COURSE DESCRIPTION CARD - SYLLABUS

Course name
Expert systems and artificial intelligence [N2IBiJ1>SEiSI]

Course

Field of study
Safety and Quality Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
10

Laboratory classes
0

Other
0

Tutorials
10

Projects/seminars
0

Number of credit points
2,00

Coordinators

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Lecturers

Prerequisites

Student has knowledge of the basics of management and information technology carried out at first cycle studies. In addition, he should also be able to use the acquired knowledge in practice and is ready to work within team structures.

Course objective

To interest the students of Safety Engineering course of the future problems of using Expert Systems as well as Artificial Intelligence methods and techniques in solving both technological and decision-making problems in this knowledge discipline.

Course-related learning outcomes

Knowledge:
1. Student knows the methods, techniques, tools and materials used in solving simple engineering tasks and conducting experiments in the field of security with the use of information technologies, information protection, computer support, artificial intelligence and cyber security [K2_W11].
2. Student knows the concept of man and the world of values, the basic ethical categories, the role of man in ensuring the reliability of systems man-technical object, man-structure and crisis management

[K2_W12].

Skills:
1. Student is able to properly select sources and information derived from them, evaluate, critically analyze and synthesize this information, formulate conclusions and exhaustively justify an opinion on the structures and scopes of security engineering [K2_U01].
2. Student is able to perceive and formulate system and non-technical aspects as well as socio-technical, organizational and economic aspects in engineering tasks [K2_U03].
3. Student is able to use research, analytical, simulation and experimental methods to formulate and solve engineering tasks, also using information and communication methods and tools [K2_U04].

Social competences:
1. Student is aware of the cause-and-effect relationships in the implementation of the set goals and the ranking of the importance of alternative or competitive tasks in the field of crisis safety and occupational safety management [K2_K01].
2. Student is aware of the recognition of the importance of knowledge in solving problems in the field of security engineering and continuous improvement [K2_K02].

Methods for verifying learning outcomes and assessment criteria
Learning outcomes presented above are verified as follows:

Formative assessment:
The knowledge acquired during the lecture is verified by carrying out a final written test consisting of a set of 10 questions. Passing threshold: 51% of correct answers (sufficient grade - 3.0).
The knowledge acquired during the exercises is verified on the basis of solving individual tasks included in the curriculum. For each task, the student receives points. Passing threshold: 51% of points (sufficient grade - 3.0).
Summative assessment:
Lecture: grade point average. Passing threshold 51%.
Classes: average of partial grades. Passing threshold 51%.
Grading scale in accordance with part C of the Regulations of First and Second Degree Studies adopted by the Academic Senate of the Poznań University of Technology.

Programme content
Lecture: Against the background of definitions of concepts such as broadly understood intelligence and data, information, knowledge and wisdom, the definitions of the Expert System and Artificial Intelligence are derived (for example, Security Engineering). In a similar context, issues of knowledge acquisition, methods of its representation in intelligent systems, creation and reconstruction of professional knowledge bases as well as expert strategy and intelligent problem solving are further developed. This part of the lecture is of a methodological nature and deals with, among others, heuristics and strategies of graph searching as well as classical and fuzzy inference methods. Expert Systems are presented in variants of solutions based on fuzzy logic systems. Among the solutions of Artificial Intelligence classified as based on Computational Intelligence, Artificial Neural Networks (in variants: Self Organizing Maps and Learning Vector Quantization) and Evolutionary Algorithms (in variants: Genetic Algorithms, Evolutionary Strategies, Evolutionary Programming) are presented. The so called hybrid systems and elements of chaos theory. The applications of artificial intelligence to support management information systems (including solutions such as the Business Intelligence System in security management) and the economy based on intelligent digital technologies (with issues of business security as the object of cyber attacks) constitute together with the issue of the so-called "intelligent dilemma of the sixth cycle conjunctural "the final part of the lecture.
Tutorials: This type of classes is implemented in a joint form with the tutor of student analysis exercises, team practical studies for the issues: a), b), c) and d) and jointly with the tutor of the analysis of an example problem prepared by him e). The list of exercises include: a) selected methods of symbolic knowledge representation in the field of security engineering for the purposes of creating and rebuilding professional knowledge bases, b) methods of building and searching knowledge graphs in the field of security engineering, c) operation on triangular and trapezoidal forms of membership functions for the purpose of inference in a fuzzy expert system of a selected issue of security engineering, d) preparation of training programs in the field of business security engineering in cyber threat conditions, e) generating in MATLAB an Artificial Neural Network with multilayer feedback and one hidden layer with

15 input nodes and one node in output layer (as a network learning algorithm - Levenberg Marquardt gradient back propagation, as a transfer function in both the input and output layers - hyperbolic tangent; the number of neurons in a hidden wa layer determined by trial and error, changing the number of neurons from the set: {7, 10, 13, 16, 19, 22, 25, 27, 29, 31}).

Course topics

Teaching methods

Information lecture in the form of a multimedia presentation, with elements of a conversational lecture.The lecture is conducted using distance learning techniques in a synchronous mode. Acceptable platforms: eMeeting, Zoom, Microsoft Teams.
Tutorials: auditorium exercises, task solving and case study.

Bibliography

Basic:
1. Pacholski L. (2011), Systemy ekspertowe i sztuczna inteligencja, Wydawnictwo Politechniki Poznańskiej, Poznań.
2. Zieliński J.S. (red.) (2000), Inteligentne systemy w zarządzaniu, PWN, Warszawa.
3. Mulawka J.J. (1996), Systemy ekspertowe, WNT, Warszawa.
4. Rutkowska D., Piliński M., Rutkowski L. (1997), Sieci neuronowe, algorytmy genetyczne i systemy rozmyte, PWN, Warszawa.
5. Cytowski J. (1996), Algorytmy genetyczne. Podstawy i zastosowania, Akademicka Oficyna Wydawnicza, Warszawa.

Additional:
1. Medsker L.M. (1994), Hybryd Neural Networks and Expert Systems, Kluwer Academic Publisher, Boston.
2. Żurada J.M., Barski M., Jędruch W. (1996), Sztuczne sieci neuronowe, PWN, Warszawa.
3. Budrewicz J. (1993), Fraktale i chaos, WNT, Warszawa.
4. Pacholski L., 2022, Managerial Recommendations Concerning the Cybersecurity of Information and Knowledge Resources in Production Enterprises Implementing the Industry 4.0 Concept, Management and Production Engineering Review, vol. 13, nr 3, pp. 30-38

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	20	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50