Computational Life Science (MSc)
Graduate Program Handbook

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Table of Contents

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:

- Essay (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.

2.1. 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. All credit points (CP) are ECTS (European Credit Transfer System) credits. Students acquire 30 credit points per semester on average.

Semester 4	**CORE 1** Foundations of Computational Life Science (20 CP)	**RESEARCH 2** Master's Thesis (30 CP)			
Semester 3		**CORE 2** Electives and Remedial Courses (15 CP)	**CORE 3** Advanced Topics and Applications (20 CP)	**CAREER** Skills and Languages (15 CP)	**RESEARCH 1** Lab Rotations (20 CP)
Semester 2					
Semester 1					

In order to graduate, students need to obtain 120 credit points. In each module, students need to obtain a minimum amount of credit points:

- 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

Each module consists of mandatory and/or elective components as outlined below. Detailed course descriptions are available in the course catalogue on CampusNet (http://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 1	550401	1	yes	5
Introduction to Computational Life Methods and Applications	tba	2	yes	5
Computational Life Science Colloquium	550402	1-4	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. Recommended courses are listed in the table 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 (http://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
Bioinformatics	tba	tba	no	tba
Computational Biology	tba	tba	no	tba
Nonlinear Dynamics and Control	tba	tba	no	tba
Nonlinear Dynamics Lab	tba	tba	no	tba

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 ($\bullet$), but the student and his or her academic advisor may agree on a different course selection if appropriate.

	Credits	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	2.5	●	○	○	
Stat. Physics of Complex Networks	2.5	●		○	○
Theoretical Biology	5	●		●	●
Models of Metabolism / Gene Regulation	2.5	○			
RNA Biology / Ribogentics	2.5		●		
Bioinformatics for Next Generation Sequencing	2.5	○	●		
Marine Ecosystem Modeling	2.5			●	
Fundamental Processes in Ecology	2.5	○		●	
Imaging and Modeling in Medicine	2.5		●		●
Fluid Dynamics and Applications to Biology	2.5				●
Theoretical and Computational Biophysics	2.5	○			
Advanced Studies in Computational Life Science	5	○	○	○	○

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 http://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 1	tba	1	no	2.5
Jacobs Track Course 1	tba	1	no	2.5
Language Course 2	tba	2	no	2.5
Jacobs Track Course 2	tba	2	no	2.5
Language Course 3	tba	3	no	2.5
Jacobs Track Course 3	tba	3	no	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 in semesters 2 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 1	540401	2	yes	10
Lab Rotation 2	540402	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 concluding 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	none	4	yes	30

3. Computational Life Science Graduate Program Policies

3.1. 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 2015. 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.

3.2. Degree

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

3.3. 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.