system (ANS) model. Preparation of initial data for ANS training. ANS education. Solution of the problem. Interpretation of the decision obtained by the neural network.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Topic 1: Development of a Production model in the chosen subject area
Topic 2. Development of a Semantic network in the selected subject area
Topic 3. Development of a Frame model in the chosen subject area
Topic 4. Development of a Decision tree in the selected subject area
Topic 5. Development of a Verbal model in the chosen subject area
Topic 6. Development of a Process model in the selected subject area
Topic 7. Formation of membership functions in Fuzzy Logic Toolbox software
Topic 8. Approximation of functions by a Neural network

Self-study

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

Course materials and recommended reading

Key literature

1. MDATA: A New Knowledge Representation Model: Theory, Methods and Applications (Lecture Notes in Computer Science), 1st ed. by Yan Jia, Zhaoquan Gu, Aiping Li, Springer, 2021, 268 p.
2. Hutsa O.M., Ovsiuchenko Y.V., Business Process Modeling: monography, KhNURE, 2019, 108 p.
3. Michael K. Bergman, A Knowledge Representation Practionary, Springer, 2018, 479 p.
4. Lytvyn V.V., Pasichnyk V.V, Nikolskyi Y.V., Data and knowledge analysis: tutorial, Mahnoliia 2006, 2017, 276 p.
5. Kolpakov V. M., Theory and practice of managerial decision-making: tutorial, IAPM, 2017, 504 p.

Additional literature

1. Prediction and Analysis for Knowledge Representation and Machine Learning, ed. by Avadhesh Kumar, Shrddha Sagar, T Ganesh Kumar, K Sampath Kumar, Chapman and Hall/CRC, 2022, 232 p.
2. Foundations of Information and Knowledge Systems, ed. by Andreas Herzig, Juha Kontinen, Springer, 2020, 356 p.
3. Danchenko O.B., Practical aspects of business process reengineering: tutorial., University of Economics and Law «KROK», 2017, 238 p.
4. Understanding Meaning and Knowledge Representation, ed. by Eva M. Mestre-Mestre Carlos Periñán-Pascual, Cambridge Scholars Publishing, 2016, 395 p.
5. E. Mendes, Practitioner's Knowledge Representation, Springer, 2014, 222 p.

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 a credit (40%) and current assessment (60%):
- 8 laboratory works (5% each);
- 2 control works (10% each).

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	08.06.2023	Head of the department Ihor HAMAIUN
	08.06.2023	Guarantors of the educational programs Andrii KOPP Uliya LITVINOVA