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<tr><td>NAME OF THE COURSE</td><td colspan="7">In silico Biology</td></tr>
<tr><td>Code</td><td>PMB741</td><td>Year of study</td><td colspan="5">2</td></tr>
<tr><td>Course teacher</td><td>Branka Bernard, PhD, Associate Research</td><td>Credits (ECTS)</td><td colspan="5">3</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Dr. Sc. Andrea Gelemanovic,
Exercises: dr. med. Tinka Vidovic, PhD student</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td colspan="2">F</td></tr>
<tr><td>15</td><td>10</td><td>20</td><td colspan="2"></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="5">25%</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Given the profound change in how biological research is performed and evaluated today, the design of In silico Biology course aims at building a foundation for the students' successful participation in the necessarily interdisciplinary biological research. The objective of the course is to introduce and familiarize students with different in silico tools and relate them to the pertinent biological question.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">After passing the exam, students will be able to:
• understand the benefits of complementing in silico and experimental methods in different biological research fields
• understand basic concepts and potential of different in silico modeling tools
• use several insilico tools (Connectivity Map, AutoDock, Cytoscape) to analyze gene pathways, make first steps for drug discovery or drug repurposing, visualize molecular interaction networks and biological pathways and integrate these networks with annotations, gene expression profiles and other state data
• present state-of-the-art research based on in silico models in biomedicine
• create outline for interdiciplinary project proposal combining experimental and in silico methods in biomedicine</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="7">Lectures:
1. An overview of the term and the field - introduction to the concepts behind system biology and the use of in silico methods in biology. Explaining the proces from in vivo to in silico and back. (2H)
2. Introduction to modeling. Students will be introduced to different aspects of modelling: what is a model: abstracting and simplifying reality; scale (spatial and temporal); systems variables; level in which the problem is framed (e.g., molecular, cellular, organismal); trade-offs between generality, precision, and realism; evaluating models. (2H)
3. Visualizing biological data: Visualisation is increasingly important in life science as data grows rapidly in volume and complexity. We will present: browsing 3D genomes, visualizing RNA structures and alignments, vizualizing protein structures and function, vizualizing proteomics data, vizualizing biological networks, vizaulizing cellular data, vizualizing tissues and organisms. (2H)
4. Hypothesis-free science - translation of various large-scale -omics data into biology: Detailed description of various -omics data sets, how they can be integrated in multi-dimensional network and how network analysis can be used in phenotype prediction.
(1H)</td></tr>
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	5. Genome-wide association studies and predictive power of genomic data: Detailed description of genome-wide association studies and terms used in genomic analyses, overview of current success and limitations of such type of studies, with emphasis on the ability to predict various phenotypic traits from genomic data. (1H) 6. Visualization and analysis of biological networks using Cytoscape-students will learn approaches to model gene regulatory networks and analyze the functional effect of sequence variations in the contex of biological networks such as protein-protein interaction networks and signaling pathways using Cytoscape. (1H) 7. Pathways and data integration workflows: Students will learn how to build models using Reactome pathways and they will use a signaling pathway to predict novel components. They will also learn how to create and expand workflows and use web services (1H) 8. Overview of systems biology tools: COPASI, COBRA, SBW, CBMPy, FAME. Students will learn the concepts and use of different systems biology tools. (1H) 9. In silico method in drug discovery: in silico methodologies have become a crucial part of the drug discovery process. Tthey can improve identifying and discovering new potential drugs with a significant reduction to cost and time, reducing the experimental use of animals for in vivo testing, help in the design of safer drugs, and supporting repurposing of known drugs. (1H) 10. Optimization of cancer treatments using *in silico* modelling: Cancer treatments require balancing the benefits of treating tumors with the adverse toxic side effects caused by the treatment itself. Students will learn of success stories where *in silico* methods helped to strike the right balance (1H) 11. *In silico* clinical trials: how are computer simulation transforming the biomedical industry. Currently, biomedical research is faced with hugely unsuccessful transition between preclinical and clinical trials. Students will learn how *in silico* methods can reduce, refine and partially replace current clinical trials. (1H) 12. Science for society. Students will be introduced to societal impact of different areas of biological research. Benefits of the complementation of wet lab and *in silico* experiments will be discussed. (1H) **Seminars:** In the seminars students will present current or recently finished EU projects relevant for the course: 1. The Virtual Physiological Human - a European initiative for in silico human modelling 2. Personalised computer models and in-silico systems for well-being 3. Vaccine Development for Malaria and/or neglected infectious diseases 4. IN-Silico trials for treatment of acute Ischemic Stroke 5. CanPathPro: Predictive cancer pathway modelling 6. REPO-TRIAL: Setting standards for in silico drug repurposing 7. InSilico Trials for drug-eluting bioabsorbable vascular scaffold (BVS) development and evaluation 8. CHIC: Computational models in cancer 9. In silico and in vitro Models of Angiogenesis: unravelling the role of the extracellular matrix (MAtrix) 10. Predicting Risk of Emerging Drugs with In silico and Clinical Toxicology (PREDICT) **Exercises:** 1. Using the Connectivity Map and LINCS database for drug repurposing-students will learn practically about analyzing disease gene expression signature obtained from GEO to obtain drugs that reverse this disease gene expression signature (3H)

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<tr><td></td><td colspan="6">2. Virtual screening of drugs using AutoDock- students will learn how to use AutoDock, a software used for ligand-based virtual screening (3H)
3. Visualization and analysis of biological networks using Cytoscape (3H)
4. Making sense of GWAS results - students will learn how to use various publicly available online softwares for functional annotation of GWAS results (e.g. DAVID, FUMA, HaploReg, STRING, LocusZoom) (3H)
5. In groups with mentoring: developing project proposal combining in vitro, in vivo and in silico tools (8H)</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students will have to attend lectures, seminars and exercises regularly. They are expected to be active during the cours so that they are prepared for lectures (elaboration of basic literature), prepared for seminar presentations, finish successfully the exercises, to critically discussion thematic units to be covered, and seminars of other students.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td>1.0</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>0.5</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td>1.0</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Attendance, evaluation of student seminars and exercises as well as the results of the written test are included in the overall final grade.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">In silico Biology, script</td><td></td><td></td></tr>
<tr><td colspan="4">Original and review scientific articles and book chapters.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6"></td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">Analysis of the quality of teaching by students and teachers
Analysis of the exam results</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
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