University of Gdańsk

Subject card

Subject name and code	Introduction to stochastic processes in bioinformatics, PG_00156255		
Field of study	Bioinformatics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish Polish
Semester of study	4	ECTS credits	2.0
Learning profile	academic	Assessment form	credit
Conducting unit	Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Adrian Kołodziejski	
	Teachers	dr Adrian Kołodziejski	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	0.0	20.0	50

Subject objectives	The aim of the course is to familiarize students with the basics of discrete stochastic processes and their applications in biology.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[BIOINL3_W03] Has sufficient knowledge of mathematical and statistical methods in order to describe and model biological phenomena and processes	The student knows and understands: the concept of a stochastic process, the concept of a discrete Markov chain and examples of its application in biology, concepts and theorems regarding the classification of states of discrete Markov chains, the concepts of initial, transitional, stationary and limit distributions, and theorems related to them, the concept of random walk and methods for examining its properties, basics of the Monte Carlo method.	[SW4] test/exam - oral or written
[BIOINL3_U03] Graduate applies fundamental mathematical and statistical methods to describe phenomena and analyze data; has the ability to perform basic data analysis in professional databases used in bioinformatics	Student is able to: classify states and, on this basis, markov chains, determine transition, stationary and limit distributions for Markov chains, determine the average time the system stays in a given state and the average time it takes to reach a given state for the first time, determine the absorption matrix and the average time to absorption, examine the basic properties of random walk, examine Markov chains using the Monte Carlo method	[SU3] text preparation/written work [SU4] test/exam - oral or written

Subject contents

1. The concept of a stochastic process
2. Discrete Markov chains: Construction of discrete Markov chain, Transition matrix, The Chapman-Kolmogorov equation, Classification of states, Periodicity, Temporary and recurring states, Random walks in one and more dimensions. Absorbing and repellent barriers, Probability of absorption and time expected to absorption.Stationary distribution, Limiting distributions
3. Examples of discrete Markov chains in biology: Genetic models, A discrete model of birth and death
4. Monte Carlo methods

Prerequisites and co-requisites

Knowledge of linear algebra, mathematical analysis and the basics of probability theory.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
	51.0%	30.0%
	51.0%	50.0%
	51.0%	20.0%

Recommended reading

Basic literature	A. Plucińska, E. Pluciński, Rachunek prawdopodobieństwa. Statystyka matematyczna. Procesy stochastyczne, Wydawnictwo Naukowe PWN, WNT Warszawa 2020 W. J Stewart, Probability, Markov Chains, Queues, and Simulation, Princeton University Press, Princeton 2009 L. Allen, An Introduction to Stochastic Process with Applications to Biology, Chapman and Hall/CRC 2010
Supplementary literature	D. J. Wilkinson, Stochastic Modelling for Systems Biology, Chapman and Hall/CRC 2018
eResources addresses	

Example issues/ example questions/ tasks being completed

Not required

Work placement

Not applicable

Document generated electronically. Does not require a seal or signature.