

## Integrative Biology (C004000)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 3.0**                      **Study time 80 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 2)	English	Gent	lecture seminar
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**Lecturers in academic year 2024-2025**

Marchal, Kathleen	WE09	lecturer-in-charge
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**Offered in the following programmes in 2024-2025**

	<b>crdts</b>	<b>offering</b>
<a href="#">Bridging Programme Master of Science in Bioinformatics(main subject Engineering)</a>	3	A
<a href="#">Master of Science in Bioinformatics(main subject Bioscience Engineering)</a>	3	A
<a href="#">Master of Science in Bioinformatics(main subject Engineering)</a>	3	A
<a href="#">Master of Science in Bioinformatics(main subject Systems Biology)</a>	3	A
<a href="#">Master of Science in Bioscience Engineering: Cell and Gene Biotechnology</a>	3	A
<a href="#">Exchange Programme in Bioinformatics (master's level)</a>	3	A

**Teaching languages**

English

**Keywords**

Network-based data analysis, systems biology, data-integration

**Position of the course**

This is an advanced course in the master of bioinformatics and systems biology which aims at introducing the importance of data-integration in systems biology. The course is tailored towards students that pursue a master in bioinformatics or any other advanced master that aims at the analysis of cellular, molecular data. The course aims at showing how in systems biology specific biological questions are solved through data-integration. The course will highlight some state-of-the-art research questions and show how they can be approached using bioinformatics tools of which the underlying methods are taught in the theoretical courses. The main emphasis is by means of examples showing that the choice of the analysis method can severely influence the outcome of the results and that therefore in bioinformatics both understanding the intricacies of the biological problem and the underlying assumptions of the tool used to solve the problem are essential to critically evaluate the results. It also shows how different tools solve slightly different research questions and how users need to be aware of the intricacies of the tool to select to most optimal tool for a given research question. By giving examples of applications of integrative data analysis in real world (in plant breeding, synthetic biology, personalized medicine) students will be informed on the ethical aspects that go hand in hand with this novel domain of data-(re) analysis.

**Contents**

The course integrates tools and techniques discussed in the other courses to solve specific 'biological problems' in bioinformatics.

Part II (semester II)

Top down network inference

- Expression based methods
- Integrative methods

## Network-based data-interpretation

- Overview of techniques to visualize data on a network (Pathfinding approaches, Graph based clustering, diffusion techniques)
- Application: eQTL analysis, gene prioritization, biomarker identification

## Genotype phenotyping mapping

- GWAS/QTL (population stratification, linear models)
- Network-aided GWAS
- Integrative genotype-phenotype mapping (cancer systems genetics)

Applications in the domain of medical, microbial and Biotechnology (plant breeding, GWAS for trait selection, personalized medicine)

### Initial competences

identical to those of the Master in Bioinformatics

### Final competences

- 1 Understanding the concepts of network inference, motif detection, data integration.
- 2 Recognize analysis techniques underlying bioinformatics tools.
- 3 Being able to independently read and analyse a systems biology paper that combines biological results with advanced data-analysis.
- 4 Being able to apply a tool given the available documentation and literature.
- 5 Being able to implement a tool given the description in a paper.
- 6 Being able to construct a model to understand a complex biological problem.
- 7 Critical reading attitude towards the domain.
- 8 Understanding bioinformatics is a fastly evolving discipline.
- 9 Functioning as a member of a multidisciplinary environment.
- 10 Communication in an interdisciplinary context.
- 11 Being aware of ethical and confidentiality aspects of some bioinformatics applications.

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Seminar, Lecture

### Study material

Type: Slides

Name: Marchal\_notes

Indicative price: Free or paid by faculty

Optional: no

Language : English

Number of Slides : 100

Available on Ufora : Yes

Online Available : Yes

Available in the Library : No

Available through Student Association : No

Additional information: cursus materiaal is online available and free

### References

recent research articles

### Course content-related study coaching

### Assessment moments

end-of-term and continuous assessment

### Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions, Written assessment

### Examination methods in case of periodic assessment during the second examination period

Written assessment

### Examination methods in case of permanent assessment

Assignment

**Possibilities of retake in case of permanent assessment**

not applicable

**Extra information on the examination methods**

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The exam is open book if it takes place online

In principle the use of generative AI during the exam is forbidden. However because it is impossible to check this, answers that are correct but do not use any concepts or terminology of the course will be judged anyhow incorrect. This will be told in advance to the students. The link in the answer to the lecture should be clear. If the student wishes to add more information than was told in the course, the source of the information should be mentioned.

**Calculation of the examination mark**

Students will be evaluated based on the written end exam (open book) for their understanding, analytical and synthesizing skills (18/20). Student will have to write a report (review of a paper, permanent evaluation). This will contribute 3/20 marks.