



UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2019/20
IN
BIOINFORMATICS FOR COMPUTATIONAL GENOMICS (Classe LM-8)
Enrolled from 2019/2020 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:	1st
Access procedures:	Cap on student numbers, student selection based on entrance test
Course code:	F4B

PERSONS/ROLES

Tutors - Faculty

For the academic year 2019/2020 students can contact: at the University of Milano Prof. Giulio Pavesi, Prof. Aureliano Bombarely, Prof. Roberto Mantovani; at the Politecnico di Milano Prof. Marco Masseroli and Prof. Francesca Ieva. 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).

Email: bcgenomics@unimi.it

<http://sites.unimi.it/bioinfo4gen>

CHARACTERISTICS OF DEGREE PROGRAMME

Introduction

This "Manifesto degli Studi" represents the syllabus for the Bioinformatics for Computational Genomics (BCG) Master degree at the University of Milan (Italian: Laurea magistrale nella classe LM-8 "Biotecnologie industriali"). The Department of Biosciences is the academic institution responsible for the BCG Master degree, in collaboration with the School of Industrial and Information Engineering of the Politecnico di Milano.

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; of 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.

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.

Pre-requisites for admission

Italian Students

Students can apply to the BCG Master degree course, provided that they satisfy one of the following two requirements:

1) they have completed a bachelor degree program (Laurea Triennale) in one of the following classes:

- Biotechnology (class L2);
- Biology (class L13);
- Agriculture and Food Sciences (class L26);
- Pharmacological Sciences (class L29);

and during their studies they have acquired at least 30 CFU in biological areas (SSD BIO) with at least 18 CFU in Genetics (BIO/18), Molecular Biology (BIO/11) and Biochemistry (BIO/10)

OR

2) they have completed a bachelor degree program (Laurea Triennale) in one of the following classes:

- Information Engineering (class L8);
- Physics (class L30);
- Computer Sciences (class L31);
- Mathematics (class L35).

and during their studies they have acquired at least 30 CFU in the areas of computer science, information engineering, biomedical engineering, mathematics and/or statistics (SSD INF/01, ING-INF/05, ING-INF/06, MAT/01-09, and/or SECS-S/01), with at least 6 CFU in mathematics (MAT/01-09) and at least 12 CFU in one or more of the following areas: computer science (INF/01), information engineering (ING-INF/05), biomedical engineering (ING-INF/06), statistics (SECS-S/01).

The same criteria are applied to candidates in possession of foreign university degrees, deemed to be suitable by the Teachers Council, in which it is possible to clearly identify disciplines and number of credits acquired for each discipline. If this is not possible, the documents certifying the career of the candidates will be examined in detail by the Teachers Council in order to assess if their background complies with the previous requirements.

Foreign Students

Students in possession of a Bachelor degree in an area of those described at the previous point (Admission for Italian Students), where courses taken in the required disciplines can be clearly identified together with the amount of hours/credits of the courses. If this is not possible, the documents certifying the career of the students will be examined by the Teachers Council in order to assess if their background complies with the previous requirements.

Language Requirements

Knowledge of English is a requirement for the access to the BCG Master degree. Students should have acquired beforehand a B2 level certification (vantage or upper intermediate, as defined by the Common European Framework of Reference for Languages: Learning, Teaching, Assessment). Students without a B2 placement test may be accepted on condition that their level of English proficiency, assessed during the interview, is evidently good, or, in alternative, can present a report or screenshot of their results at the self-test Dialang (that can be taken on the internet at <http://dialangweb.lancaster.ac.uk>).

The adequate personal preparation of the candidates, their ability to communicate in English and their motivation are decisive elements for the admission and they are going to be verified and tested during an admission interview.

Knowledge of Italian is not required for attendance. However, as required by regulations, foreign students will have to demonstrate to have acquired basic knowledge of the Italian language before the final dissertation.

Programme structure

The BCG Master degree is a 2-year course; each year is divided in two terms (semesters). The programme 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. Students can also choose 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 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.

Libraries

The main campus library is the Biblioteca Biologica Interdipartimentale (Via Celoria, 26).

Tutoring

Tutors will provide students with academic advice, guidance on their course choices and personal advice. For the academic year 2019/2020 students can contact: at the University of Milano Prof. Giulio Pavesi, Prof. Aureliano Bombarely, Prof. Roberto Mantovani; at the Politecnico di Milano Prof. Marco Masseroli and Prof. Laura Sangalli. 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.

Language test / computer literacy test

Knowledge of English is a requirement for the access to the BCG Master degree. Students should have acquired beforehand a B2 level certification (vantage or upper intermediate, as defined by the Common European Framework of Reference for Languages: Learning, Teaching, Assessment). Students without a B2 placement test may be accepted on condition that their level of English proficiency, assessed during the interview, is evidently good, or, in alternative, can present a report or screenshot of their results at the self-test Dialang (that can be taken on the internet at <http://dialangweb.lancaster.ac.uk>).

Knowledge of Italian is not required for admission or attendance. However, as required by regulations, foreign students will have to demonstrate to have acquired a basic knowledge of the Italian language before the final dissertation.

Compulsory attendance

Course attendance is highly recommended. Exceptions for students planning not to attend all or most of the classes of a course ("student 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, 6 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.

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 (i.e., before the end of September). 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.

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

Lessons of the first term (semester) will take place between September 16th 2019 and January 17th 2020.

Lessons of the second term (semester) will take place between March 2nd 2020 and June 19th 2020.

Lesson timetables will be available at the URL: <http://sites.unimi.it/bioinfo4gen>

EXPERIENCE OF STUDY ABROAD AS PART OF THE DEGREE PROGRAM

The University of Milan supports the international mobility of its students, offering them the opportunity to spend periods of study and internship abroad, a unique opportunity to enrich their curriculum in an international context.

To this purpose, the University of Milan takes part to the European Erasmus + program, which includes over 300 universities in more than 30 countries. Within this program, students can visit one of these universities in order to pursue educational activities as a part of their curriculum, including training activities / internships at companies, training and research centers or other organizations, or even to prepare their dissertation.

The BCG degree program supports the international mobility of the University program: a lecturer (for the academic year 2019/2020, Prof. Giulio Pavesi) 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.

Study and internships abroad

In the frame work 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: <http://www.unimi.it/studenti/erasmus/79224.htm>

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

To gain access to mobility programs for study purposes, lasting 3-12 months, the enrolled students of the University of Milan must attend a public selection that starts usually around the month of February each year through the presentation of specific competition announcements, which contain information on available destinations, respective duration of the mobility, requirements and deadlines for submitting the online application.

The selection, aimed at evaluating the proposed study abroad program of the candidate, knowledge of a foreign language, especially when this is a preferential requirement, and the motivations behind the request, is performed by specially constituted commissions.

Each year, before the expiry of the competition announcements, the University organizes information sessions for the specific study course or groups of study courses, in order to illustrate to students the opportunities and participation rules. To finance stays abroad under the Erasmus + program, the European Union assigns to the selected students a scholarship that - while not covering the full cost of living abroad - is a useful contribution for additional costs as travel costs or greater cost of living in the country of destination.

The monthly amount of the communitarian scholarship is established annually at national level; additional contributions may be provided to students with disabilities.

In order to enable students in economic disadvantaged conditions to participate in Erasmus+ program, the University of Milan assigns further additional contributions; amount of this contributions and criteria for assigning them are established from year to year.

The University of Milan promotes the linguistic preparation of students selected for mobility programs, organizing every year intensive courses in the following languages: English, French, German and Spanish.

The University in order to facilitate the organization of the stay abroad and to guide students in choosing their destination offers a specific support service.

More information in Italian are available on www.unimi.it > Studenti > Studiare all'estero > Erasmus+

For assistance, please contact:

E-mail: mobility.out@unimi.it, international.education@unimi.it, diploma.supplement@unimi.it

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

Application and enrolment information and procedures

APPLICATION FORM

Both Italian and foreign students must submit admission applications by the deadlines indicated in the "student area" of the University of Milan website. Undergraduates who intend to achieve a Bachelor degree (or equivalent) before 31 October 2019 may also apply. Completion of the application form is compulsory and must be submitted electronically to the following address: http://www.unimi.it/studenti/servizi_online.htm

BACKGROUND KNOWLEDGE

The prerequisite to access the BCG Master degree program is an adequate knowledge of the fundamentals of either (1) genetics, molecular biology and biochemistry or (2) computer science, information engineering and mathematics.

This will be verified through 1) evaluation of the bachelor study program and 2) direct assessment of candidate scientific background knowledge.

Evaluation of the bachelor study program

Students satisfying the above criteria will be admitted to an interview for the assessment of their scientific background knowledge

Interview for direct assessment of candidate scientific background knowledge.

The candidate's background knowledge will be verified by an interview with the Commission for Admittance to the Master, composed by teaching members appointed by the Teaching Board. The interview will evaluate the expertise of the candidate in topics related to their bachelor degree.

The committee will evaluate each applicant on a 100-point scale:

- 1) Up to 50/100 points will be awarded for the applicant resume (type of bachelor degree attended, exam grades, further courses attended, additional degrees, etc.)
- 2) Up to 50/100 points will be awarded for the interview.

The minimum score required for admission is 60/100.

For the Academic Year 2019-2020, interviews for Italian students will take place at the Department of Biosciences, Via Celoria 26, on July 16th 2019, h.9.30. Foreign students who reside in Italy must attend the evaluation interview as well. Foreign applicants who are not resident in Italy and have achieved their Bachelor degree abroad may opt for an online interview. At the beginning of the interview, students must show a valid ID card or passport for identification. It is advisable to check for any possible updates concerning dates and times of the examination on the website: <http://sites.unimi.it/bioinfo4gen>

Links to enrolment information and procedures

<http://www.unimi.it/ENG/admission/92320.htm>

Practical instructions

ENROLLING IN THE BCG COURSE

Once the results have been published, students who occupy the first 50 positions in the merit ranking must complete their enrolment within the deadline set out in the competition notice. Subsequently, if after the initial deadline the first 50 available positions are not saturated, enrolment will be possible for students with lower merit ranking, provided they have achieved at least 60/100 in the admission test. Enrolment of undergraduates will be validated only if they obtain their Bachelor degree (Laurea Triennale for Italian students) by 31 October 2019. Students from other Universities, upon graduation by 31 October 2019, must present certification of the awarded degree at the Segreteria Studenti.

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

10

Number of places assigned

50

1st COURSE YEAR Core/compulsory courses/activities				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
1 semester	Bioinformatics and Computational Biology		6	ING-INF/05
1 semester	Organic Chemistry		6	CHIM/06
2 semester	Biostatistics		6	SECS-S/01, MAT/06
2 semester	Genomics and Transcriptomics		12	BIO/11
2 semester	Machine Learning		6	ING-INF/05, INF/01
2 semester	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".				
1 semester	Biochemistry (Knowledge Alignment Plan 1)		6	BIO/10
1 semester	Genetics, Cellular and Molecular Biology (Knowledge Alignment Plan 1)		12	BIO/11, BIO/18, BIO/13
1 semester	Programming and Data Bases (Knowledge Alignment Plan 2)		12	ING-INF/05, INF/01
1 semester	Statistics (Knowledge Alignment Plan 2)		6	SECS-S/01, MAT/06
2nd COURSE YEAR (available as of academic year 2020/21) Core/compulsory courses/activities				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
1 semester	Advanced Genomics and Epigenomics		12	BIO/19, BIO/18
1 semester	Structural Chemistry		6	ING-IND/34, 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				
Language Skills and other activities: 3 CFU will be assigned for knowledge of the English language, or of the Italian language for foreign students, or by other activities like attending seminars from invited experts and scientists.				
End of course requirements				
	Final dissertation		21	ND
Total number of compulsory credits/ects			21	

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 9 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.