TEACHING REGULATION OF THE MASTER DEGREE COURSE IN MEDICAL BIOINFORMATICS (CLASS LM-18)

Art. 1 Subject / Purpose of the regulation

This regulation specifies the organizational aspects of the Master Degree Course in Medical Bioinformatics, Class LM-18-Informatics, established and activated at the University of Verona starting in the academic year 2016/17.

In particular it illustrates: the educational goals and career opportunities, requirements for the access, delivery modes of teaching and verification of learning outcomes achieved by students. It also regulates the mechanisms of curriculum change and transfer from other courses of studies.

Art. 2 Training objectives

SPECIFIC OBJECTIVES OF THE COURSE

The goal of the Master Degree in Medical Bioinformatics is to train graduates able to perform executive and coordination functions in the areas of design, development, management and maintenance of information systems in medicine, biology and health systems, with particular regard on biomedical oriented complex software innovation in science and technology for diagnostic and therapeutic purposes, to complex information systems for the management of clinical and bioinformatic data bases, software for processing medical and biological data in clinical decision support systems, health information systems with heterogeneous and complex architectures, visual interfaces for bioinformatics. To that objective, the Master Degree in Medical Bioinformatics will provide the theoretical basis, methodological and technological multi- and inter- disciplinary needs to address the problems related to the design, analysis and development of intelligent systems in complex bioinformatics and medical informatics.

The specific educational objectives of the degree course can be articulated as follows:

- Theoretical, methodological, experimental and applied knowledge in the core areas of
computer science, with particular reference to the application domains of biology and medicine;

- Knowledge of techniques and methodologies in data and processes design for the development of computer systems in medical and bioinformatics-genomic;
- Knowledge of information systems, analysis and mining of bioinformatics and medical data;
- Knowledge of the main software platforms, sequencing techniques, bioinformatics data bases for public use and the used standards for the representation and communication of data;
- Ability to design, implement and integrate software modules for genome analysis and web services implementation oriented to the management of biological and clinical data;
- Ability to identify the components and tools suitable for the treatment of complex problems of bioinformatics and medical informatics, where interdisciplinary skills must be integrated.

For the internationality of the scientific, technical and economic aspects of informatics and its applications in Medicine and Health Systems, the training will be entirely offered in English.

The training course, in line with the above objectives, aims to deeply investigate the theoretical, methodological and technological aspects of computer science and their applications to biological and medical fields. It provides the biological and medical knowledge adequate to address with awareness these complex application domains.

In order to achieve this, the course provides in the first year, teachings in the area of basic skills. Students will learn the foundational and essential skills necessary to master students and necessary to deal with specialized applications for the biomedical field. In the first year it is also provides lessons giving to students a thorough understanding of the biological and medical knowledge needed in the Bioinformatics and Medical Informatics area.

In the second year, students will complete the knowledge and their skills in the Bioinformatics and Medical Informatics areas with classes in computer science focused on architectures for the development of biological data, genomic sequence analysis, models of natural computing, databases, health information systems, clinical decision support techniques and biomedical images processing.

The training is completed by the courses chosen by the student and further training activities related to language skills and work experience/internships. The final test consists in the
development of a doctoral thesis, which commitments the student in research work, formalization, design or development: this work will contribute substantially to the completion of its technical and scientific education.

EXPECTED LEARNING RESULTS

1.a Knowledge and understanding and ability to apply knowledge and understanding: summary

Knowledge and ability to understanding

The Master Degree in Medical Bioinformatics consists of three training areas: the area of basic skills, the area of bioinformatics expertise, and the area of medical informatics skills. These areas are considered interconnected and mutually dependent, in order to offer a complete and robust set of skills and capabilities to the Master Degree Graduates.

- In the **area of knowledge and core skills** (Scientific disciplinary sectors INF / 01 Computer science and ING - INF / 05 Information Processing Systems), the students will learn the foundational and essential skills for a master computer scientist, essential to address specialized applications in the biomedical field. The specific knowledge base for medical bioinformatics concern the methods of analysis and development of algorithms for bioinformatics applications, programming languages and their use in solving complex bioinformatics problems, theory and advanced techniques for managing and querying biological and biomedical data, and computational analysis techniques of complex biological data.

- As part of the disciplinary sectors BIO and MED, the students will achieve a thorough understanding of the biological and medical knowledge needed to the Bioinformatics (BIO/11 Molecular Biology, BIO/13 Applied Biology, BIO/18, Genetics, MED/03, Genetics medical) and to the medical Informatics (MED/01 medical Statistics, BIO/12 Clinical Biochemistry and Molecular Biology) areas.

The completion of knowledge and skills in Bioinformatics and Medical Informatics will take place in the area of information technology (sectors INF/01 and ING-INF-05), with the focus on aspects such as architectures for processing biological data, analysis of genomic sequences, natural computing models, health information systems, data analysis techniques to support clinical decision making and processing of biomedical images.
Graduates will have demonstrated knowledge and understanding that extend and/or strengthen those typically associated with the first degree and allowing to develop and/or apply original ideas, often within a research context.

Ability to apply knowledge and understanding

Graduates are able to apply their knowledge, understanding and ability to solve problems in new or unfamiliar environments, within broader contexts (or multidisciplinary) related to their field of study.

The Master Degree Graduate, once they have acquired the basic and advanced knowledge of their area, will be able to identify the central aspects of new issues and bring them back to the acquired schemas or to propose innovative solutions.

In particular, graduates will have the following abilities to apply their Knowledge and skills:

- Ability to design, deploy, and integrate software modules for the analysis of genomes and of typical data in bioinformatics (disciplinary sectors INF/01 Computer science, ING-INF/05 to information processing systems, BIO/11 Molecular Biology, BIO/13 Applied Biology, BIO/18 Genetics, MED/03 Medical Genetics);
- Ability to design algorithms and related software tools for the analysis of biomedical data with machine learning techniques and for mining large amounts of biomedical data (disciplinary sectors INF/01 Computer science, ING-INF/05 Information Processing Systems, BIO/18 Genetics, MED/03 Medical Genetics, BIO/12 Clinical Biochemistry and Molecular Biology, MED/01 Medical Statistics);
- Ability to propose and design software modules for the structuring of web services and distributed platforms for integrated management of clinical and biological data to support clinical activities (disciplinary sectors INF/01 Computer science, ING-INF/05 Information Processing Systems, MED/03 Medical Genetics, BIO/12 Clinical Biochemistry and Molecular Biology);
- Ability to integrate advanced information technology solutions for the treatment and processing of biomedical data in complex health information systems, regional, national and international, based on a solid understanding of health organization (disciplinary sectors INF/01 Computer science, ING-INF/05 Information Processing Systems, MED/01 Medical Statistics, BIO/12 Clinical Biochemistry and Molecular Biology).

At the end of this training course, with the attainment of the degree, students will possess knowledge, skills, and techniques in the different fields related to medical bioinformatics that
will enable them to play an active role and responsibility in the planning, implementation and management complex and integrated systems oriented to the management of biological and medical data in support of health and clinical processes for the treatment and prevention of diseases and in support of biomedical research, including interdisciplinary research team in the biomedical field.

2.a Knowledge and understanding and ability to apply knowledge and understanding: detail

Basic skills area

Knowledge and understanding

Master degree graduate in Bioinformatics, in addition to basic training in informatics and bioinformatics provided by the first three-year degree, must have more foundational and essential skills necessary for a master graduate computer scientist to address specialized applications in biomedicine.

The student must be able to master the methods of analysis and algorithms development, with particular emphasis on bioinformatics applications, and analyze its complexity. He must also get to know the basics of programming languages and know how to use these languages in the solution of complex bioinformatics problems. He must know the theory and advanced techniques for the management and interrogation of biological and biomedical data. He must know the techniques of computational analysis of biological data of a complex nature.

Activities that contribute to the achievement of this result are provided in the form of lectures and exercises in the classroom. The verification of the educational attainment of the objective is achieved through final evaluations in the form of tests to detect the capacity of understanding and knowledge gained by the student.

Ability to apply knowledge and understanding

The programs of the teachings and the verification procedures allow the student to apply his basic skills in different contexts, to address and solve problems by themselves. The presence of specific laboratory activities in all shared and obligatory courses allows the student to check his abilities on the field and apply his acquired basic skills.
The achievement of this educational objective is obtained by final (exam-test) written and oral, designed to detect the effectiveness of the learning process, but also through practical experiments addressed in the common teaching in medical bioinformatics area.

Bioinformatics Area

Knowledge and understanding

Specific aspects of bioinformatics than knowledge and understanding in bioinformatics are notably: the acquisition of theoretical, methodological, experimental and applied knowledge in key areas of information technology, with particular emphasis on applications related to bioinformatics activities of biomedical laboratories; the knowledge of the techniques and design methods for data analysis, and for the development of computer systems in the field of genomic; knowledge of common software platforms in bioinformatics; knowledge of the main bioinformatics data bases and the used standards for the representation and communication of data; knowledge of the main genomic sequencing technologies and related formats.

Compared to such knowledge and its arguments, the master degree graduate should know how to read and understand the scientific and technical literature, as well as being able to develop a project, organize it and document it.

Ability to apply knowledge and understanding

The master degree graduates are able to apply their knowledge, understand and solve problems in new or unfamiliar environments, within broader contexts (or multidisciplinary) related to their field of study.

Graduates, once acquired the basic and advanced knowledge, will be able to identify the key elements of the new issues and bring them back to acquired schemes or propose innovative solutions: the teaching programs and the verification procedures are oriented in this direction. In particular, graduates in Medical Bioinformatics will have the following skills to apply their knowledge and skills in bioinformatics area: ability to design, deploy, and integrate software modules for the analysis of genomes and typical biological data in bioinformatics; ability to design algorithms and related software tools for the analysis of biological data with machine learning techniques; ability to propose innovative solutions in the field of interdisciplinary research team in the biomedical field.
To this end, the theory lessons are complemented by in-depth application and practical activities with direct involvement of the student (exercises in the classroom and in the laboratory), also in interdisciplinary research groups applied in bioinformatics. To achieve these learning outcomes, in addition to lectures and classroom exercises are important exercises and activities in research laboratories, where students can experience the application of acquired knowledge to real situations, and specific training activities at companies, research centers and public authorities. The verification of the achievement of this training objective is obtained both with final evaluations (tests) adapted to detect the effectiveness of learning processes which may include application projects, and also through the evaluation of the activities carried out in the laboratory and during external training.

**Medical Informatics Area**

**Knowledge and understanding**

Specific aspects of the Master Degree with respect to knowledge and understanding in medical informatics are in particular: acquisition of theoretical, methodological, experimental and applied capabilities in the core areas of information technology, with particular emphasis on applications related to clinical activities and healthy system organizations; knowledge of the techniques and design methods for data analysis, and for the development of computer systems in the medical field; knowledge of information systems, computer systems, and of biomedical data management methods; Knowledge of methods of "data mining" of the biomedical - clinical interest. Compared to such knowledge and its arguments, the masterful graduate should know how to read and understand the scientific and technical literature, as well as being able to develop a project, organize it and document it.

**Ability to apply knowledge and understanding**

Graduates are able to apply their knowledge, understanding and ability to solve problems in new or unfamiliar environments, within broader contexts (or multidisciplinary) related to their field of study. Graduates, once acquired the basic knowledge and advanced his area, will be able to identify the key elements of the new issues and bring them back to acquired schemes or propose innovative solutions: the teaching programs and the verification procedures are oriented in this direction.
In particular, graduates in Medical Bioinformatics will have the following skills to apply their knowledge in medical informatics: ability to design, deploy, and integrate software modules for the structuring of web services in the management of biomedical data; ability to design algorithms and related software tools for the analysis of biomedical data with machine learning techniques and for the mining of large moles of biomedical data; ability to propose and design distributed platforms for integrated management of clinical and biological data to support clinical activities; ability to propose innovative solutions in the field of interdisciplinary research team in the biomedical field; ability to integrate advanced information technology solutions for the treatment and processing of biomedical data in complex health information systems, regional, national and international, based on a solid knowledge of the healthcare organization. To this end, the theoretical lessons are complemented by in-depth application and practical activities with direct involvement of the student (exercises in the classroom and in the laboratory), even within the organizational reality of the health care system and with the collaboration of hospital clinical divisions.

To achieve these learning outcomes, in addition to lectures and classroom exercises are important the exercises and activities in research laboratories, where students can experience the application of acquired knowledge to real situations, and specific training activities at companies, organizational units of the health system, and government agencies. The verification of the achievement of this training objective is obtained both with final evaluations (tests) adapted to detect the effectiveness of learning processes which may include application projects, and also through the evaluation of the activities carried out in the laboratory and during external training.

**Autonomy on the judgment**

Graduates, once acquired the basic knowledge and advanced its area, will be able to identify the key elements of the new issues and bring them back to skills acquired or to propose innovative solutions. Fundamental is the independent evaluation capacity of the complexity of the data and its scientific value, the correct interpretation of results, and the responsible use of the data obtained.

Graduates must be able to justify the used method and compare with alternative approaches to validate the robustness of the method and the reliability of results in relation to current standards of the specific application domain.

The training objective achievement will be demonstrated by passing the assessment tests (also intermediate), the level of participation in the activities that characterize each discipline, and the proper conduct of the final examination. The autonomy on the judgment of the
graduates is also stimulated and developed by the laboratory activities and the development of projects related to application-specific issues.

Communication ability

Graduates will acquire adequate skills and written and oral communication instruments, also in English, developing the skills necessary to analyze, propose and critically discuss the details of its activities with both specialist and non-specialist. Communication skills are developed through the encouragement of discussion and interaction during the course of the various disciplines. They have occurred during the evaluations (including intermediate) of the various disciplines and the thesis, through exposure and discussion of what is proposed. The final test will be the culmination of these skills.

Learning ability

Graduates will have acquired sufficient capacity for learning and deepening of research topics and current issues affecting the field of medical bioinformatics essentially applied to genomic and medical information technology in its aspects of the collection, integration and navigation of complex data. The ability of consulted bibliographic material, the ability to use databases in the medical field and the continuous professional development through participation in thematic seminars are part of a set of skills that it is needed to maintain effective competence in interpretation of scientific reality and professional in continuous and rapid evolution. The verification of such learning skills obviously culminates in the interim and final evaluations of the various disciplines and in a careful evaluation of the final examination.

Art. 3 Professional profile and employment and career opportunities for graduates

In general, the Graduate in Medical Bioinformatics has a computer professional profile explicitly addressed to treatment (representation, processing, analysis, visualization, storage and communication) of large amounts of data ("Data Scientist" is the expression to characterize this professional) structured, semi-structured and unstructured, in order to extend and employ advanced techniques and tools in the integrated fields of biology, medicine and health.

Professions for Graduates in Medical Bioinformatics helps to expand scientific knowledge by conducting research and experiments in the fields of computer science and telematics
applied to medicine and biology. Apply this knowledge and make it available for clinical, medical, biomedical, and scientific research bioinformatics.

Graduates may find employment in IT organizations/companies operating in the fields of production of software and hardware for bioinformatics or medical and clinical applications at hospitals and health institutions/organizations centers, at pharmaceutical companies, at research institutions - public and private - and genomics and health services, in private practice and in the sectors of public employment.

**Function in a work environment:**

Graduate in Medical Bioinformatics is able to carry out executive functions and coordination in the areas of design, development, management and maintenance of information systems in medicine, biology and health systems, with particular regard to:

- Biomedical oriented software design in science and technology for diagnostic and therapeutic purposes;
- Design of complex information systems for the management of clinical and bioinformatics data bases;
- The design of systems for the processing of medical and biological data in clinical decision support systems;
- Management of health information systems with heterogeneous and complex architectures;
- Systems design and visual interfaces for bioinformatics.

**Skills associated with the function:**

In carrying out his functions, the Graduate in Medical Bioinformatics will be able to deal with computer problems in the biomedical field from a managerial point of view, to coordinate working groups and to define innovative approaches compared to the state of art.

Skills related to the professional skills that can be covered by the master's degree in Medical Bioinformatics are therefore linked to the following aspects:

- Theoretical, methodological, experimental and applied capabilities in the core areas of information technology, with particular emphasis on bioinformatics activities of biomedical laboratories, to those more specifically clinics, and those typically addressed in health organization;
- Ability to face and to analyze complex problems in biology, medicine and health, and to coordinate the development of computer systems for their solution;
- Knowledge of research methodologies and ability to know how to apply in a particular case, managing of a working group in projects that require skills in medical informatics and bioinformatics;
- Appropriate mastery of knowledge in the biomedical field of completion and support of computer skills.

**Career opportunities:**

Graduates may find employment in IT organizations/companies operating in the fields of production of software and hardware for bioinformatics or medical-clinical applications, research organizations - public and private - and genomic and health services, and in private practice in the areas of public employment.

The acquired skills will enable them to take roles and perform tasks of the following types:

- Activities of scientific and technological development for diagnostic and therapeutic purposes;
- Planning, organization, management and maintenance of complex medical information systems for the management of clinical data bases or bioinformatics, for processing and medical bioinformatics data in clinical decision support systems, both in health information systems and hospital;
- Support to the organizational activities, clinical and scientific inter- and intra-hospital, both at research laboratories in bioinformatics, and at IT companies operating in the medical sector;
- Teaching activities in different schools and grades, when completed additional specific training.

The working opportunities for graduates in Medical Bioinformatics go beyond the territory of Verona and regional areas: by observing the Italian and international realities, the skills from a master's degree like that allow us to consider positions in the IT companies operating in the medical sector, at hospitals, in bioinformatics, in research laboratories, in medicine for use in clinical and scientific activities.
The course prepares students for the profession of (encodings ISTAT)

1. Analysts and software designers - (2.1.1.4.1)
2. System Analysts - (2.1.1.4.2)
3. Analysts and web application designers - (2.1.1.4.3)
4. Analysts and database designers - (2.1.1.5.2)
5. Systems administrators - (2.1.1.5.3)

Art. 4 Teaching Board

Organizational management of the Master Degree is entrusted to the Teaching Board (TB) of Computer Science in agreement with the Statute of the University. The TB can create internal commissions delegating the performance of specific tasks as required by the University Academic Regulations.

Art. 5 The conduct of teaching and report credits / hours

The teaching activities of the Degree Course comprise:
• Lectures carried out by a teacher
• Exercises done in the presence of a teacher
• Laboratory work and practical training / internship carried out independently by the student

The conversion ratio CFU/hours related to various activities is defined by the resolutions of the Department of Computer Science in accordance with article 10 of the University Teaching Regulations. The total duration of each course or module in which it provides educational plan is established annually and communicated through the Computer Science Department web site.

The lectures are in English.

Art. 6 Teaching programming

The Master Degree offers to students a set of educational activities organized in a structure diagram that is reported in this Regulation (Annex no. 2).

Any changes to the structure diagram can be decided by the Teaching Board of Computer Science and approved by the Department Council according to the norms and the deadlines set by the University. Such changes, if necessary, are reported as changes to this Regulation. Further specifications about the academic program are set out in General Study Manifesto and training offer summary prospectus published on the website of the course.
**Art. 7 Academic calendar**

The periods of lecture/tutorial, holiday periods, exam periods and graduation sessions constitute the teaching calendar.

The lesson activities and exercises are organized in teachings allocated into two teaching periods per academic year (semesters). Each period lasts about 14 weeks. Before each academic year the Teaching Board of Computer Science Department proposes to the Department Board the allocation of teachings in the semesters.

Exam periods are three and begin at the end of each period of lecture/tutorial. For each academic year the Academic Calendar is resolved according to the rules and within the deadlines set by the University boards (this information is returned to the Department website before each academic year).

**Article 8. Skills required for the access**

For admission to the Master Degree is required:

a) Possession of a bachelor degree in the following degree classes: L-31 (Computer Science), L-8 (Information Technology) or the possession of a college degree, three-year university degree or other qualification university equivalent, obtained abroad and recognized as equivalent in accordance with current legislation, or

b) Possess the following qualifications: at least 60 credits in the SSD INF/01 Group, ING-INF/05, BIO/ *, CHIM / * or MED / *, of which at least 30 credits accumulated for the following SSD: INF / 01 and ING-INF / 05.

You also need the possession of the English language at B1 level.

Among the knowledge/skills that a student must possess to effectively attend the course, there are: the basic knowledge of mathematics and the continuous discrete, the ability to specify and analyze an algorithm in terms of its concrete complexity and needed data structures, the ability to use a programming language, the knowledge of architecture of computers and major network protocols, knowledge of the principles of operating systems and resource management, knowledge of databases and related technologies.

Those who have graduated in classes 9 or 26 (DM 509/99) or L-8 and L-31 (DM 270/04) are allowed without any further evaluation if they have obtained a degree vote higher or equal to 88/110 within 10 years before the date of application for registration to the Master Degree.
For students who do not meet this constraint and for students who have earned a bachelor's degree in classes other than those listed and that nevertheless satisfy the curricular criteria stated above, there is a designed evaluation to determine if the skills acquired are such allowing the frequency of the course of studies with adequate profit.

The University annually organizes the evaluation with respect what is approved by the Teaching Board taking into account the timing for registration established.

The positive outcome of the evaluation leads to the immediate registration of the student who has requested. The negative result precludes the registration for the entire A.A. and it refers to the request for registration.

Students who have not obtained the three-year degree at least 24 credits in scientific subject sectors BIO/ *, CHIM/ * or MED/ * will have to follow two specific basic teachings among those in the field of BIO/ MED * or / *, for a total of 12 credits, given annually by the Teaching Board.

**Art. 9 Examinations Profit**

Regarding the exams, it is applied the provisions of Art. 21 of the University Academic Regulations and Rules Students. Note that, each teacher must indicates before the start of the academic year, together with the planning of teaching on the web page of his teaching, the specific modality of exams for his course. The examination takes place after the conclusion of the course during the periods provided for exams in dates proposed by the teachers responsible for the course or agreed with them. The exams may also provide in-course tests for the verification of learning the skills of the student. The teacher into account in determining the final grade can take these checks.

The verification of individual profit achieved by the student and the consequent recognition of credits earned in the various training activities are carried out with the following criteria and methods: written and oral examinations and possible projects to be carried out in the laboratory.

The final rating is expressed in thirtieths. The outcome of the vote is considered positive for the allocation of credits if students get a score of at least 18/30. The attribution of 'lode', in the case of a vote of at least 30/30 is at the discretion of the examination committee.

The Department Council defines the number of exams date.

**Art. 10 Exam Commissions**

For the exam commissions it is applied the provisions of Art. 22 of the University Teaching Regulations.
Art. 11 Free choice of activities and other activities

There are reserved 12 CFU "D" to the activities free chosen by the student. These activities are chosen within all learning activities of the Master type provided by the University. For the training of type D credits (chosen by the student):
- If the training activities are choices among magisterial teachings of a degree course in the LM-18 and LM-32 class of the University of Verona, the curriculum that contains them is considered automatically approved;
- Otherwise the student must submit to the Teaching Board of Computer Science the list of training activities that it is intended to follow to acquire these loans. For these cases, the TB whose opinion is binding on the admission to the Degree carries out the check. Will not be recognized exams characterized by elementary contents of Informatics.
For the other activities are reserved 6 CFU of type "F", 4 of which are tied to the achievement of English language skills at B2 level and the other 2 are freely achievable with work experience and / or training or other activities.

The training activities are aimed to make the student acquire a direct knowledge of particular use in the fields for entering the world of work and the acquisition of specific skills of professional interest. These activities can be carried out in the context of laboratory courses or seminars under the direct responsibility of a single teacher or by companies accredited by the University of Verona, public administration entities, public or private research laboratories (are to be understood in this group also the Area Science and Engineering laboratories). The terms for the acquisition of credits for internship and / or work experience and other skills are defined by the University authorities and published on the University website.

Art. 12 Final exam

To the thesis are devoted 24 credits, for a job that should not exceed 4-5 months full time for the student. The dissertation will be compiled and discussed in English, even with the aid of media such as slides, movies, images and sounds.

The purpose of the thesis

The aim of the thesis is to develop an original study that can culminate with an application project or a theoretical loss related to specific design problems or a critical review on the state in a given field of study.
During the course of thesis the graduate will, under the guidance of the advisor and any co-advisor, dealing with the study and deepening of the chosen topics, but also gain synthesis and creative application of the acquired knowledge.

The content of the thesis must be relevant to issues of bioinformatics and medical informatics or closely related disciplines. The thesis consists of writing the activities that can be articulated as:
- Design and development of applications or systems;
- Critical analysis of contributions from literature;
- Original research contributions.

**The conduct and evaluation**

The final test consists in the development of a doctoral thesis, which commitments the student in research work, formalization, design or development: this work will contribute substantially to the completion of his technical and scientific education. Each thesis may be internal or external, depending on which is carried out at the University of Verona, or in collaboration with another entity.

Each thesis provides a advisor, possibly joined by one or more co-advisors, and an external reviewer. The Academic Board appoints the external reviewer at least 20 days before the discussion of the thesis, verified the eligibility of the student to take the exam Master Degree.

As for the legal aspects (for example, intellectual property results) related to the thesis and the results contained herein, reference should be made to the legislation in force and Regulations of the University.

**Thesis evaluation**

Advisor and any co-advisor must consider the following criteria:

1. Deepening the level of work done in relation to the state of the disciplines of computer science relevance, with emphasis on applications to medical and biological fields;
2. Cognitive or technological progress made by the thesis;
3. Critical commitment expressed by the student;
4. Experimental commitment and / or formal development expressed by the student;
5. Working autonomy expressed by the student;
6. Significance of the methodologies used;
7. Accuracy of the progress and of writing;

The external reviewer is not required to advise on the point 5.

**Degree grade**

The degree grade (expressed in 110mi) is an integer value between 66/110 and 110/110, and is formed from the sum, rounded to the nearest whole number (e.g., 93.50 becomes 94, 86.49 becomes 86), the following addenda:

1) Weighted average lending and compared to 110 of votes obtained in the examinations;
2) An assessment of the degree of the interview and thesis as follows:
   a) Assignment of a factor between 0 and 1 (fractional to one decimal place) for each of the points 1-7 above;
   b) Assignment of a factor between 0 and 1 (fractional to one decimal place) for the quality of the presentation;
   c) The sum of the coefficients attributed to a) and b) points.

The presence of any ‘lode’ obtained in the exams, participation in internships officially recognized by the Teaching Board in Computer Science, taking examinations in excess and the achievement of the degree in a short time compared to the legal duration of the course of studies can be used by the Commission to assign a further increase of a point. If the sum obtained reaches 110/110, the Commission may decide the attribution of ‘lode’.

‘Lode’ is proposed and discussed by the Committees, without the adoption of special automatic calculation mechanisms.

Under current rules, ‘lode’ is given only if the opinion is unanimous.

**External thesis**

An external thesis is carried out in collaboration with a different institution from the University of Verona. In this case, the graduate must first agree on the theme of the thesis with the University advisor.

In addition, there is at least a co-advisor from the outside entity, as an immediate reference for the student during the course of the dissertation. Advisor and co-advisor must be designated in the thesis assignment.
The insurance of the student's regarding his staying in the external institution is governed by regulations at the University of Verona. If the thesis is set up as a training period in that entity, then it is necessary to conclude an agreement between the University and that institution.

The results contained in the thesis are assets in the communion of all the people and institutions involved. In particular, the content and the results of the thesis must be considered public. Please refer all matters not strictly scientific (e.g., conventions, insurance) to the resolution of the Academic Senate of 12 January 1999.

Advisor, co-advisor, external reviewer

An advisor presents the thesis. Advisor has an official appointment at University of Verona. Advisor can be a teacher in the Master Degree in Medical Bioinformatics or in Department of Computer Science of University of Verona or a teacher framed in SSD present in the Teaching Plan of the Master Degree in Medical Bioinformatics.

In addition to those who have the requirements with respect to the role of advisor (as shown above), can play the role of co-advisor also researchers active in extra-university research institutes, post-doctoral fellows, PhD students, technical persons of the Department, the matter devotees appointed by an Italian university and still in force, experienced company representatives in the relevant sector in the thesis.

The external reviewer can be any teacher from University of Verona of scientific disciplines present in the degree in Medical Bioinformatics of the University of Verona, which is particularly relevant in the specific field of study of the thesis.

Method and time limits

The student who is preparing the end of the studies must find a topic of thesis proposed or approved by an advisor and any co-advisor.

When the thesis work will approach to the end, the student will have to present at the students secretary office the demand for taking the degree, containing the title, even provisional, of the thesis, the name of the advisor and any co-advisors. Later in the dates established by the secretary office and in any event no later than 20 days before the exam to graduate, the student must submit the graduation statement, including the definitive title of
the thesis, signed by the advisor. These documents must be delivered according to the times established by the secretary office.

It will also deliver to student secretary office n. 2 copies of the thesis, signed by the advisor. The student, in order to be admitted to the Degree, must have acquired the credits in the disciplines provided by law and by the curriculum of the Master's Degree Course, and comply with any payment of fees for the payment of school fees and contributions. The secretariat of Degree will take charge of inviting to the Graduation session all the advisor and co-advisors involved in the Degree, providing them the time that will take place the presentations/discussions of the Thesis of interest to them.

Commission of the final degree

The Committee on the final examination must include 7 members, of which at least 4 faculty members with teaching assignment at the Master Degree in Medical Bioinformatics. In base of the number of undergraduates, the Teaching Board will identify the most appropriate organizational arrangements for carrying out the exams and to make public the calendar of tests at least one week before the holding of the same. The Teaching Board and the competent secretariats shall determine the procedures and deadlines for the submission of the Degree.

Art. 13 Transfers and passages / recognition of credits obtained in other courses of study

The Teaching Board of Computer Science is responsible for the recognition of credits earned by the student, and score, in other Master programs. In the case of transfer from another Master course, it is required the presentation of appropriate documentation by the original entity office, certifying the exams taken with relative obtained grades, programs of examinations and credits. Whenever it is not possible an automatic predetermination of recognizable credits, the Teaching Board will make awards on the following bases:

- For other courses of the same graduating class (LM-18) or other class, and for activities for which there is reference to a specific disciplinary area admitted in the tables of the LM-18 class, without prejudice to obligation to recognize at least 50% of the accrued credits for students from degree courses in the LM-18 class, the Teaching Boards of Computer Science will distribute the credits acquired by the student within the areas identified in the syllabus (Annex 3) of the Master Degree in Medical Bioinformatics. The Teaching Board of Computer Science will consider, case by case, the content of training activities and the achievement of
educational objectives by determining, based on the previous subdivision, equivalences between the activities carried out and planned by the Master of Science. Following this evaluation, the Teaching Board will determine the year of enrollment. Complementing any deficiencies of credits, the TB can identify, case by case, the most appropriate activities (projects, practical work or other supplementary activities) until the credits required for the individual asset. It is not possible to integrate with additional activities, teaching for which they have a number of credits of less than 40% of the credits necessary for that teaching. In this case it is necessary to take the exam in that teaching.

• In the case of activities for which it is not possible to refer to a subject area, or do not fit within the syllabus of the Master Degree in Medical Bioinformatics, Teaching Board of Computer Science will evaluate case by case the content of the training activities and their consistency with the objectives of the course of study, defining the amount of the credits that can be recognized as part of the training activities provided for in the undergraduate program.

• In case the vote to be associated with a particular training activity is the contribution of several activities that have given rise to different grades, the final grade will be the average weighted value of each activity expressed in credits, grades, rounded to the nearest integer. With equal distance, it is rounded to the next higher.

Amounts in credits, however accumulated in area representing new skills compared to what is offered by the degree course, at the request of the student, they are automatically recognized in the optional activities (up to 8 credits) and internship (up to 4 credits).

**Art. 14 Foreign qualifications and periods of study undertaken abroad**

The Board of Computer Science is responsible for the recognition of qualifications (total or partial equivalence) and credits earned abroad by student, and score, in accordance with the rules of the previous Art. 13.

In case of a partial equivalence, then the valuations of credits achieved, the Board will determine the year of enrollment.

In case of a total equivalence, it will proceed ex officio to give the homolog Italian title according the Rector's Decree.

Recognition of exams taken during study periods spent abroad is established in accordance with the "Guidelines for the management of the Erasmus Program" issued by Area of Sciences and Engineering, in international programs to which adheres the University of Verona and in the context of international agreements with educational facilities of universities or higher education institutes.
**Art. 15 Forms of mentoring**

In accordance with Art. 31 of the University Teaching Regulations, the Department may prepare, organize and manage forms of tutoring in favor of students to guide them during the entire course of study, to guide them in the choice of educational paths, to make them active participants in the educational process and to contribute to overcome any individual difficulties.

**Art. 16 General manifesto of studies and students communications**

In accordance with Art 16 of the University Teaching Regulations, information on activated courses, conditions, procedures, terms, the amount of taxes and contributions owed, together with the required documentation, as well as any other indication about the steps necessary for the registration are published in the general manifesto of the University studies.

The teaching and the related services are disseminated through the university web site. The deliberations of the Teaching Board regarding the degree program are given in the summary table and communicated through the website of the Department, ensuring a complete, correct and timely communication with students and interested people.

**Art. 17 Part-time students**

The training of students upon enrollment that agree the part-time commitment is governed by University Regulations for students engaged in part-time.

Students, who request, are granted the opportunity to agree, upon enrollment, to the definition of a training program with a CFU number between 12 and 40 per each academic year.

The student status (part-time or full-time) can be changed if requested when registering for the course each academic year. In the case of transfer of a student from the state part-time to full-time, the Teaching Board of Computer Science will determine the curriculum in relation to the remaining years of the Degree course. From what it is not expressly provided herein, the University Regulations for students engaged in part-time is referred.
Art. 18 Reception of students

Teachers must provide at least two hours per week, during the whole academic year, for the reception of students, publicizing through the appropriate Department web site page site and time. Any time variations must be communicated well in advance. Purpose of the students receiving activities are: orientation courses, study and clarification of specific issues related to teaching, conducting exercises in exam preparation, supporting activities and address to the ultimate test, tutoring for the filling of Master Degree thesis. The advisor has the further obligation to follow the master graduate student in the realization of the thesis through additional activities during further to reception time.

Art. 19 Transitional provisions

For students already enrolled in a degree of Class 23/S "Computer science" ordering former ex D.M. 509/99, willing to apply for the transition to the Master Degree in Medical Bioinformatics order ex D.M. 270/04, the Teaching Board of Computer Science will examine each case and will provide every possible suggestion for any necessary additions.

There is no provision for automatic approval of curricula for students from ordering former ex D.M. 509/1999.

Art. 20 Validity of these regulations

This Regulation applies to all students enrolled in the Master of Science in Medical Bioinformatics from the 2016/17 cohort.

Annex 1 - Ordering
Annex 2 - Study plan
Annex 3 - Learning outcomes of teachings (Syllabus)
Annex 4 - Frequency/Prerequisites/Weirs
Annex 1 - Ordering
### Characterizing activities

<table>
<thead>
<tr>
<th>Disciplinary area</th>
<th>area</th>
<th>CFU</th>
<th>Minimum from D.M. for the area</th>
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<tr>
<td></td>
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<td>66</td>
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<td>“ING-INF/05 Information processing systems”</td>
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Minimum credits reserved by the university minimum from D.M. 48:

Total characterizing activities 48 - 66

### Related activities

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<td>BIO/11 - Molecular Biology</td>
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<tr>
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<td>BIO/12 - Clinical Biochemistry and Clinical Molecular Biology</td>
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<td>BIO/13 - Applied Biology</td>
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<td>BIO/18 - Genetics</td>
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<td>MED/01 - Medical statistics</td>
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<td>MED/03 - Medical Statistics</td>
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<tr>
<td></td>
<td>MED/04 - General Pathology</td>
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<td>MED/08 - Pathological anatomy</td>
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Total Related Activities 12 - 24

### Other Activities

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<td>Chosen by student</td>
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<td>Computer science abilities</td>
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<td>Other skills needed to enter the world of work</td>
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Minimum credits reserved by the university to activities art 10, paragraph 5 letter d 6

For internships and training in the industries, public or private organizations, professional associations 0 0

Total Other Activities 39 - 57

### Summary CFU

| Total CFU to get the title | 120 |
| Total Range CFU of the course | 99-147 |
## Annex 2 – Teaching Plan

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<td></td>
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</table>
Annex 3 - Specific learning objectives of the lessons (Syllabus)

For the specific learning outcomes, please refer to the web page of the degree course in every teaching.
Annex 4 – Frequencies /Prerequisites /Weirs

Prerequisites: not provided.

Obligations Frequency
There is not a general obligation to attend, in any case attendance in educational activities is strongly recommended.