COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced Optimization Methods [S2Bioinf2>ZMO]

Course

Field of study
Bioinformatics

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
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

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Prerequisites

The student starting this subject should have knowledge and skills in the field of discrete mathematics, calculus and linear algebra, as well as algorithms and data structures. He/she should also know and be able to use in practice the programming language C or C ++. Moreover, the student should present such attitudes as: honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The aim of the course is to provide students with knowledge about optimization problems and methods, both continuous and discrete, and an indication of the methods of solving selected types of optimization problems.

Course-related learning outcomes

Knowledge:
1. The student knows and understands in depth the issues of selected exact sciences useful for modeling biological processes.
2. The student knows and understands the methods, techniques and tools used for solving complex

bioinformatics problems, mainly of an engineering nature.
3. The student knows and understands detailed issues in the field of biological system modeling and analysis based on reliable theoretical foundations.

Skills:
1. The student is able to fluently use and integrate information obtained from literature and electronic sources, in Polish and in English, interpret and critically evaluate them.
2. The student is able to draw conclusions, clearly formulate and exhaustively justify his/her opinions on the basis of data from various sources.
3. The student is able to use advanced computer science techniques and tools to solve biological problems and evaluate their usefulness.

Social competences:
1. The student is ready to learn throughout the whole life, inspiring and organizing the learning process of other people.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of lectures on the basis of a test. To obtain a positive grade it is necessary to receive at least 50% of the maximal number of points.
In terms of laboratory classes on the basis of a current assessment of students' work and on the basis of a report on the project done during the classes. The grade for the report is a basis for determining the grade for passing the laboratory classes.

Programme content

The course concerns issues related to advanced optimization methods and their practical application for analyzing and solving problems.

Course topics

The lectures covers the following topics:
1. Introduction to optimization problems and methods.
2. Selected issues of mathematical programming.
3. Selected issues of discrete optimization.
4. Exact and approximate algorithms for optimization problems.
5. Elements of computational complexity theory.
6. Elements of multicriteria optimization.
As part of the laboratory classes, students, based on the knowledge acquired during the lectures and a discussion with the lecturer, solve selected optimization problems, i.e., they formulate them in the form of mathematical programming problems, estimate their computational complexity and design and implement exact and approximate algorithms.

Teaching methods

Lecture: multimedia presentation with additional examples given on the blackboard.
Laboratory classes: discussion with students about properties of the analyzed optimization problems and methods of solving them proposed by the students.

Bibliography

Basic:
1. R. Baldick. Applied Optimization. Formulation and Algorithms for Engineering Systems. Cambridge University Press, Cambridge 2006.
2. J. Kusiak, A. Danielewska-Tułecka, P. Oprocha. Optymalizacja. Wybrane metody z przykładami zastosowań. PWN, Warszawa 2009.
3. Ch. H. Papadimitriou. Złożoność obliczeniowa. WNT, Warszawa 2002.

Additional:
1. W. Findeisen, J. Szymanowski, A. Wierzbicki. Teoria i metody obliczeniowe optymalizacji.

PWN,Warszawa 1977.
2. E. Konarzewska-Gubała. Programowanie przy wielorakości celów. PWN, Warszawa 1980.
3. Ch. H. Papadimitriou, K. Steiglitz. Combinatorial Optimization: Algorithms and Complexity. Dover Publications Inc., Mineola, New York 1982.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00