

# Probabilistic Methods in Computer Science

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Course description

## Basic information

Field of study : Analytical Computer Science

Path : -

Organizational unit : Faculty of Mathematics and Computer Science

Education level : first-cycle

Form of study : full-time studies

Study profile : general academic

Mandatory status : obligatory

Education cycle : 2022/23

Course code : UJ.WMIANS.140.03339.22

Languages of instruction : Polish

Disciplines : Computer Science, Mathematics

ISCED classification : 0541 Mathematics, 0613 Software and applications development and analysis

USOS code : WMI.TCS.MPI.OL

Course coordinator

Piotr Micek

Course instructors

Piotr Micek

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Form of verification of learning outcomes

exam

Period Semester 3

Form of instruction and hours

Number of ECTS credits 6.0

lecture: 30 exercises: 30

## Educational aims for the course

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Familiarizing students with concepts and theorems from the field of probability calculus and developing the ability to use them freely

## Learning outcomes for the course

Code	Outcomes in the field of	Field-specific learning outcomes	Verification methods
Knowledge – The student knows and understands:			
W1	Student knows classical distributions of random variables and can analyze their modifications.	IAN_K1_W01, IAN_K1_W02	oral exam, credit
W2	Student understands the principle of linearity of expected value and can use it in solving problems.	IAN_K1_W01, IAN_K1_W02	oral exam, credit
W3	Student can recognize and analyze simple random processes: walks, branching processes, Markov chains.	IAN_K1_W01, IAN_K1_W02	oral exam, credit
Skills – The student can:			
U1	Student can model a probability space for described random experiments.	IAN_K1_U01, IAN_K1_U02	oral exam, credit
U2	Student understands the idea of simulation of random variables in computer science.	IAN_K1_U01, IAN_K1_U02	oral exam, credit

## ECTS credits balance

Student activity form	Average number of hours* devoted to completed activity types
lecture	30
exercises	30
preparation for exercises	90
preparation for exam	29
participation in exam	1

Total student workload	Number of hours 180	ECTS credits 6.0
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\* hour (lesson) means 45 minutes

## Program content

No.	Program content	Learning outcomes for the course
1.	1. Axioms of probability calculus. 2. Conditional probability and independence of events. 3. Random variable: its distribution and cumulative distribution function. 4. Discrete random variables and their parameters. 5. Random walks. 6. Continuous random variables and their parameters. 7. Buffon's needle and geometric probability. 8. Generating functions of random variables. 9. Generating functions for random walks and branching processes. 10. Limit theorems and characteristic function. 11. Poisson process and Markov chain. 12. Theory of codes and entropy. 13. Simulation of random variables. Elements of statistics.	W1, W2, W3, U1, U2

## Extended information

### Teaching methods:

conventional lecture, multimedia presentation lecture, subject exercises

Type of classes	Credit forms	Course credit conditions
lecture	oral exam	Obtaining an appropriate number of points for the exam and exercises
exercises	credit	Obtaining an appropriate number of points for exercises

## Prerequisites and additional requirements

knowledge of discrete mathematics and mathematical analysis

## Literature

### Required

1. Geoffrey G. Grimmet, David R. Stirzaker, Probability and Random Processes, Oxford University Press 2001
2. Jacek Jakubowski, Rafał Sztencel, Wstęp do teorii prawdopodobieństwa, Wydawnictwo SCRIPT 2004
3. Agnieszka i Edmund Plucińscy, Probabilistyka, Wydawnictwo Naukowo-Techniczne Warszawa
4. Sheldon Ross, A first course in probability, 8th edition