COURSE DESCRIPTION CARD - SYLLABUS

Course name

Systems Approaches in Biomedical Research

Course

Field of study

Bioinformatics

Year/Semester

2/4

Area of study (specialization)

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

Other (e.g. online)

Tutorials

15

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

Kaja Gutowska, M.Sc.

phone: 61-665-3041

e-mail: Kaja.Gutowska@put.poznan.pl

Faculty of Computing and Telecommunications

ul. Piotrowo 2, 60-965 Poznań

Responsible for the course/lecturer:

Mateusz Twardawa, M.Sc.

phone: 61-665-3041

Mateusz.Twardawa@cs. put.poznan.pl

Wydział Informatyki i Telekomunikacji

ul. Piotrowo 2, 60-965 Poznań

Prerequisites

A student undertaking the second-cycle studies of Bioinformatics should have achieved assumed learning objectives from the first-cycle studies (these effects are available on the department's website www.cat.put.poznan.pl).

A student starting this module should have basic knowledge of molecular biology, systems biology, functional and structural genomics. Should have the abilities to solve basic biological and bioinformatics problems, use biological databases, modelling the structure of biomolecules and biological processes. Moreover, in terms of social competencies, a student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. Providing basic knowledge of the practical use of systems approaches in biomedical research, including applications of genomics, transcriptomics, and proteomics in medicine.

2. Developing the ability to analyze data and modelling on the basis of selected examples from systems medicine.

3. Acquaintance with the basic strategies of biomarker search, identification of therapeutic targets, potential drugs, as well as statistical analysis of biomedical research.

4. Acquaintance with the basic strategies of searching and learning about the mechanisms of disease processes.

5. Developing the ability to plan research and formulate basic assumptions of research projects.

Course-related learning outcomes

Knowledge

1. A student learns the basic strategies and methods used in the process of searching for mechanisms laying in the basis of diseases, biomarkers, new therapeutic targets and drugs.

2. A student has the knowledge necessary to solve tasks related to the analysis of complex biological systems with the use of known bioinformatics tools and databases.

3. A student has the knowledge necessary to implement a project consisting of creating a research plan. This plan should focus on one of the following goals: understanding the mechanism of the diseases process, biomarkers identification, therapeutic targets identification, or potential drugs identification.

4. A student knows the principles of research planning in the field of biomedicine and bioinformatics.

Skills

1. A student is able to use basic techniques and bioinformatics tools to solve biological problems, and is also able to interpret the obtained results and draw conclusions.

2. Under the supervisor, a student designs research plans with the use of analytical and bioinformatics methods.

3. A student applies appropriate statistical methods and proper tools to describe processes and analyze biomedical data.

4. A student prepares a presentation of research results and discusses the results of work in the scientific community.

5. A student understands systems approaches and is able to apply them in bioinformatics tasks. Student notices not only a technical approach to the problem but also an important biological context.

6. A student formulates and tests hypotheses related to biological, biomedical and bioinformatics problems.

Social competences

1. A student properly define the priorities for the implementation of the task proposed by himself/herself or others.

2. In the context of various systems approaches, a student is able to identify and resolve ethical dilemmas.

3. A student demonstrates a creative attitude in professional and social life.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) Verification of assumed learning objectives related to lectures:

- based on answers to questions a concerning the material discussed in previous lectures,

- evaluation and "defense" of the project developed by a student.

b) Verification of assumed learning objectives related to laboratory classes:

- based on the assessment of the current progress in performing tasks and evaluation of correctness,

- based on continuous assessment during classes,

- based on the evaluation of reports prepared partially during the classes and partially after their completion; this assessment also includes the ability to teamwork.

Summative assessment:

a) Verification of assumed learning objectives related to lectures:

- assessment of knowledge and skills demonstrated during the presentation of the project and discussions. The evaluation will be focused on the various stages of the research project implementation, inter alia, selection of the selected issue, selection of the project objectives, selection and scope of use of existing databases and available literature, selection of the proposed methodology and resented solutions to the problem.

b) Verification of assumed learning objectives related to laboratory classes:

- evaluation of task reports carried out within particular classes.

Activity during classes is rewarded with additional points, in particular for:

- discussion of additional aspects of the issue,

- the effectiveness of applying the acquired knowledge to solving a given problem,

- the use of creative and innovative solutions to solving planned tasks.

Programme content

During the lecture, students gain knowledge related to the application of basic methods of systems biology and systems medicine in the process of searching and identification the mechanisms of diseases processes, potential biomarkers, therapeutic targets and drugs. The following issues will be discussed, including:

1. Introduction to systems study

2. Statistics in biomedical research

3. Dimensionality reduction

4. Genome-wide association studies

5. Precision oncology

6. Biomarkers identification

7. Screening tests

During the laboratory classes, students solve in a theoretical and practical way bioinformatics problems related to the subject of the lectures.

Teaching methods

1. Lecture: multimedia presentation illustrated with examples given on the blackboard.

2. Laboratory class: practical exercises, discussion, teamwork.

Bibliography

Basic

1. Statystyka medyczna w zarysie, J. Moczko, Wydawnictwo Lekarskie PZWL (2006).

2. Exploratory multivariate analysis by example using R, F. Husson, S. Lê, J. Pagès, CRC press (2017).

3. Biologia molekularna w medycynie. Elementy genetyki klinicznej, Jerzy Bal (Wydawnictwo Naukowe PWN)

4. Genetyka medyczna. Podręcznik dla studentów, G. Drewa, oprac. T. Ferenc (Elsevier Urban & Partner)

5. The Handbook of Biomarkers, J. Kewal (Humana Press-Springer)

6. Biomarkers in Drug Development: A Handbook of Practice, Application, and Strategy, M. R. Bleavins, C. Carini, M. Jurima-Romet, R. Rahbari (John Wiley & Sons)

Additional

1. Systems Biology, E. Klipp, W. Liebermeister, C. Wierling, A. Kowald, H. Lehrach,R. Herwig (Wiley-Blackwell)

2. Bioinformatics for Systems Biology, Krawetz, Stephen. Humana Press

3. Immunologia, Jakub Gołąb, Marek Jakóbisiak, Witold Lasek, Tomasz Stokłosa Wydanie: 7, 2020 Wydawnictwo Naukowe PWN

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/tutorials, preparation for tests/exam, project preparation) [1]	20	1,0

[1] delete or add other activities as appropriate