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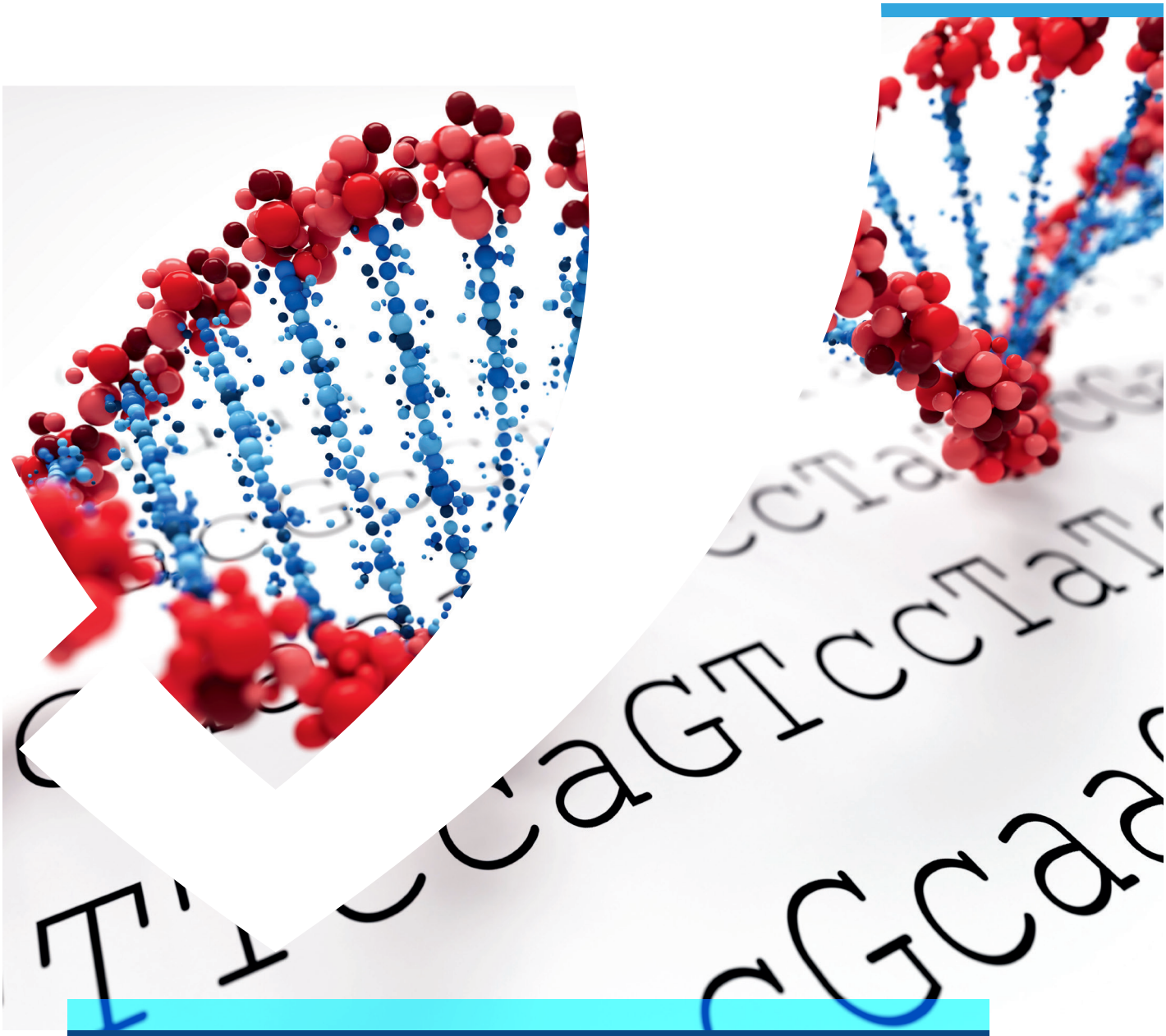

Study Program Handbook

Computational Life Science

Master of Science

Valid for all students starting their studies in fall 2016
Date: August 18, 2016
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1. Program Overview

1.1. Concept

"It is not the goal of Science to tear at the tapestry of the world and pull out the threads to see what colors the threads are. It is the goal of science to see the picture on the tapestry." (Erwin Chargaff 1975)

In recent years, biological research has become increasingly interdisciplinary, focusing heavily on mathematical modeling and on the analysis of system-wide quantitative information. Sophisticated high-throughput techniques pose new challenges for data integration and data interpretation. The Computational Life Science program meets these challenges by covering computational, theoretical and mathematical approaches in biology and the life sciences. Jacobs University has an outstanding expertise in biomedical modeling, systems biology, bioinformatics, computational neuroscience and computational biology. Computational Life Science unites these strengths in a single graduate program.

1.2. Qualification Aims

Studying life sciences from a computational perspective requires interdisciplinary understanding and specialization at the same time. The Computational Life Science program integrates these goals by offering a mixture of theory-oriented lectures, methods courses, computer labs and various forms of guided research projects. In particular, students learn

- to understand that scientific knowledge is constantly evolving;
- to independently obtain and update their knowledge;
- to conduct research in a precise, diligent and reproducible manner;
- to design, understand and critique scientific investigations using mathematical and computational methods;
- to understand the value, challenges and practice of interdisciplinary approaches;
- to develop their personal career perspective.

1.3. Target Audience

The computational Life Science program is geared towards students who hold a bachelor's degree in bioinformatics, computer science, life sciences, physics, applied mathematics and related areas.

1.4. Career Options

Graduates of the Computational Life Science program are prepared for a career in biotechnology and biomedicine in industry and the public sector. Likewise, graduates of the program are in an excellent position to move on to a PhD.

1.5. Admission Requirements

Applicants need to submit the following documents in order to be considered for admission:

- Letter of motivation
- Curriculum vitae (CV)
- University transcript in English or German
- Bachelor's degree certificate or equivalent
- Two letters of recommendation
- English language proficiency test with a minimum score of 90 (TOEFL) or 6.5 (IELTS). Alternatively, students may submit a confirmation from their previous university that their education was conducted in English.

Please visit http://www.jacobs-university.de/study/graduate/application-information for more details on the application process.

2. The Curriculum

2.1. The Curriculum at a Glance

The Computational Life Science curriculum is composed of six modules over four semesters (two years). The following table shows an overview of the program structure.

<table>
<tr><td>Semester 4</td><td rowspan="4">CORE 1
Foundations of Computational Life Science
(20 CP)</td><td></td><td rowspan="4">CORE 3
Advanced Topics and Applications
(20 CP)</td><td colspan="2">RESEARCH 2
Master's Thesis (30 CP)</td></tr>
<tr><td>Semester 3</td><td rowspan="3">CORE 2
Electives and Remedial Courses
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(20 CP)</td></tr>
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- Module CORE 1 - Foundations of Computational Life Science: 20 Credit Points
- Module CORE 2 - Electives and Remedial Courses: 15 Credit Points
- Module CORE 3 - Advanced Topics and Applications: 20 Credit Points
- Module CAREER - Skills and Languages: 15 Credit Points
- Module RESEARCH 1 - Lab Rotations: 20 Credit Points
- Module RESEARCH 2 - Master's Thesis: 30 Credit Points

In order to graduate, students need to obtain 120 ECTS credit points. The ECTS (European Credit Transfer System) is a system defining the student workload required to achieve the objectives of a study program. At Jacobs University, 1 credit point is equivalent to 25 hours of student workload. In each module, students must obtain a minimum amount of credit points (with an average of 30 credit points per semester).

Each module consists of mandatory and/or elective components as outlined below. Please check the course catalogue for detailed course descriptions and current course offerings (https://campusnet.jacobs-university.de).

2.2. Modules

2.2.1. CORE 1 - Foundations of Computational Life Science

Amount of credit points to be obtained in this module: 20

This module equips all students of Computational Life Science with a common methodological ground and provides an introduction to all topical areas that are represented in the related research groups on campus. The module contains a two-semester lecture series as well as a research colloquium.

Course Title	Course No.	Semester	Mandatory	Credits
Introduction to Computational Life Science	550401	1	yes	5
Introduction to Computational Life Science: Methods and Applications	550411	2	yes	5
Computational Life Science Colloquium	550402 550404 550414 550424	1 2 3 4	yes	4 x 2.5 = 10

2.2.2. CORE 2 - Electives and Remedial Courses

Amount of credit points to be obtained in this module: 15

The Computational Life Science program attracts students with diverse career goals, backgrounds and prior work experience. This module allows students to make up for missing academic prerequisites or to strengthen their knowledge in specific areas of Computational Life Science by taking courses from the undergraduate or graduate programs at Jacobs University. Mandatory and mandatory-elective courses are listed below. In addition, students are invited to improve their competencies by taking courses in applied mathematics, computer science and natural sciences, e.g. machine learning, databases, statistical physics and stochastic processes. Please see CampusNet (https://campusnet.jacobs-university.de) for up-to-date course offerings. The course selection in this module needs to be approved by the program coordinator.

Course Title	Course No.	Semester	Mandatory	Credits
Introduction to Bioinformatics	JTME-550201	1	yes	2.5
Bioinformatics Applications	550444	2	mandatory -elective	2.5
Introduction to Systems Biology	550432	2	yes	2.5
Dynamical Systems and Control	300301	1	mandatory -elective	5.0
Applied Dynamical Systems	CO18-110231	2	mandatory -elective	5.0
Applied Dynamical Systems Lab	CO18-110233	2	mandatory -elective	2.5

Students have to earn at least 10 Credit Points from introductory courses in Bioinformatics, Systems Biology, and Dynamical Systems. At least 2.5 Credit Points must be earned in each of these three areas.

2.2.3. CORE 3 - Advanced Topics and Applications

Amount of credit points to be obtained in this module: 20

In this module, each student selects courses on specific topics of Computational Life Science in semesters 1 to 3. It is recommended that the student focuses his or her studies in this module on two of the four specialization areas indicated below. In each of the two selected specialization areas, the course selection should include at least 5 credit points from courses with central topics (●), but the student and his or her academic advisor may agree on a different course selection if appropriate.

Course Title	**Course No.**	**Credits**	**Semester**	**Specialization Area 1:** Computational Systems Biology, Computational Physics and Biophysics	**Specialization Area 2:** Bioinformatics and RNA Biology, Imaging and Modeling in Medicine	**Specialization Area 3:** Ecological Modeling and Theoretical Biology	**Specialization Area 4:** Applied Mathematics and Numerical Methods
Network Approaches in Biology and Medicine	550443	5	3	●	○	○	
Statistical Physics of Complex Networks	550433	5	1	●		○	○
Theoretical Biology	550403	5	1 3	●		●	●
Models of Metabolism	530481	2.5	1	○	●		
Models of Gene Regulation	530681	2.5	3	○	●		
Literature Course RNA Biochemistry I	530473	2.5	1		●		
Ribogenetics: Molecular Biology and Biotechnology of RNA Molecules	520362	2.5	2		●		

Bioinformatics for Next Generation Sequencing	550441	2.5	2		●		
Marine Ecosystem Modelling	550431	5	1	○		●	
Fundamental Processes in Ecology	040231	5	3	○		●	
Medical Data Analysis	550442	2.5	4	○	●		●
Partial Differential Equations	100472	7.5	2			○	○
Introduction to Computer Simulation Methods	CO14-200331	5	2	○	○	○	○
Theoretical and Computational Biophysics	550434	2.5	4	●			
Advanced Studies in Computational Life Science	550421 550422 550423 550425	5	each semester	○	○	○	○
Numerical Analysis	110341	7.5	2				○

2.2.4. CAREER - Skills and Languages

Amount of credit points to be obtained in this module: 15

In this module students select language courses and other courses from the "Jacobs Track". Please see http://language-program.user.jacobs-university.de and https://campusnet.jacobs-university.de for more information and current course offerings. A typical course selection is shown in the table below.

Course Title	Course No.	Semester	Mandatory	Credits
Language Course/ Triangle Area	depending on course	1	mandatory -elective	2.5
Language Course/ Triangle Area	depending on course	1	mandatory -elective	2.5

Language Course/ Triangle Area	depending on course	2	mandatory -elective	2.5
Language Course/ Triangle Area	depending on course	2	mandatory -elective	2.5
Language Course/ Triangle Area	depending on course	3	mandatory -elective	2.5
Language Course/ Triangle Area	depending on course	3	mandatory -elective	2.5

2.2.5. RESEARCH 1 - Lab Rotations

Amount of credit points to be obtained in this module: 20

Students take part in two research laboratory rotations between semesters 1 and 3 and, upon agreement, in the surrounding intersession breaks. A lab rotation lasts two months. In each lab rotation, students spend at least two full days per week working in the laboratory of their choice. If applicable, students participate in work group meetings related to their project. The results are communicated in a report and a short oral presentation with discussion in the research group. A detailed schedule for the lab rotations is agreed upon with the respective hosting research group.

Title	Course No.	Semester	Mandatory	Credits
Lab Rotation in Comput. Life Sc. I	550412	1 - 3	yes	10
Lab Rotation in Comput. Life Sc. II	550413	1 - 3	yes	10

2.2.6. RESEARCH 2 - Master's Thesis

Amount of credit points to be obtained in this module: 30

For the master's thesis, students conduct research in one of the Computational Life Science research groups. Usually, students choose one of the research groups in which they did their lab rotations.

Students have at least one supervisor taking responsibility for progress and mentoring of the thesis, as well as providing guidance on good scientific practice. Supervision can be partially delegated or shared, especially if the thesis is closely associated with an existing project or is part of an interdisciplinary collaboration. In any case, the responsibilities for supervision need to be agreed upon at the start of the thesis.

The master's thesis is scheduled for the fourth and last semester. Upon agreement with the hosting research group, the thesis may be started earlier than the end of the

third semester. It should take six months of full-time workload (including writing the thesis). A detailed schedule is agreed upon with the respective research group.

In the master's thesis colloquium, students give a comprehensive presentation on their research similar to a contributed talk at a conference. They discuss and defend main results in front of a competent audience, typically the respective research group.

Additional regulations regarding the master's thesis can be found in § 5.3 of the Policies for Academic Master Studies (http://www.jacobs-university.de/academic-policies).

Title	**Course No.**	**Semester**	**Mandatory**	**Credits**
Master's Thesis and Colloquium	no number	4	yes	30

3. Computational Life Science Graduate Program Policies

§1 Scope of these Policies

The policies in this handbook are valid for all students who entered the Computational Life Science graduate program at Jacobs University in fall 2016. Besides the Computational Life Science Graduate Program Policies, the general Policies for Academic Master Studies at Jacobs University (http://www.jacobs-university.de/academic-policies) apply to this program. In cases of conflict between the program policies and the general policies, the general policies apply.

§2 Degree

Upon successful completion of the program, students are awarded a Master of Science (MSc) degree.

§3 Graduation Requirements

In order to graduate, students need to obtain at least 120 credit points. In addition, the following graduation requirements apply:

- In each module, students need to obtain a minimum amount of credit points as indicated in chapter 2 of this handbook.
- Students need to complete all mandatory components of the program as indicated in chapter 2 of this handbook.