COURSE DESCRIPTION CARD - SYLLABUS

Course name
Introduction to probability [S1SI1E>PROB]

Course

Field of study
Artificial Intelligence

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

dr hab. inż. Wojciech Kotłowski prof. PP
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Prerequisites

A student beginning this course should have a basic knowledge of calculus, discrete mathematics, linear algebra and logic. In addition, in terms of social competences, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

The objective of the course is to provide students with basic knowledge of the axiomatic definition of probability, random events, random variables and limit theorems, as well as to develop students' skills in calculating probability, basic parameters of distributions of random variables including marginal and conditional distributions, understanding and applying limit theorems.

Course-related learning outcomes

Knowledge
1. Has an extended, in-depth knowledge of probability, which is inspensible for many fields of computer science and artificial intelligence, in particular machine learning, operation research, statistical data analysis, decision theory.

Skills
1. Can formulate and solve complex problems within the scope of computer science and, in particular, artificial intelligence by applying appropriately selected methods (including analytical, simulation, or experimental approaches)

Social competences
1. Is aware of the importance of scientific knowledge and research related to computer science and AI in solving practical problems which are essential for the functioning of individuals, firms, organizations, as well as the entire society

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
(a) lectures: on the basis of answers to questions on the material discussed in previous lectures;
b) for tutorials/classes: on the basis of the assessment of the current progress of tasks
Summative evaluation:
a) lectures: the knowledge acquired during the lecture is verified by two written tests consisting in solving a number of mathematical questions. The condition for passing the course is to obtain at least 50% of the total points from both tests
b) tutorials/classes: learning outcomes are verified through two tests, continuous assessment at each class (oral answers) and obtaining additional points for activity during the classes. The condition to obtain a positive evaluation from the classes is to obtain at least 50% of points.

Programme content

The course syllabus includes the following topics:
1) Sample space, random events and operations on them, classical probability, combinatorics, geometric probability;
2) Probabilistic space, sigma-algebras of events, Kolmogorov axioms, properties of probability, inclusion and exclusion principle, interpretation of probability;
3) Conditional probability, chain rule, total probability formula, Bayes' theorem;
4) Independent events and their properties, conditional independence, product spaces, reliability of systems, Bernoulli scheme, random walk;
5) Random variables, distribution, discrete random variables, distributions: degenerate, two-point, uniform, binomial, geometric, Pascal, Poisson distribution as limit of binomial distribution;
6) Moments of random variables, expected value and its properties, variance and its properties, standard deviation, moments of basic probability distributions, Markov's inequality, Chebyshev's inequality;
7) Multidimensional random variables, joint distribution, marginal and conditional distributions, conditional expected value;
8) Additivity of expected value, covariance and its properties, correlation coefficient, independent random variables, properties of independent random variables;
9) Continuous random variables, probability density, uniform distribution, exponential distribution, cumulative distribution function of a continuous variable, density of a function of a continuous random variable, moments of continuous random variables, normal distribution and its properties;
10) Multidimensional continuous random variables, joint, marginal, conditional density, independent continuous random variables, distribution of sum of independent random variables, chi-square distribution, Student's t distribution;
11) Bernoulli's and Khinchin's laws of large numbers, Monte Carlo method, sequences of random variables and their convergence, Moivre-Laplace theorem, central limit theorem.

Course topics

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Teaching methods

Lecture: multimedia presentation with additional examples solved on the blackboard
Tutorials/classes: solving exercises

Bibliography

Basic
1. D. Bertsekas, J. Tsitsiklis: Introduction To Probability. Athena Scientific, 2002
2. J. K. Blitzstein, J. Hwang: Introduction to probability. CRC Press, 2019
3. Jacek Jakubowski, Rafał Sztencel: Rachunek prawdopodobieństwa dla prawie każdego. Script, 2002.

Additional
1. H. Pishro-Nik: Introduction to Probability, Statistics,and Random Processes. Kappa Research, LLCR, 2019.
2. Rachunek prawdopodobieństwa, statystyka matematyczna, procesy stochastyczne, Plucińska A., Pluciński E., WNT, W-wa, 2000
3. W. Feller: Wstęp do rachunku prawdopodobieństwa. Tom 1 i tom 2. PWN, 2009
4. Jacek Jakubowski, Rafał Sztencel: Wstęp do teorii prawdopodobieństwa. Script, 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50