Mandatory courses

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-001	Computer Science for Life Scientists	L, E	None	D: 1 Sem. S: 1. Sem.	Contents: Outline of practical computer science: Concept of imperative and object-oriented programming Techniques for design and analysis of algorithms Examples of classic algorithms and data structures Basics of numeric algorithms Aims: Preparation and good understanding of module contents	Exercises: 12 assignment sheets are grouped into three sets of four sheets. Students have to achieve at least 50% of the points overall, and at least 35% for each set of four sheets. As will be clearly indicated, the first set has to be done individually, others can be handed in in groups of up to three. Each student has to be able to explain the solution to the tutors upon request to obtain the points.	Written Examination	9
M-LSI-P-002	Mathematics for Life Scientists	L, E	None	D: 1 Sem. S: 1. Sem.	Contents: Concepts and application of basic mathematical concepts, linear algebra, analysis, and probability theory/statistics Goals: Familiarity with mathematical formulations of concepts in the life sciences. Proficiency in mathematical calculations and manipulations for problem solving in the life sciences and computer science.	Exercises, optional.	Written examination. 50% required for a passing grade.	3

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-003	Chemistry and Biology for Life Science Informatics	L, E	None	D: 1 Sem. S: 1. Sem.	Content: Overall view of relevant topics in Chemistry and Biology for Life Science Informatics Aim: General knowledge of the functioning of the cell as the smallest integral part of life, some specialized cells	Optional exercises Optional mock exam	Written Examination	7

M-LSI-P-004	Biological Databases	V, Ü	None	D: 1 Sem. S: 1. Sem.	Contents: Introduction into molecular biology Objects in Biology, Objects in Chemistry, Objects in Medicine, Genomics, Functional Genomics and Proteomics, Pharmaceutical Research Processes, Data Generation Technologies, Data Types and Formats, Information systems representing biomedical data •From Object Orientation to Knowledge Representation, the Role of Ontologies for Biomedical Knowledge Representation •Logic Inference, Biomedical Data Integration Technologies Aims: Knowledge The module introduces students to modern concepts for the representation of biological, chemical and pharmacological data and knowledge in information systems Skills Foundations of meaningful and effective use of biological, chemical and pharmacological data, databases and information systems. Competences: Biomedical knowledge management has a key role in pharmaceutical industry and biotechnology. With our module we lay the foundation for the ability to •Understand what biologists, chemists and medical researchers need from a specialist in life science informatics	Exercises	Written Examination	6

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					•Communicate, as a life science informatics specialist, with biologists, chemists and medical researchers •Translate scientific questions from the empirical, experimental sciences into IT-based, model-driven approaches Work in a data-driven, pharmaceutical research environment			
M-LSI-P-005	Bioinformatics I	V	None	D: 1 Sem. S: 1. Sem.	Contents: Principles of computer scientific methods of Life Sciences, especially molecular biology (genomics, proteomics, expression profiling, network analysis) Computational mapping (Begriff richtig?) of natural phenomenons, especially probalistic shapes (?) Aim: Interdisciplinary thinking Understanding of algorithmic approaches of trade-offs	Optional exercises	Written Examination, 50 % of points have to be achieved in order to pass.	3

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-006	Molecular Modeling and Drug Design	L, E	Computer Science for Life Scientists, Mathematics for Life Science Informatics, Chemistry and Biology for Life Science Informatics	D: 1 Sem. S: 2. Sem.	Contents Principles of protein structure Protein structure prediction Principles of protein-ligand interactions Thermodynamic foundations of ligand binding Energy functions and computational force fields Molecular mechanics Modeling of bioactive ligand conformations Pharmacophore concept Molecular docking algorithms Aims Developing an understanding of scientific and algorithmic foundations of molecular modeling and drug design.	The lecture is accompanied by integrated exercises. For admission to the MMDD exam, achieving 50% of the points granted for the exercise program in a final test that can be repeated once will be required.	Written Examination	6
M-LSI-P-007	Bioinformatics II – Visual Computing in the Life Sciences	L, E	keine	D: 1 Sem. S: 2. Sem	Content: Overall view off specific methods of data visualisation and image processing Aim: Application of those methods in biology and Life Sciences	Exercises: Students have to achieve at least 50% of the points from the exercises, which can be submitted in groups of up to three students. Each student has to be able to explain the solution to the tutors upon request to obtain the points.	Written Examination	6

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-008	Programming Lab I	LC	Computer Science for Life Scientists	D: 1 Sem. S: 2. Sem.	Contents: Practical programming in Python. Implementation of algorithms focusing on bioinformatic problems. Problem solving in Python using algorithmic approaches. Goals: Proficiency in general Python programming. Competence in the application of Python for solving bioinformatic and chemoinformatic problems ranging from data handling to algorithmic implementations. Programming skills for the automation of workflows. Ability to solve of computational and algorithmic challenges in interdisciplinary research and applications.		(Bi-)Weekly programming exercises followed by individual code discussions. Point-based system, 50% required for a passing grade.	8
M-LSI-P-010	Scientific Presentation I	S	None	D: 1 Sem. S: 2. Sem.	Topics: Overview of he the forms of scientific presentation: slide design, stricture of scientific presentation using selected examples from literature, presentation training Goals: Improvement of presentation skills, that are important to exchange scientific ideas and concepts.		Presentation	4

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-011	Chemoinformatics	L, E	Molecular Modeling and Drug Design	D: 1 Sem. S: 3. Sem.	Contents Computational molecular representations Molecular descriptors Molecular similarity (graph- or descriptor-based) Chemical space representations Similarity searching Compound classification / clustering methods Machine learning algorithms Similarity-property principle Structure-activity relationships Activity landscapes Molecular networks Aims Comprehending and applying standard methods in chemoinformatics and understanding their algorithmic foundations.	The lecture is accompanied by integrated exercises.	Written Examination	7

Module Code	Module Name	Module Type	Pre-requisites for Attendance	Duration/ Semester	Content of examination / Aim of module course	Coursework	Form of Examination	CP
M-LSI-P-012	Programming Lab II	LC	Programming Lab I	D: 1 Sem. S: 3. Sem.	Content: - Short introduction to Java - Basic Data Processing with Java - Network Analyses with Java - Image Processing with Java - Sequence Analyses with Java - Text & Data Mining with Java - Structural Biology with Java Aim: In this course students will learn how to develop software, test it purposefully and release it into the wild. A main challenge which every software developer is faced, is to write readable, maintainable, testable and distributable software. One of the goals of this course is to introduce patterns (sometimes also 'anti-patterns') that will show ways how to develop software with a minimum amount of time and resources. This can be done using existing libraries, frameworks and build systems. In detail this means, after this semester students should know, how to (a) solve problems in life science with a new Java program, (b) run and test Java applications in a Linux or Unix environment, (c) use external libraries and packages to save work and (d) handle data retrieved in life science informatics.		Presentation	8

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M-LSI-P-014	Biomedical Data Science & AI	L, E		D: 1 Sem. S: 3. Sem.	Topics: - Statistical Foundations of Data Mining - Clustering - Foundations of supervised learning - Classical ML algorithms - Deep Learning Qualification goals: - Students learn and understand foundational methods of data mining and machine learning - Students are able to apply them to basic problems - Students understand the limitations of the methods taught	Exercises, more than 50% must be reached in order to be admitted to the exam	Written Examination	6
M-LSI-P-013	Master‘s Thesis		A minimum of 60 CP in mandatory courses, successful attendance of module 1 to 9	D: 1 Sem S: 4. Sem.	Content: The candidate is conducting independent work on a problem taken from the Life Science Informatics field and is producing findings within a specified period of time under application of scientific state-of-the-art methods. Aim: Correct usage of state-of-the-art methods to solve a scientific problem taken from the Life Science Informatics field		Master’s Thesis	30