COURSE DESCRIPTION CARD - SYLLABUS

Course name

Modeling of Biological Processes

Course

Field of study

Bioinformatics

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/6

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

15

Tutorials

Laboratory classes

15

Projects/seminars

Other (e.g. online)

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

Prof. Piotr Formanowicz, Ph.D., Dr. Habil.

Faculty of Computing and Telecommunications

Responsible for the course/lecturer:

Prerequisites

The student starting this subject should have basic knowledge and skills in the field of discrete mathematics, mathematical analysis and linear algebra and should know the basic phenomena and processes in the living world and understand their biochemical basis. 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 present students the possibilities of the modeling and analyzing complex biological processes with the use of selected mathematical and computer science methods and techniques.

Course-related learning outcomes

Knowledge

1. The student knows and understands the basic biological phenomena and processes, and bases their interpretation on empirical basis using mathematical methods.

2. The student knows and understands problems in the field of mathematics useful for formulation and solution simple bioinformatics problems, including discrete mathematics, algebra, mathematical analysis, probability and statistics.

3. The student knows and understands the basic methods, techniques and tools used in the process of solving bioinformatics problems, mainly of an engineering nature.

4. The student knows and understands the theoretical basis of modeling biological processes.

5. The student knows and understands the development trends of bioinformatics.

Skills

1. The student is able to obtain information from literature, databases and other properly selected sources, also in English.

2. The student is able to integrate and interpret the obtained information, as well as draw conclusions and formulate and justify his/her opinions.

3. The student is able to use basic computer science techniques and tools for solving biological problems and evaluate their usefulness.

4. The student is able to apply analytical and simulation methods under the supervision of a research tutor for formulating and solving research problems.

5. The student is able to apply basic statistical methods as well as algorithms and computer science techniques for describing biological processes and data analysis.

6. The student notices the systems and non-technical aspects of the undertaken bioinformatics tasks.

Social competences

1. The student is ready to learn throughout the whole life and improve his/her competences.

2. The student is ready to cooperate and work in a group, assuming various roles in it.

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.

In terms of laboratory classes on the basis of a current assessment of a student work and a project prepared in the second part of the semester.

Programme content

The lectures covers the following topics:

1. Introduction to mathematical methods of biological processes modeling and analysis.

2. Review of selected methods of modeling and analysis of biological processes.

3. Elements of Petri net theory.

4. Methods of analyzing biological processes using Petri nets.

5. Extensions of Petri nets.

6. Selected issues of an application of differential equations for modeling and analysis of biological processes.

7. Application of agent methods for modeling and analysis of biological processes.

As part of the laboratory classes in the first part of the semester students model and analyze simple biological processes using selected methods discussed during the lectures. In the second part of the semester, using appropriate methods, they develop and analyze a model of a complex biological process on the basis of scientific literature recommended by the lecturer.

Teaching methods

Lecture: multimedia presentation with additional examples given on the blackboard.

Loboratory classes: discussion with students about possibilities of an application of methods presented during lectures for modeling and analysis of selected biological problems.

Bibliography

Basic

1. I. Koch, W. Resing, F. Schreiber (Eds.). Modeling in Systems Biology. The Petri Net Approach. Springer, London 2011.

2. J. D. Murray. Wprowadzenie do biomatematyki. PWN, Warszawa 2006.

3. Z. Szallasi, J. Stelling, V. Periwal (Eds.). System Modeling in Cellular Biology. From Concepts to Nuts and Bolts. The MIT Press, Cambridge, Massachusetts 2006.

4. C. H. Taubes. Modeling Differential Equations in Biology. Cambridge University Press, Cambridge 2008.

Additional

1. D. Formanowicz, A. Kozak. T. Głowacki, M. Radom, P. Formanowicz. Hemojuvelin-hepcidine axis modeled and analyzed using Petri nets. Journal of Biomedical Informatics. 46 (2013) 1030-1043.

2. E. Klipp, W. Liebermeister, Ch. Wierling, A. Kowald, H. Lehrach, R. Herwig. Systems Biology. A Textbook. Wiley-Blackwell, Weinheim 2009.

3. J. B. Reece, L. A. Urry, M. L. Cain, S. A. Wasserman, P. V. Minorsky, R. B. Jackson. Biologia Campbella. REBIS, Poznań 2016.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	20	1,0

[1] delete or add other activities as appropriate