



UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2025/26

IN
BIOINFORMATICS FOR COMPUTATIONAL GENOMICS (Classe LM-8)

Enrolled from 2019/2020 to 2024/2025 academic year

HEADING

Degree classification - Denomination and code:	LM-8
Degree title:	Dottore Magistrale
Length of course:	2 years
Credits required for admission:	180
Total number of credits required to complete programme:	120
Course years currently available:	2nd
Access procedures:	Cap on student numbers, student selection based on entrance test
Course code:	F4B

PERSONS/ROLES

Head of Study Programme

Prof. Giulio Pavese

Tutors - Faculty

Students can contact, according to their needs, tutors from both University of Milan and Politecnico di Milano:

Academic guidance tutor: Giulio Pavese (Unimi), Marco Masseroli (Polimi)

Erasmus and international mobility tutor: Matteo Chiara (Unimi)

Study plan tutor: Roberto Mantovani (Unimi)

Internship tutor: Roberto Mantovani (Unimi)

Seminar and workshop tutor: Giulio Pavese (Unimi), Marco Masseroli (Polimi)

Dissertation tutor: Roberto Mantovani (Unimi), Marco Masseroli (Polimi)

University and programme transfer tutor: Matteo Chiara (Unimi)

Master's degree admission tutor: Giulio Pavese (Unimi), Marco Masseroli (Polimi)

Credit recognition tutor: Giulio Pavese (Unimi), Marco Masseroli (Polimi)

Degree Course website

<http://bcg.cdl.unimi.it>

Email: bcgenomics@unimi.it

Academic Services Office

via Celoria, 26 - 20133 Milan - ground floor, C Building Tel. 0250314870 By appointment. [https://informastudenti.unimi.it/saw/ess?](https://informastudenti.unimi.it/saw/ess?AUTH=SAML)
AUTH=SAML

Student Desks

via Celoria, 18 - 20133 Milan Tel. 0250325032 <https://www.unimi.it/en/node/360> <https://www.unimi.it/en/node/359>

CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The Master Degree in 'Bioinformatics for Computational Genomics' (BCG) aims to form graduates with an adequate knowledge about the molecular basis of biological systems; the structure and function of biological molecules and how they participate in cellular processes; the technologies and platforms for the analysis of genomes; the tools for bioinformatic and genomic analysis; and the statistical and computational methodologies for the analysis of biomolecular data.

The BCG degree therefore includes activities providing in depth knowledge on:

1. the organization of information in the genome and the molecular and cellular processes at the basis of gene expression and its regulation
2. the experimental methods used for studying genes and their function in different model species, both prokaryotic and

eukaryotic

3. the technologies employed in modern genomic research

4. methods and protocols of bioinformatic analysis in functional genomics studies

5. algorithmic, mathematical and statistical approaches underlying bioinformatic and genomic analysis tools

6. data base technologies for the storage and organization of the data

7. modelling and analysis techniques employed in systems biology for the study of interactions in complex biological systems.

The program includes, as a fundamental step in the formation of the students, an internship in research laboratories either at the University of Milan or in other Italian or foreign research institutes. The research experience of the internship and its results will be described in a final written dissertation, to be discussed in front of a thesis committee.

Expected learning outcomes

Knowledge and understanding

Graduates in BCG will acquire an in depth knowledge allowing them to apply a multidisciplinary and computational approach to solving complex problems in the fields of biology and biotechnology. The degree aims at providing integrated knowledge on different fields of chemistry and biology, which represent the foundations for a Master degree in the class of Biotechnology. The BCG Master degree aims in particular at providing solid inter-disciplinary knowledge for the development and application of computational tools for bioinformatic and genomic analysis.

Applying knowledge and understanding

A fundamental objective of the Master degree in BCG is to provide students with the ability of applying the knowledge acquired. This aim will be achieved both with class contents and with the final internship in a research laboratory. Suitable teaching time will thus be devoted to problem solving and to activities that will augment the analytical and methodological skills of the students. The skills acquired in classes on fundamental topics will be applied to the design and development of bioinformatic tools for genomic, transcriptomic, epigenomic, and systems biology studies.

Autonomy / judgment (Making judgments)

The acquisition of autonomous skills for making judgements will be made possible by the teaching methods employed in classes and the respective topics. The latter ones will often refer to relevant problems and research lines in different areas, and will include problem solving activities that will take place during classes or the development of projects to be discussed at exams. The usage of teaching material alternative to textbooks (research articles, on line tutorials and videos) will be encouraged, in order to make students acquire notions with a proactive and autonomous approach.

Communication skills

Communication skills can be defined as the acquisition of tools and knowledge for scientific communication using the English language; skills in computing for the elaboration, presentation, and discussion of experimental data; being able to work autonomously, and being able to communicate the results of one's activities to others in seminars, journal clubs, etc. The acquisition of these skills will be included in classes and in the experimental laboratory activities leading to the final dissertation (reading and discussion of scientific literature; reading and discussion of analysis protocols; elaboration and discussion of experimental data).

Learning skills

Learning skills can be defined as the development of suitable skills for the acquisition of novel knowledge, also through retrieval and study of scientific articles in English or access to databases and retrieval of information. These skills will be acquired during the experimental laboratory activities leading to the final dissertation, or the reading and discussion of scientific literature during classes or exams. These activities will allow students to learn through a 'hands on' approach and through the constant interaction both with their peers and the instructors.

Professional profile and employment opportunities

The BCG Master degree aims to train highly skilled professionals able to merge in depth knowledge on the molecular foundations of life sciences with up-to-date knowledge of the current techniques and technologies for bioinformatic and genomic analysis. Particular emphasis will be put on the quantitative and computational aspects of the latter ones, which will be focused on the analysis, modelling, and comprehension of biological systems. The ultimate goal is to train in a multi-disciplinary context professionals ready to cope with the challenges deriving from modern biomolecular sciences in the post-genomic era, and able to conjugate and integrate knowledge on biology, genetics, computer science, information engineering, and statistics in different fields of basic or applied research. The BCG program aims to train the following professional figures: biologist and related figures, biotechnologist.

Graduates in BCG will thus be able to:

1. take part in the design and execution of large scale genomic analyses
2. identify and extract the biological meaning from the results obtained
3. design autonomously tools and protocols for the bioinformatic analysis of different types of experimental data
4. play a pivotal role in research groups focused on basic or applied genomic research
5. coordinate and supervise research projects and groups focused on bioinformatics and genomics.

Programme structure

The BCG Master degree is a 2-year course; each year is divided in two terms (semesters). The program includes different activities, such as frontal lectures, practical classes, and an experimental project leading to the final dissertation. 120 educational credits (CFU, Crediti Formativi Universitari) are required to complete the Master degree.

A CFU corresponds to a standard student workload of 25 hours, and it is calculated as follows:

- for frontal lectures, 1 CFU = 8 hours of lectures and 17 hours of personal elaboration
- for practical classes, 1 CFU = 16 hours of laboratory activities and 9 hours of personal elaboration
- for experimental projects, 1 CFU = 25 hours of laboratory and/or training activities.

Students will acquire 84 CFU from 11 mandatory courses, scheduled in the first and second year, and a minimum of 12 CFU that can be freely chosen. At least 6 CFU out of these 12 CFU must be acquired through attendance of a course (and passing the exam): the course can be chosen either from the list of the BCG elective courses or from any course offered by the University of Milan or the Politecnico di Milano, as long as it is considered consistent with the aims of the BCG degree and is not a repetition of courses already offered by the degree program. For the Academic Year 2024-2025 the following elective courses will be available for students:

- Genomic Big Data Management and Computing
- Interdisciplinary Project
- Neurogenomics and Brain Disease Modelling

Students can also choose courses and classes taught in Italian as freely chosen CFU. 6 CFU can be acquired by additional laboratory activity, (namely, an extension of the thesis period) upon submission of a written request and thesis project that must be approved by the BCG Study Plan Committee.

21 CFU are assigned to the individual experimental project leading to the final dissertation, to be started in the second year. Finally, 3 CFU will be assigned for knowledge of the English language, or of the Italian language for foreign students, or for other activities like attending seminars from invited experts and scientists.

In the first semester of the first year the student will follow a course plan that will be assigned by the Teaching Board upon admission, depending on the student's background and degree(s) previously acquired:

- Students with a degree/background in computer science, engineering, mathematics or physics will attend the courses of the "Percorso 1" ("Knowledge Alignment Plan 1") in Genetics, Cellular and Molecular Biology (12 CFU) and Biochemistry (6 CFU).
- Students with a degree/background in life sciences (biology or biotechnology or equivalent) will attend the courses of the "Percorso 2" ("Knowledge Alignment Plan 2") in Programming and Data Bases (12 CFU) and Statistics (6 CFU).

All the other mandatory courses will be common to all students, regardless of their previous degree/background.

Conscientious objection policy

In the BCG Master degree the use of animals for teaching purposes is not allowed as stated by the law: art. 5f of the Legislative Decree 26/2014. Such procedures are allowed during the traineeships for thesis preparation. However, they must be carried out exclusively by authorized staff, since, in this case, the Legislative Decree 26/2014 does not apply. According to Italian law n. 413, October 12 1993, "Norme sull'obiezione di coscienza alla sperimentazione animale", students have the uncontested right to conscientiously object to participation in any experimental activity using animals. In this case, the Teaching Board will suggest alternative traineeships, which are consistent with the educational goals of the BCG course, to ensure the correct acquisition of the study credits necessary for degree completion.

Campus

Lecture rooms and laboratories are located:

- in the "Città Studi" campus of the University of Milan, mostly in the University buildings of via Celoria, 26 and via Golgi;
- in the "Leonardo" Campus of the Politecnico di Milano, Piazza Leonardo da Vinci 32.

Libraries

The main campus library is the "Biblioteca di biologia, informatica, chimica e fisica" (Via Celoria 18). Link: <http://www.sba.unimi.it/en/libraries/13453.html>

Notes

Students with a Bachelor degree (Laurea Triennale) in Information Engineering who obtained the BCG Master degree will also have the opportunity of enrolling in the Master degree program in 'Computer Science and Engineering' of Politecnico di Milano, with the automatic transfer in their career of part of the CFUs acquired in the BCG program; thus, they will have a very significant reduction of the number of exams to be taken to obtain the second degree in 'Computer Science and Engineering'. Students interested in this opportunity can contact Prof. Marco Masseroli (marco.masseroli@polimi.it) for further information.

Tutoring

Tutors will provide students with academic advice, guidance on their course choices and personal advice. Students can contact, according to their needs, tutors from both University of Milan and Politecnico di Milano.

They can be reached at their institutional e-mail addresses (name.surname@unimi.it for the University of Milano teachers or name.surname@polimi.it for Politecnico di Milano teachers).

Core / compulsory activities

All training activities mentioned in "Program structure" are considered mandatory for the Master degree.

Compulsory attendance

Course attendance is highly recommended. Exceptions for students planning not to attend all or most of the classes of a course ("studenti non frequentanti") must be motivated and authorized by the lecturer.

Testing and assessment procedures

Each course is followed by an exam, usually in the form of a written or oral test (or a combination of the two). Exam grades are calculated on a 30-point scale, 18/30 is the minimum passing grade. Credits for a course are only granted upon passing the corresponding exam. Courses can be taught by more than one instructor: in this case, only one lecturer will be responsible for the final assessment of the student.

Procedures for exam registration and admittance

Exam sessions are scheduled during recess at the end of each semester. For each course, a minimum of 5 tests are scheduled per academic year. Although in principle there is no limit in the number of tests that the student can take per year, some limitations can occur for exams not managed within the BCG Master degree.

Exam registration is compulsory and must be carried out through the UNIMIA - exams registration online service (available at <https://bcg.cdl.unimi.it/en/study/exams>) in order to allow CFUs to be automatically accredited to the student's personal record.

Study plan definition and submission for approval

The students will submit a "Study plan", with the indication of elective courses they intend to attend and how they want to utilize the 12 CFU of freely chosen activities, before the beginning of the classes of the second year (from September 1st to September 15th). The Study plan must be approved by a Study Plan Committee, composed of BCG lecturers. The Study plan can be changed upon request; however, it represents the official record of the degree, and the list of courses must correspond to the exams passed by the student in order to grant admission to the final dissertation.

Information about dates and procedures for submitting the official study plan: <https://www.unimi.it/en/study/bachelor-and-master-study/following-your-programme-study/plan-study>.

Internship criteria

The students will carry out an experimental project leading to writing a dissertation in English, whose discussion will constitute the final exam. The experimental project involves the attendance of a research laboratory either at University of Milan or in other research laboratory, upon previous authorization of the Coordinator of the Master degree. The experimental project accounts for a minimum of 21 CFU, that can be extended by employing CFU for freely chosen activities, and thus it represents a fundamental moment of the Master degree program. The dissertation will describe the original research or project carried out by the student under the supervision of a lecturer within the BCG Master degree, and its subject must be consistent with the goals and the disciplines taught in the Master degree.

Degree programme final exam

The final exam consists of the oral presentation and discussion of the research project main results in front of a dissertation committee and it contributes with a maximum of 10 points to the final grade. The final grade will be thus assigned as the weighted average of the grades in the lecture courses, calculated on a scale of 110, to which the points of the final dissertation will be added.

Lecture timetable

Lesson timetables are available at the URL: <https://easystaff.divisi.unimi.it/PortaleStudenti/> or by downloading the official student Class timetable app of the University of Milan "Lezioniunimi".

EXPERIENCE OF STUDY ABROAD AS PART OF THE DEGREE PROGRAM

The University of Milan supports international mobility by providing its students with the opportunity to spend study and

internship periods abroad. It is a unique chance to enrich your educational path in a new exciting environment. The agreements entered into by the University with over 300 universities from the 27 EU member countries under the European Erasmus+ programme allow regularly enrolled students to carry out part of their studies at one of the partner universities or to undertake internships at companies, training and research centres and other organizations. Similar international mobility opportunities are provided outside Europe, through agreements with a number of prestigious institutions.

Study and internships abroad

The BCG degree program supports the international mobility of the University program: a lecturer (for the academic year 2024/2025, Prof. Matteo Chiara) acts as a tutor for students interested in the Erasmus+ program, in order to guide students in their choice of the most suitable program for their formation.

In the framework of the Erasmus+ program, the BCG Master course has in place agreements with Universities in Denmark, Germany, Spain, France, Norway, and The Netherlands, all offering courses in English.

Calls for participation can be found at the following link: <https://www.unimi.it/en/international/study-abroad/studying-abroad-erasmus>

The time spent abroad can be used to attend courses and pass the relative exams, thus collecting credits towards the Master degree, as well as to carry out the experimental project for the dissertation. The student admitted to the mobility program must submit a study plan detailing the training activities that he/she plans to carry out, with the corresponding credits. The number of credits should correspond as much as possible to the number of credits that the student should acquire in a similar time at the home University. The proposed activities must be consistent with the goals and the contents of the Master degree. The study plan must be approved by the BCG Student Mobility Committee, which can request changes or integrations. At the end of the mobility program, according to the guidelines provided by the University of Milan, the courses attended (with a passed exam) by the student are registered in his/her career, preferably with its original name and with an indication of the ECTS (European Credit Transfer and Accumulation System) and their conversion in CFU (usually 1 ECTS = 1 CFU). The students willing to carry out their dissertation work as part of a mobility program abroad must have an internal supervisor (chosen among the BCG lecturers) and the study plan must be approved by the BCG Teaching Board.

How to participate in Erasmus mobility programs

The students of the University of Milan can participate in mobility programmes, through a public selection procedure.

Ad hoc commissions will evaluate:

- Academic career
- the candidate's proposed study programme abroad
- his/her foreign language proficiency
- the reasons behind his/her application

Call for applications and informative meetings

The public selection for Erasmus+ mobility for study generally begins around February each year with the publication of a call for applications specifying destinations and requirements. Regarding the Erasmus+ Mobility for Traineeship, the University of Milan usually publishes two calls a year enabling students to choose a destination defined by an inter-institutional agreement or to find a traineeship position on their own.

The University organizes informative meetings to illustrate mobility opportunities and rules for participation.

Erasmus+ scholarship

The European Union grants the winners of the Erasmus+ programme selection a scholarship to contribute to their mobility costs, which may be supplemented by the University funding for disadvantaged students.

Language courses

Students who pass the selections for mobility programmes can benefit from intensive foreign language courses offered each year by the University Language Centre (SLAM).

<https://www.unimi.it/en/node/8/>

Learn more at <https://www.unimi.it/en/node/274/>

For assistance, please contact:

International Mobility Office

Via Santa Sofia 9 (second floor)

Tel. 02 503 13501-12589-13495-13502

Contacts: InformaStudenti; mobility.out@unimi.it

Student Desk booking through InformaStudenti

ADMISSION CRITERIA: 1ST YEAR CAP ON STUDENT, STUDENT SELECTION BASED ON ENTRANCE TEST

N° of places reserved to non-EU students resident abroad

Number of places assigned

50

1st COURSE YEAR (Cancelled since academic year 2025/26) Core/compulsory courses/activities				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
	Bioinformatics and Computational Biology		6	ING-INF/05
	Organic Chemistry		6	CHIM/06
	Biostatistics		6	(5) SECS-S/01, (1) MAT/06
	Genomics and Transcriptomics		12	BIO/11
	Machine Learning		6	(5) ING-INF/05, (1) INF/01
	Scientific Programming		6	ING-INF/05
		Total number of compulsory credits/ects	42	
Elective courses				
Students with a degree/background in computer science, engineering, mathematics or physics will attend the courses of the "Knowledge Alignment Plan 1".				
Students with a degree/background in life sciences (biology or biotechnology or equivalent) will attend the courses of the "Knowledge Alignment Plan 2".				
	Biochemistry (Knowledge Alignment Plan 1)		6	BIO/10
	Genetics, Cellular and Molecular Biology (Knowledge Alignment Plan 1)		12	(5) BIO/11, (5) BIO/18, (2) BIO/13
	Programming and Data Bases (Knowledge Alignment Plan 2)		12	(10) ING-INF/05, (2) INF/01
	Statistics (Knowledge Alignment Plan 2)		6	(5) SECS-S/01, (1) MAT/06
2nd COURSE YEAR Core/compulsory courses/activities				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
1 semester	Advanced Genomics and Epigenomics		12	(6) BIO/19, (6) BIO/18
1 semester	Structural Chemistry		6	(4) ING-IND/34, (2) CHIM/06
1 semester	Systems Biology and Network Analysis		6	ING-INF/06
		Total number of compulsory credits/ects	24	
Further elective courses				
Open choice courses: 12 CFU				
The student can employ part of all of the 12 CFU of freely chosen activities in attending one or more of the following courses:				
1 semester	Genomic Big Data Management and Computing		6	(1) BIO/11, (5) ING-INF/05
1 semester	Interdisciplinary Project		6	(1) BIO/11, (5) ING-INF/05
1 semester	Neurogenomics and Brain Disease Modelling		6	BIO/11
End of course requirements				
	Final dissertation		21	ND
year	Language Skills and other activities (attendance to seminars, etc.)		3	ND
		Total number of compulsory credits/ects	24	

COURSE PROGRESSION REQUIREMENTS

There are no propaedeutic courses in the BCG degree that can limit progression from the first to the second year.

VALIDATION OF ECTS ACQUIRED IN OTHER/PREVIOUS DEGREE PROGRAMMES/ THROUGH PROFESSIONAL EXPERIENCE**Validations of previously acquired ects**

CFU PREVIOUSLY ACQUIRED IN OTHER MASTER DEGREES

Students that previously acquired CFU in another Master program will undergo the audit of an ad hoc committee that will decide if and how many of the CFU can be validated upon admittance to BCG.

CFU ACQUIRED DURING PROFESSIONAL EXPERIENCES

A maximum of 12 CFU can be acquired (according to art. 5, comma 7, del DM 270/2004) by certified professional experiences and by post-secondary level educational activities performed in association with the University.