University of Milano-Bicocca

Teaching Regulations

Course of study	FDS01Q - DATA SCIENCE
Type of course	Master Degree
Class	Data science (LM Data)
Year of ordering	2022/2023
Year regulation	2024/2025

Presentation

Reference teaching structure	INFORMATICS DEPARTMENT SYSTEMS AND COMUNICATION
Reference teachers	- SAMUEL ALBANI - DAVIDE CHICCO - MICHELE CIAVOTTA - MARCO CREMASCHI - GIANLUCA DELLA VEDOVA - GIOVANNI DENARO - CLAUDIO FERRETTI - ELISABETTA FERSINI - GABRIELE GIANINI - ANDREA MAURINO - VINCENZINA MESSINA - MATTEO LUIGI PALMONARI - MATTEO MARIA PELAGATTI - ALESSANDRO RAGANATO - MARCO VIVIANI

Tutors	- ELISABETTA FERSINI - ANDREA MAURINO - GABRIELLA PASIMATTEO MARIA PELAGATTI
Duration	2 years
CFU	120
Qualification issued	Master in DATA SCIENCE
Joint title	No
Double title	No
Teaching mode	Conventional
Language/s in which the course is held	English
Internet address of the course	https://elearning.unimib.it/course/index.php?categoryid=9172&lang=en
The course is	newly instituted course
Maximum number of credits recognised	12
Locations	MILANO (Educational responsibility)

Art.1 The Course in brief

The Master Degree in Data Science is part of the Class of Master Degrees Data Science; it lasts two years and is awarded with 120 ECTS.

12 exams are envisaged, corresponding to 90 ECTS mainly in the fields of computer science, computer science engineering, statistics and law. Courses of other disciplinary fields concerning the application of data science techniques and methodologies in various areas are envisaged, too. Remaining credits will be acquired in terms of “further didactic activities” including the mandatory stage, further language skills / other activities useful for job placement, and the final thesis. 7 exams are normally held in the first year, and 5 exams in the second year.

The master is freely accessible to graduate students. The access is subject to the verification of curricular requirements, and an interview in order to evaluate the personal preparation. The interview will mainly focus on basic knowledge of computer science (programming languages and databases) and statistics (descriptive statistics, probability, inference).

The language of the master degree is English.

At the end of the master course, a Master Degree in Data Science is earned.

The Master Degree allows access to PhD and Master courses of advanced level (level II).

The Master’s degree program aims to provide a solid cultural and methodological preparation in the disciplines that deal with models and techniques for the collection, management and analysis of digital data, to improve the services provided, the administrative and business processes, the descriptive and predictive models used by institutions and companies, extracting value from digital data (Business Data Scientist) or optimizing the choice of models and analysis techniques (Analytical Data Scientist).

The goal is to allow graduates to hold professional positions as data scientists, both of a generalist type, getting them used to interact with domain experts, and of a specialist type, in the wide variety of domains in which digital data are used, from medicine to genetics, from marketing to economic / financial applications, from physical sciences to human resources management.

Art.2 Specific educational objectives and description of the educational path

The Master's Degree in Data Science, in English, aims to train generalist professionals (possibly oriented towards technological or business aspects), capable of operating with different types of data (structured, textual, graphs, images, sensors, time series) using a variety of computer and statistical techniques to carry out descriptive, predictive and prescriptive analyses.
The strategic choice inherent in the educational path is to intensely involve the student in the application of techniques and technologies to real cases, encouraging the involvement of companies from the first year through the provision of data, presentation of case studies or real problems.

In particular, the course aims to provide students with:
1. advanced knowledge and skills on the principles of modeling, representation and management of a large set of data types (structured, textual, images, sensors, time series),
2. advanced knowledge and skills on statistical models, techniques and methodologies for dataset analysis under uncertainty, on probability calculation and statistics, on the statistical analysis of large amounts of data and time series,
3. advanced knowledge and skills on machine learning and deep learning techniques and methodologies in order to improve the quality of decision-making and operational processes, based on digital data in the public and private sectors,
4. advanced knowledge and skills on how to present the results of the analyses carried out also through interactive visualization tools,
5. advanced knowledge of the issues relating to the legal and ethical aspects relating to the use of data, with particular attention to aspects relating to privacy, security and respect for human dignity;
6. advanced knowledge and skills in some specific application fields (for example biology, marketing, finance, medicine, environment) related to the use of digital data for new research methods and scientific discoveries, more efficient production processes, more effective management and delivery of services;
7. skills for inclusion in interdisciplinary groups in which experts in Data Science and experts in specific application domains work together;
8. ability to operate and compete in the national and international context.

The first four objectives are achieved through teaching in the disciplinary field of information technology and mathematics and statistics, objective 5 is achieved through teaching in the human-social-legal disciplinary field, objective 6 is achieved through teaching in the disciplinary fields related to the application fields. Objective 7 is reached through the internship activity and through the creation of projects on real cases during the training course. And objective 8 is achieved through the delivery of the entire master's degree course in English.

Educational Path
The educational path includes courses in the first year in the areas of computer science and statistics, aimed at acquiring skills related to: methodologies and languages for organizing, exploring, querying, analyzing digital datasets, including large ones, the analysis of large data flows, machine learning, decision-making models, deep learning. Courses related to the economic, social, legal educational area on the legal and ethical aspects of digital technologies complete the first year offer.
The courses of the second year allow the student to delve deeper into the topics of interest related to the educational areas defined above with reference to security, technological infrastructures, data semantics, business intelligence, time series, interpretative, predictive and prescriptive models for decision-making problems and the development of the digital economy. The student must also choose disciplinary courses and laboratory activities that address a broad range of application areas, such as life sciences (biology, genomics and medicine), economics, marketing, territory, environment, the physical world, security, the Internet of Things, smart cities.

The training program also includes activities chosen by the student, a mandatory internship, additional training activities and the final exam. The internship and the final exam represent a focal element in the

training of future graduates, as they allow them to apply the topics covered in the courses and laboratory activities in the world of production of goods and services and in Public Administration, to have in-depth knowledge of a specific application area, the information technologies and statistical techniques used, to actively collaborate with professionals from other disciplines learning to operate in a multidisciplinary environment. The internship and the final exam thus complete the university-work transition path that takes place throughout the training program.

Taking into account the heterogeneity of the three-year training programs of the students, specific courses in the fields of computer science and statistics are planned in the first year to ensure the homogenization of skills and knowledge. The wide choice of courses within the characterizing activities in the computer science and statistics field guarantees the completion of the knowledge and skills with respect to the training program followed by the students in the three-year degree.

2.1 Expected learning outcomes, expressed through the European Descriptors of the qualification

2.1.a Knowledge and understanding, and Ability to apply knowledge and understanding: Summary

2.1.a.1 Knowledge and understanding
The specific disciplinary knowledge and skills of the course of study that each student must possess when obtaining the qualification must be referred to the specific objectives described above and to the characteristics of digital datasets (volume, speed, variety, value).
During the training course, master's graduates will acquire knowledge and skills regarding the learning areas related to the computer science and statistical training fields, in particular on:

- methodologies and techniques for the acquisition, storage, querying and management of different types of data, including large ones;

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- methodologies and techniques for the acquisition, storage, querying and management of different types of data, including large ones;
- computer techniques and methodologies for scalability with respect to volume and speed, even in secure contexts;
- machine learning and deep learning techniques for large datasets and decision-making models;
- methodologies and techniques for semantic modeling;
- programming languages;
- methods for natural language processing;
- optimization methods for decision-making processes;
- methods and techniques for communicating analysis results through visualization tools;
- statistical models, techniques and methodologies for dataset analysis under uncertainty;
- probability calculation and statistics;
- statistical analysis of large amounts of data and historical series.

With regard to the learning areas of economic, social and legal disciplines, the graduate has knowledge of:

- aspects of privacy, data security;
- ethics of artificial intelligence applied to Data Science;
- digital economy.

The graduate also has in-depth knowledge of the English language, acquired thanks to having taken and completed the entire training course in English.

The master's degree graduate acquires the aforementioned knowledge through lectures, exercises, laboratory activities and through additional teaching support tools, including online, through individual and group activities in the form of projects and through internships at public or private companies, public administrations, or University laboratories. A further way of acquiring knowledge is through students' participation in open lessons by experts, including international ones, on topics or application areas that are transversal to the contents of the individual courses.

Verification of the achievement of the expected results will be carried out, depending on the characteristics of the courses and the choices of the teachers, through ongoing tests and exams that include written and oral tests or only oral exams. The preparation of the master's degree thesis allows the student to demonstrate the ability to analyze the problem addressed, to develop the project and its implementation and to know how to place the topic addressed in the current panorama of knowledge in the field of Data Science.

2.1.a.2 Ability to apply knowledge and understanding
Master's degree graduates in Data Science will be characterized by a solid statistical and computer science foundation, but also by knowledge in the legal field and in some specific fields in order to be able to extract value from different types of data (structured data, texts, images, sensors, time series). The master's degree graduate will be able to: develop new processes for extracting value from data through predictive models thanks to the use of existing systems or development of new machine learning systems; solve application problems through the use of learning and predictive modeling methodologies based on machine and deep learning; create new data-based services, develop systems related to the processing of text in natural language. Master's degree graduates in Data Science will also have acquired the ability to collaborate with experts from other disciplines.

The ability to apply the knowledge acquired will be stimulated through a problem solving approach during lectures, laboratories, internships and during the thesis work. A fundamental role will be played by laboratories that integrate the teachings in addition to autonomous or group project activities. These skills will be further strengthened through external activities, such as the internship. Finally, with the thesis work, graduates in Data Science will deepen the knowledge and skills thus acquired through a design or research activity, capable of demonstrating the ability to operate autonomously.

The ability to apply the knowledge acquired will be assessed through the discussion of projects developed in groups or alone in the teachings, including laboratory projects and in the discussion of the thesis.

2.1.b Knowledge and understanding, and ability to apply knowledge and understanding: Detail

2.1.c STATISTICS AND COMPUTER SCIENCE AREA

Knowledge and understanding
The learning area includes:
a. models, techniques, statistical methodologies for the analysis of large datasets under conditions of uncertainty, in order to guarantee the usefulness, quality and effectiveness of the analysis. Knowledge concerns probability

calculation and statistics, statistical techniques for data analysis and statistical methodologies for large datasets and for historical series;
b. technologies, techniques and computer methodologies for the acquisition, management, integration, analysis of large datasets, in order to guarantee scalability with respect to the volume and speed of acquisition of the datasets and the management of the heterogeneities present in the datasets. The knowledge concerns in particular the management systems of databases and large datasets and the related visualization techniques, the models and languages for expressing the semantics of data, learning techniques, decision-making models, the organization of information systems, Web search techniques, data flow management techniques.
In many courses, as well as in the laboratory courses, the data analysis activity is carried out on real cases proposed by companies and Public Administrations.

Ability to apply knowledge and understanding
The learning area includes the ability to:
a. use statistical and computer science techniques and methodologies in an integrated way, in order to build efficient application solutions. Widely used, versatile and open languages are chosen (for example the R environment and the Python language). There are no specific courses dedicated to environments and languages; their organization, architecture and syntax are described in the statistics and computer science courses, so that they can be immediately applied in real cases;
b. apply statistical techniques and computer techniques and technologies to develop insights and case studies in widely used application domains, such as web marketing, network security, signal and image processing, social media, design of services based on digital data, business intelligence.

Knowledge and skills are achieved and verified in the following training activities:

- Data management and visualization, 12 CFU, consisting of the modules: Data management, (INF/01), 6 CFU Data visualization, (INF/01), 6 credits
- Foundations of computer science (INF/01), 6 CFU
- Foundations of probability and statistics (SECS-S/01), 6 credits
- Foundations of deep learning (INF/01), 6 credits
- Financial markets analytics (SECS-S/01), 6 credits
- Data semantics (INF/01), 6 credits
- Digital signal and image management (INF/01), 6 CFU
- Natural Language Processing (INF/01), 6 CFU
- Machine learning and decision models, 12 CFU, consisting of the modules: Machine learning (INF/01), 6 CFU Decision models (MAT/09), 6 credits
- Statistical modelling (SECS-S/01), 6 credits
- Green Computing (INF/01), 6 credits
- Reinforcement Learning (INF/01), 6 ECTS
- Technological infrastructures for data science (INF/01), 6 credits
- Text mining and search (INF/01), 6 credits
- Cybersecurity for data science (INF/01), 6 ECTS
- Data science lab (SECS-S/01), 6 credits
- Social media analytics (INF/01), 6 credits
- Service science (ING-INF/05), 6 CFU
- Business intelligence and big data analytics (INF/01), 6 credits
- High dimensional data analysis (SECS-S/03), 6 CFU
- Streaming data management and time series analysis (SECS-S/03), 6 credits
- Marketing analytics (SECS-P/08), 6 credits
- Economics for data science, 6 CFU, consisting of the modules: Big data in economics (SECS-P/06), 3 credits Digital economy (SECS-P/06), 3 credits
- Data science lab in environment and physics, 6 CFU, consisting of the modules: Big data in geographic information systems (GEO/04), 3 CFU, Big data management and analysis in physics research (FIS/01), 3 credits
- Data science lab in biosciences, 6 CFU, consisting of the modules: Big data in biotechnology & biosciences

(INF/01), 3 CFU Making sense of biological data (BIO/05), 3 CFU
- Data science lab in medicine 6 CFU, consisting of the modules: Big data in health care (MED/01), 3 CFU
  Medical imaging & big data (ING-INF/06), 3 credits
- Data science lab in business and marketing, 6 CFU, consisting of the modules: Big data in business, economics and society (SECS-S/06), 3 CFU; Big data in behavioral psychology (M-PSI/03), 3 credits
- Data science lab in public policies and services, 6 CFU, consisting of the modules: Big data in public health (MED/01), 3 CFU
  Data in public and social services (INF/01), 3 credits
- Data science lab on smart cities, 6 CFU, consisting of the modules: Smart mobility (INF/01), 3 CFU
  Policies for smart cities (SPS/09), 3 ECTS
- Internships
- Further training activities
- Final test

SOCIAL, LEGAL AND ECONOMIC DISCIPLINES AREA

Knowledge and understanding.
The learning area includes:
a. social and legal issues, examining the co-evolution of technologies and society, information ethics, the limits of information technologies, the issues of accessibility to digital data in the public and private sectors, aspects of data as common goods, copyright and privacy protection;
b. economic issues, covering both the topic of statistical and computer techniques and methodologies for applications to economics and finance, and the topic of the digital data economy and its impact on work and the production of goods and services.

Ability to apply knowledge and understanding
Several case studies on ethical, legal and economic aspects will be taken into consideration, showing both cases of failure and good practices, making students play an active role, showing them the application scenarios and examining the evolution of the case studies.
As an example, it will be shown how the topic of individual privacy and that of groups of people is comparatively treated in different countries and organizations, also analyzing the limits of the current legislation.

Knowledge and skills are achieved and verified in the following training activities:
- Juridical and social issues in information society (IUS/09), 6 CFU
- Economics for data science, 6 CFU, consisting of the modules: Big data in economics (SECS-P/06), 3 CFU Digital economy (SECS-P/06), 3 CFU
- Marketing analytics (SECS-P/08), 6 CFU
- Data science lab in business and marketing, 6 CFU, consisting of the modules: Big data in business, economics and society (SECS-S/06), 3 CFU
Big data in behavioral psychology (M-PSI/03), 3 CFU
- Data science lab in public policies and services, 6 CFU, consisting of the modules: Big data in public health (MED/01), 3 CFU
Data in public and social services (INF/01), 3 CFU
- Data science lab on smart cities, 6 CFU, consisting of the modules: Smart mobility (INF/01), 3 CFU
Policies for smart cities (SPS/09), 3 CFU

2.2 Autonomy of judgment
The teachers of the courses adopt a learning method based on the active participation of the student in the process of acquiring concepts. This method promotes autonomous cognitive growth and autonomy of judgment also in relation to ethical limits and data protection. The multidisciplinary approach of the master's degree program promotes the development of autonomous judgment and critical reasoning skills, offering students the opportunity to compare methodological approaches belonging to different

disciplines. Master's graduates will be able to identify the decision-making criteria, methodologies, techniques and technologies best suited to solving specific problems and classes of problems, as well as an awareness of the legal limits relating to the techniques and technologies used.

The achievement of the educational objective will be verified through the ability to critically expose the different theoretical positions and the different technological alternatives pertaining to the specific topics covered during the exams and in the discussion of the thesis. Independent judgment is also verified, developed and strengthened within the internship activity.

2.3 Communication skills
Written and oral communication skills in English are developed mainly through the performance of training activities in English and the related tests. In this way, the graduate in Data Science will have acquired the necessary skills for correct and precise communication supported by the evidence of the data. Furthermore, the data scientist will be able to choose and use specific dedicated software solutions to communicate effectively and rigorously, through visualizations, both with sector specialists and with non-specialists. The objective is therefore to promote the acquisition of those skills (soft skills) related, among others, to the relational, communication and organizational skills necessary for the profession of data scientist. The ability to "tell a story with data" (data storytelling) will be acquired thanks to laboratory-type teaching activities, as well as in the implementation of projects.
Communication skills will be assessed through oral exams, evaluation of the reports produced by students relating to their projects and discussion of the thesis.

2.4 Learning skills
Learning and independent study skills are acquired first and foremost through the teaching method, oriented towards problem posing and solving, so as to involve the student as much as possible in the learning process, in the development and application of knowledge relating to the contents of the master's degree course. Master's graduates will have the ability to develop and deepen their skills by consulting specialized scientific publications and databases. They will also be able to independently proceed with the research, selection and in-depth analysis of sources available online, evaluating their reliability, in order to document themselves regarding a specific application area or topic of interest. Finally, future data scientists will be able to correctly evaluate and interpret the results of data analysis. These skills, combined with solid preparation on the methodologies and techniques underlying data science, will allow the master's graduate to learn methodologies and operational methods useful for keeping their skills up to date in a constantly evolving sector also with reference to new application scenarios. The Master's Degree in Data Science also provides the methodological skills to continue studies in second-level university master's degrees or doctoral programs in Italy or abroad.

The assessment of learning skills will be carried out continuously during the various training activities, during the discussion of projects and during the internship and the preparation of the degree thesis.

Art.3 Professional profiles and career opportunities

Data Scientist
Functions
The specific functions of the Data Scientist are:
- to identify and use innovative solutions in the field of acquisition, management, processing and analysis of data sets (datasets); in particular, choose, compare, adapt, apply statistical analysis techniques, methodologies and environments and languages, techniques and information technologies (hereinafter, the synthetic term statistical techniques and information technologies will be used) of data analysis;
- to choose and use statistical techniques and information technologies of data analysis to provide economic and social value to decision-making and operational processes; - analyze and present data for descriptive, predictive and prescriptive purposes;

- to interact with the domain specialist in identifying statistical techniques and information technologies for domain analysis;
- to analyze events and facts of interest to the organization in which he or she works, in light of data and signals from the Web, the Internet of Things and Social media;
- to manage the open data publication cycle.

Skills
Statistical analysis; data management; social, legal and economic skills of digitalization processes.

Career opportunities
Large, medium and small companies, public administrations, research institutions, freelance professionals and the creation of innovative start-ups.

Analytical Data Scientist - Functions
The specific functions of the Analytical Data Scientist are:
- design and use innovative solutions in the field of data acquisition, management, processing and analysis;
- choose and use statistical techniques and information technologies for data analysis to provide economic and social value to decision-making and operational processes;
- compare, choose, adapt, apply statistical techniques and information technologies for data analysis;
- design high-level services based on digital data, also through the use of data from the Web, the Internet of Things and Social media;
- collaborate with the IT professional in the design and implementation of services based on digital data as well as in the development of new technologies for the analysis and presentation of data for descriptive, predictive and prescriptive purposes.
- Skills
Statistical analysis with learning and Big Data-oriented techniques; decision-oriented modeling; Big Data management; technical design of services based on digital data, techniques for the analysis and processing of textual and speech data.

Career opportunities
System integrators, large, medium and small companies, public administrations, research institutions, freelancers and the creation of innovative start-ups.
Business Data Scientist - Functions
The specific functions of the Business Data Scientist are:
- define and use innovative solutions in the field of acquisition, management, processing and analysis of data sets (datasets) using statistical techniques and information technologies;
- choose statistical techniques and information technologies that create value for the organization's decision-making processes for strategic and operational support;
- conceive new services based on digital data, which bring value of use to the user and exchange value to the service provider, also through the use and analysis of data from the Web, the Internet of Things and Social media;
- collaborate in defining the strategies and choices of the organization in which he or she operates, linked to the valorization of data to plan investments, generate competitive advantage and create new business models;
- design and implement self-entrepreneurship initiatives through the creation of new and original products/services based on the use of digital data.

Skills
Data driven process management; value-oriented design of services based on digital data; economic skills on digitalization processes.

Career opportunities
Consulting firms, large, medium and small companies, public administrations, research institutions, freelance professionals and creation of innovative start-ups.

The course prepares for the professions:

Class: 2.1. Specialists in mathematical, computer, chemical, physical and natural sciences Category: 2.1.1.4 Software analysts and designers
Professional Unit: 2.1.1.4.1 Software analysts and designers

Class: 2.1. Specialists in mathematical, computer, chemical, physical and natural sciences Category: 2.1.1.4 Software analysts and designers
Professional Unit: 2.1.1.4.3 Web application analysts and designers

Class: 2.1. Specialists in mathematical, computer, chemical, physical and natural sciences Category: 2.1.1.5 System designers and administrators
Professional Unit: 2.1.1.5.2 Database analysts and designers.

Art.4 Rules relating to access

The Master's Degree in Data Science is aimed at students who:

- have obtained a three-year degree or university diploma, or another qualification obtained abroad, recognized as suitable, provided that they have acquired at least 30 total CFU in the following Scientific-Disciplinary Sectors:
▪ INF/01;
▪ ING-INF/05;
▪ from SECS-S/01 to SECS-S/06;
▪ from MAT/01 to MAT/09;
▪ from FIS/01 to FIS/08;

- have a knowledge of the English language equal to or higher than level B2.

Art.5 Admission Procedure

Once the curricular requirements have been verified, admission to the course is subject to the assessment of the adequacy of the personal preparation.

The assessment of the adequacy of personal preparation will be carried out through an interview, aimed at ascertaining knowledge in the field of computer science and statistics.

Candidates will be admitted to the interviews:

a) who have obtained (or are about to obtain) a degree (or master's degree) belonging to one of the following degree classes (or equivalent qualification) with a grade equal to or higher than 83/110 (or weighted average of the grades recalculated if graduating):
- Degree Class L-31 (Computer science and technology);
- Degree Class L-8 (Information engineering);
- Degree Class L-41 (Statistics);

- Degree Class L-30 (Physical science and technology);
- Degree Class L-35 (Mathematical sciences). Or:
b) who have (or are about to obtain) a degree (or master's degree) belonging to a class other than those mentioned above, obtained with a grade equal to or higher than 83/110 (or weighted average of grades recalculated if graduating), and who have acquired, within the 30 total CFU in the sectors referred to in art. 4:
- at least 6 CFU in courses belonging to at least one of the following Scientific-Disciplinary Sectors: from SECS-S/01 to SECS-S/06 or MAT/06 or MAT/09;
and
- at least 6 CFU in courses belonging to at least one of the following Scientific-Disciplinary Sectors: INF/01 or ING-INF/05.

During the interview, the commission may suggest to the candidates the opportunity of in-depth disciplinary courses.

Those who do NOT fall into one of the two categories indicated above will be excluded from the admission procedure and will therefore not be called for interview.

Knowledge of the English language at a level equal to or higher than B2 can be verified with one of the following methods:
- certification issued by the University or by an institution accredited by the University, corresponding to level B2;
- open badge Bbetween “English B2” of the University of Milan-Bicocca;
- exam of at least 4 CFU in the Scientific-Disciplinary Sectors L-LIN/10, L-LIN/11, L-LIN/12, resulting from the previous career;
- possession of a degree delivered entirely or predominantly in English.

Information regarding the methods and times for submitting applications for evaluation of qualifications, as well as the dates of the interviews will be published on the website of the University of Milan-Bicocca (https://www.unimib.it/didattica/corsi-studio).

Art.6 Course Organization

The Master's Degree in Data Science provides for the acquisition of:
36 CFU related to characterizing training activities, disciplinary area "Computer science training", in the scientific-disciplinary sectors INF/01, ING-INF/05;
18 CFU related to characterizing training activities, disciplinary area "Mathematical-statistical training", in the scientific-disciplinary sectors MAT/09, SECS-S/01;
6 CFU related to characterizing training activities, disciplinary area "Legal, business, linguistic and social training", in the scientific-disciplinary sector IUS/09;
18 CFU for similar training activities;
12 CFU for training activities chosen by the student; 6 CFU for internship activities;
3 CFU for additional linguistic knowledge / other knowledge useful for entering the world of work;
21 CFU related to the final exam.

6.1 FIRST YEAR EDUCATIONAL COURSE

MANDATORY ACTIVITIES (characterizing)
- Data management and visualization, 12 CFU, consisting of the modules: Data management, (INF/01), 6 CFU Data visualization, (INF/01), 6 CFU
- Data science lab (SECS-S/01), 6 CFU
- Juridical and social issues in information society (IUS/09), 6 CFU
- Machine learning and decision models, 12 CFU, consisting of the modules: Machine learning (INF/01), 6 CFU Decision models (MAT/09), 6 CFU
- Statistical modelling (SECS-S/01), 6 CFU

MANDATORY ELECTION ACTIVITIES (similar)
The student must choose 6 CFU from the following courses:

- Foundations of probability and statistics (SECS-S/01), 6 CFU
- Marketing analytics (SECS-P/08), 6 CFU
- Financial markets analytics (SECS-S/01), 6 CFU

MANDATORY CHOICES (characterizing)
The student must choose 6 CFU from the following courses:

- Foundations of computer science (INF/01), 6 CFU
- Data semantics (INF/01), 6 CFU
- Foundations of deep learning (INF/01), 6 CFU
- Green Computing (INF/01), 6 CFU

SECOND YEAR
MANDATORY CHOICES

- Text mining and search (INF/01), 6 CFU
- Student's choice of course, 12 CFU
- Internship, 6 CFU
- Further linguistic knowledge/Other knowledge useful for entering the world of work, 3 CFU
- Final exam, 21 CFU

MANDATORY CHOICES (characterizing)
The student must choose 6 CFU from the following courses:

- Cybersecurity for data science (INF/01), 6 CFU
- Technological infrastructures for data science (INF/01), 6 CFU
- Digital signal and image management (INF/01), 6 CFU
- Social media analytics (INF/01), 6 CFU
- Service science (ING-INF/05), 6 CFU
- Business intelligence and big data analytics (INF/01), 6 CFU
- Natural Language Processing (INF/01), 6 CFU
- Reinforcement Learning (INF/01), 6 CFU

MANDATORY CHOICE ACTIVITIES (similar)
The student must choose 6 CFU from the following courses:

- Economics for data science, 6 CFU, consisting of the modules: Big data in economics (SECS-P/06), 3 CFU Digital economy (SECS-P/06), 3 CFU
- High dimensional data analysis (SECS-S/03), 6 CFU;
- Streaming data management and time series analysis (SECS-S/03), 6 CFU The student must choose 6 CFU from the following courses:

- Data science lab in environment and physics, 6 CFU, consisting of the modules: Big data in Geographic information systems (GEO/04), 3 CFU
Big data management and analysis in physics research (FIS/01), 3 credits
- Data science lab in biosciences, 6 CFU, consisting of the modules: Big data in biotechnology & biosciences (INF/01), 3 CFU Making sense of biological data (BIO/05), 3 CFU
- Data science lab in medicine, 6 CFU, consisting of the modules: Big data in healthcare (MED/01), 3 CFU
Medical imaging & big data (ING-INF/06), 3 credits
- Data science lab in business and marketing, 6 CFU, consisting of the modules: Big data in business, economics and society (SECS-S/06), 3 CFU
Big data in behavioral psychology (M-PSI/03), 3 CFU
- Data science lab in public policies and services, 6 CFU, consisting of the modules: Big data in public health (MED/01), 3 CFU
Data in public and social services (INF/01), 3 CFU
- Data science lab on smart cities, 6 CFU, consisting of the modules: Smart mobility (INF/01), 3 CFU
Policies for smart cities (SPS/09), 3 CFU

Depending on the courses chosen from those offered in the second year of the course, whether of a characterizing type or of a similar or integrative type, the student will be able to acquire a set of skills oriented towards the generalist figure of the Data Scientist, or oriented towards the specialized professional figures of the Analytical Data Scientist or the Business Data Scientist.

As an example, the following is a set of courses for the two professional figures of Analytical Data Scientist and Business Data Scientist:

ANALYTICAL DATA SCIENTIST

one course chosen from:
- Cybersecurity for data science (INF/01), 6 ECTS
- Digital signal and image management (INF/01), 6 CFU
- Technological infrastructures for data science (INF/01), 6 credits

one course chosen from:
- Data science lab in environment and physics, 6 CFU, consisting of the modules: Big data in Geographic information systems (GEO/04), 3 CFU
Big data management and analysis in physics research (FIS/01), 3 credits
- Data science lab in biosciences, 6 CFU, consisting of the modules: Big data in biotechnology & biosciences (INF/01), 3 CFU Making sense of biological data (BIO/05), 3 CFU
- Data science lab in medicine, 6 CFU, consisting of the modules: Big data in health Care (MED/01), 3 CFU
Medical imaging & big data (ING-INF/06), 3 CFU
- Data science lab on smart cities, 6 CFU, consisting of the modules: Smart mobility (INF/01), 3 CFU
Policies for smart cities (SPS/09), 3 ECTS

BUSINESS DATA SCIENTIST

one course chosen from:
- Social media analytics (INF/01), 6 credits
- Service science (ING-INF/05), 6 CFU
- Business intelligence and big data analytics (INF/01), 6 credits

one course chosen from:
- Data science lab in business and marketing, 6 CFU, consisting of the modules: Big data in business, economics and society (SECS-S/06), 3 CFU

Big data in behavioral psychology (M-PSI/03), 3 credits
- Data science lab in public policies and services, 6 CFU, consisting of the modules: Big data in public health (MED/01), 3 CFU
Data in public and social services (INF/01), 3 credits
- Date science lab on smart cities, 6 CFU, consisting of the modules: Smart mobility (INF/01), 3 CFU
Policies for smart cities (SPS/09), 3 CFU

6.2 Student elective training activities
The student may acquire the 12 CFU required in the context of the freely elective training activities by choosing courses activated in the Master's degree program in Data Science or in other Master's degree programs of the University.
The freely elective training activities of the student are an integral part of the study plan since they complete the student's university education, and must therefore be submitted for approval by the competent bodies in order to verify their consistency with the training project. According to current legislation, for the purposes of calculating the total number of exams, the activities of the student's choice count only as one exam.

6.3 Internship
The training program includes a mandatory internship (6 CFU). The internship offers the student the opportunity to delve deeper into the world of production of goods and services and Public Administration, the topics covered in the teaching and laboratory activities.

6.4 Further linguistic knowledge/other knowledge useful for entering the world of work. The acquisition of 3 CFU relating to "Further training activities" occurs according to the methods specified below.

ITALIAN students can choose between:
- 3 CFU of "other knowledge useful for the world of work", with participation in the activities described on the E-learning page of the Degree Course (https://elearning.unimib.it/course/view.php?id=53439). or
- 3 CFU of "further linguistic knowledge", with passing a University test to verify knowledge of a foreign language other than English, at level B2, chosen between French, Spanish or German, or with passing a University test to verify knowledge of the English language at level C1.
Italian students who already have certifications issued by the University or by bodies accredited by the University, attesting language skills, at a level equal to or higher than B2 for French, Spanish or German, or attesting language skills, at a level equal to or higher than C1 for English, will be entitled to exemption from the test and recognition of the expected credits.

FOREIGN students must instead necessarily obtain 3 CFU of "additional linguistic knowledge", by passing a University test to verify knowledge of the Italian language, at level A2.
Foreign students who already have certifications issued by the University or by bodies accredited by the University, attesting knowledge of the Italian language, at level A2 or higher, will be entitled to exemption from the test and recognition of the expected credits.

Information about the procedures for carrying out the tests or acquiring credits are defined at the University level and will be available on the University website, at https://www.unimib.it/didattica/lingue-unimib

6.5 Teaching methods
The acquisition of knowledge and professional skills during the course of study is measured in university training credits. Training credits represent the student's learning work, including the training activities implemented by the master's degree course and the commitment to personal study or other individual training activities. One CFU corresponds to 25 hours of overall work, distributed between hours of lectures, exercises and laboratory activities, and individual study.
At least 60% of the overall annual commitment is reserved for personal study and individual training

activities. E-learning teaching methods are provided, in accordance with the University Teaching Regulations.
Teaching activities are organized into courses. A course usually includes lectures, exercises and laboratory activities for which the following correspondences apply:
1 CFU of lectures: 7 - 8 hours;
1 CFU of exercises: 10 - 12 hours;
1 CFU of laboratory activities: 9 - 12 hours.

6.6 Method of assessing profit
A course corresponds to an exam that involves the acquisition of the related CFU.
A course may include multiple modules that give rise to a single integrated exam. The
exams give rise to an evaluation in thirtieths. The exams may be oral and/or written.
Details on the verification and evaluation method of each individual course included in the didactic plan are available in the syllabus of the courses, available on the e-learning website of the course of study under COURSES (https://elearning.unimib.it/course/index.php?categoryid=9173).

6.7 Attendance
Attendance is mandatory for at least 75% of the laboratory hours, with the possibility of individual exemption for motivated justification.
Attendance of lectures and exercises is not mandatory but is strongly recommended.

6.8 Study plan
The study plan is the set of compulsory training activities, the activities foreseen as compulsory and chosen by the student, and the training activities chosen autonomously by the student.
The student is automatically assigned a study plan upon enrollment in the first year, which constitutes the statutory study plan. Subsequently, the student must present his/her own study plan indicating the compulsory and freely chosen activities.
It is possible to obtain the qualification according to an individual study plan also including training activities other than those foreseen by the teaching regulations, provided that they are consistent with the teaching organization of the course of study of the academic year of enrollment.
Also in order to pursue the adequacy of their personal preparation, students can include in their study plan one or more additional courses in addition to those required for obtaining the qualification, which involve the acquisition of no more than 16 CFU. The CFU and grades obtained for additional courses are not included in the calculation of the average grades of the exams but are recorded in the student's career.
Interested students can request a meeting with the Teaching Commission to better discuss the possible choices of the independent plan.
The Teaching Coordination Council approves the study plan. The University defines the methods and deadlines for submitting the plan.
The student's right to take assessment tests relating to a training activity is subject to the presence of the activity itself in the last approved study plan. For anything not provided for, please refer to the University Regulations for students.
For further information or doubts on the submission of study plans, you can write to the Teaching Commission (commissione-didattica-data-science-groups@unimib.it).
The timetable of the lessons, the calendar of the exam sessions in which the dates, times and place where the exams will be held are indicated in the student's web diary: http://gestioneorari.didattica.unimib.it/PortaleStudentiUnimib/ and in the exam session noticeboard of Segreterie Online: https://s3w.si.unimib.it/Home.do

6.9 Preparatory courses
There are no preparatory courses. Students are advised to read the prerequisites indicated in the course programs published on the course website.

6.10 Schedule of training activities and exam sessions

Training activities are organized in such a way as to balance attendance at lectures/exercises/labs and are divided into two semesters in the periods October-January and March-June.
Exams are usually scheduled during the periods of suspension of lessons defined annually and are in no less number than that established by the University Teaching Regulations.
The procedures for carrying out the exams and more information on the minimum number of sessions are available in the Student Regulations published on the University website.

6.11 Orientation and tutoring activities
Ongoing tutoring activities are planned, and carried out mainly by professors of the course of study with the aim of identifying and resolving any critical situations relating to both individual courses and the student's overall training path. Since students come from a wide range of degree courses, from economics and marketing, to computer science, statistics, physics, mathematics and others, these activities are more intense for courses that provide technical content such as programming languages or analysis environments.
Taking into account the needs reported by student representatives, transversal tutoring has also been established relating to the R and Python programming languages, basic for many courses of the study course, in order to offer students support in the development and maintenance of code written in the two most used languages for data science.

In order to direct students towards the educational choices most suited to their interests and job prospects, the study course considers it essential to have students and companies interact from the beginning of the first semester of the first year. To achieve this, the following tools are used:

1. the Kaggle website. This is a platform commonly used by data scientists from all over the world where it is possible to launch challenges on particular topics. Through this platform, and with limited intermediation by teachers, companies enter dataset analysis proposals and students respond to these challenges alone or in groups. The outcome of the challenges can be a project contribution for passing an exam or a financial prize provided directly by the company. The Kaggle challenge can be preceded by an intervention by the company in a course aimed at providing the context of the domain of the analysis;

2. agreements for educational collaboration with numerous companies. The agreements include scholarships, degree prizes, hackathons, the issuing of certifications relating to the use of specific technological platforms such as SAP, SAS, TIBCO. Possession of these certifications enriches the portfolio of extracurricular skills highly sought after by companies.

The teachers of the course of study, using the University e-learning platform, make the slides presented during the lessons, exercises and laboratories available to students. Some teachers also make recordings of their lessons available to accommodate student workers. Exercise notebooks are often made available for the laboratories.

With the e-learning platform, it is possible to send notices to students; open discussion forums on topics related to the teaching; insert internet links to sites of interest for the teaching; carry out tests, exercises and online assessments (without formal evaluation); deliver laboratory reports and other work reports to the teacher; insert video recordings of lessons, and any other digital material useful for teaching. The course of study offers students in-depth meetings (distinguished lecture series) relating to topics not included in the educational offer (for example genetic programming), particular application domains (sport analytics) or of interest to students of the course of study itself (gender bias in Machine Learning). These meetings with external teachers often include a laboratory activity and can be recognized through Open Badges. The University of Milan-Bicocca recognizes the need to provide additional knowledge and transversal skills to better face the world of work and beyond. For this reason, two projects relating to soft skills (Bbetween) and the culture of innovation (iBicocca) are active. In addition to the traditional teaching activities that allow students to obtain the necessary credits for the chosen study path, the University promotes the growth and enhancement of students' transversal skills

by organizing various initiatives every year through the iBicocca courses, aimed at developing entrepreneurship and the spirit of innovation. These skills are certified by the University through the issuing of Open Badges. Open Badges can be used in electronic curricula and on social networks to communicate in a concise, rapid and credible way what has been learned, how it has been learned and with what results. Open Badges are digital, difficult to falsify and recognized internationally. They are portable and can be inserted in electronic curricula and on social networks to communicate in a concise, rapid and credible way what has been learned, how it has been learned and with what results to employers around the world. An Open Badge consists of an image and metadata. The latter allow you to verify the assignment of the badge to a user and access all the descriptive contents of the badge (organization that issued the badge, assignment criteria, knowledge, skills and competences acquired, path followed to acquire them, any results obtained).
The Open Badges issued by the University are currently of the following types: Open Badges that certify the degree and master's degree, Open Badges that certify transversal skills, including linguistic and IT skills, Open Badges that certify specific skills in a given disciplinary area, Open Badges that certify membership in a community and Open Badges of the competence type, which certify a skill, acquired through the attendance of multiple paths.
Bbetween is the project of the University of Milano-Bicocca aimed at increasing and enhancing the transversal skills of students, teaching, technical and administrative staff, and citizens. The project invites you to cultivate your interests and aptitudes, to invest in yourself, in the awareness that the most solid and versatile skills are the personal ones. Bbetween is between the University and the territory, between technical and contextual knowledge, between formal and informal languages, where transversal skills are activated. Completing these courses does not provide additional credits but issues Open Badges (digital certifications of skills acquired through extracurricular activities), which are internationally recognized and conveniently spendable in electronic CVs and on social networks and are recorded in the Diploma Supplement. The Diploma Supplement (DS) is a supplementary document to the official qualification obtained at the end of a course of study at a university or higher education institution. Upon request by the student, the Diploma Supplement provides a description of the nature, level, context, content and status of the studies undertaken and completed by the student according to a standard 8-point model, developed on the initiative of the European Commission, the Council of Europe and UNESCO. The document is written in Italian and English.
Students can also access the Job Placement course "Build your career". This activity aims to offer suggestions, food for thought and practical content to provide operational methods and tools for building a professional career. At the end of the e-learning course, if successfully passed, an Open Badge will be issued.
The University offers a specific service, called B.Inclusion, mainly intended for future freshmen and students with disabilities or specific learning disorders.

At the B.Inclusion space, students receive information and assistance both for the support that the University makes available during the entrance tests, and for the specific services that are offered to individual students, once enrolled, based on their actual needs. Students can avail themselves of the services by contacting the B.Inclusion space in order to agree on a date for the welcome interview and formulate the Individualized University Project (PUo.I).

University services are also available for individual psychological and psychosocial counseling regarding personal and social difficulties that students may encounter in their university career (solely by way of example, to overcome 'exam anxiety blocks').

Starting from the 2021/2022 academic year, the University has established the Dual Career path for student athletes who meet the required requirements. The program includes a series of benefits and services that allow student athletes to reconcile their sports commitments and university studies (flexibility in teaching and exams, a personalized orientation program, a "mental coach" and a team of sports medicine professionals).

Students with young children can use the 'Bambini Bicocca' nursery and kindergarten.

6.12 Agreements for international student mobility
The International Affairs Sector of the University is responsible for the operational management of international student mobility. The course of study promotes and encourages international mobility through the ERASMUS+ program with the partner universities.
The activity to be carried out abroad may concern both attendance of courses and the carrying out of internships and theses (https://www.unimib.it/internazionalizzazione/mobilita-internazionale).
The delivery of the master's degree course in English will encourage the participation of incoming students and double degree agreements. In particular, discussions are underway with foreign universities for double degree agreements.
The University provides an integration to the Erasmus+ mobility grant from MUR funds and its own funds according to the methods established by the University's governing bodies annually and based on its budget allocation.

The Erasmus Coordinator, appointed from among the Department's professors, organizes a presentation of the Erasmus program and the various locations available for the course of study for interested students. Furthermore, all students interested in the University's international mobility programs can contact the "Bicocca University Angels" for general information and clarifications on the calls (https://www.unimib.it/internazionalizzazione/bicocca-university-angels).

For activities related to the thesis or internship, students can participate in the Erasmus Traineeship call to spend a period abroad in Europe, or in the Erasmus Extra-UE call, for activities to be carried out at universities, research laboratories or companies.

Art.7 Final exam

The final exam consists of the presentation of a thesis developed in an original way, in English, by the student under the guidance of a Supervisor. The thesis will concern a design or research or case analysis activity.
The final exam aims to verify the overall quality of the work carried out, the candidate's ability to communicate, justify and identify logical connections between different scientific topics, the mastery of the topics and tools used, as well as the ability to operate autonomously in the field of organizations that use data science tools.
The thesis work can also be carried out as part of the internship.

Art.8 Method of conducting the Final Exam

The final exam consists of the production of a written paper in English and its presentation and discussion to highlight the results achieved in relation to the reference context. The discussion also aims to evaluate the student's ability and versatility in carrying out in-depth studies on the topics addressed in the thesis or topics logically related to those addressed in the thesis.

Art.9 Recognition of CFU and transfer methods

A special commission, appointed by the Teaching Coordination Council, will evaluate the applications for recognition of the previous career.
Recognition is carried out according to criteria of conformity between the contents of the course of origin and those of the course to be accessed. Partial recognition of a course is permitted.

Students transferred from another master's degree course or students who have withdrawn, lapsed or in possession of another master's degree must still request the evaluation of the career in order to verify the adequacy of personal preparation and possession of the curricular requirements. The Teaching Coordination Council will decide on the total or partial recognition of the teaching activities already passed.
In the case of transfer of the student from another master's degree course belonging to the LM Data-Data Science Class, the share of credits relating to the same scientific-disciplinary sector, directly recognized to the student, cannot be less than 50% of the credits already earned (Ministerial Decree 16 March 2007). The professional knowledge and skills certified in accordance with the legislation in force on the matter, as well as other knowledge and skills acquired in post-secondary level training activities, in the planning and implementation of which the University has contributed, can be recognized as credits, to the extent established by the teaching regulations of the study courses, and within the limit defined by law and according to predetermined criteria in the course regulations.
The recognition must be made exclusively on the basis of the skills demonstrated by each student.
Activities already recognized for the purpose of awarding university training credits in the context of degree courses cannot be recognized again as training credits in the context of master's degree courses.
Students who intend to make an incoming transfer/change must first of all (for the purposes of submitting the application for assessment of curricular requirements and the subsequent interview) comply with the provisions of art. 5 "Admission Procedures" of these regulations. For subsequent transfer/incoming transfer procedures, please refer to the University website https://www.unimib.it/didattica/corsi-studio

Art.10 Research activities to support the training activities that characterize the profile of the Degree Course

The training activities that make up the Master's degree and, in particular, the internship and thesis activities can be linked to the research activities developed, in particular, within the Departments of:
- Computer Science, Systems and Communication,
- Economics, Quantitative Methods and Business Strategies,
- Physics,
- Sociology and Social Research,
- Medicine and Surgery,
- Environmental and Earth Sciences,
- Statistics and Quantitative Methods,
- Economic-Business Sciences and Law for Economics,

and in the research laboratories active in these Departments, in which basic research, applied research and technology transfer activities are carried out.
Students will be able to carry out the activities related to the internship and the thesis also in the context of these laboratories.
As regards the specific disciplines covered by the Master's Degree in Data Science, the main research topics are: the management and analysis of large datasets (data search, data quality, data semantics, data abstraction, knowledge representation, data integration, data analysis, high dimensional data analysis, data visualization, data as a service), data and text mining, machine learning, deep learning, decision-making models, economic-business, legal and social issues.
All the previous topics present aspects of basic research, applied research and technology transfer in a vast set of disciplines investigated in almost all the Departments of the University of Milan-Bicocca.

Art.11 Course teachers

Teachers responsible for teachings/modules

ANDREOTTI Alberta Argia, ssd SPS/09
BERNASCONI Davide Paolo, ssd MED/01
BIANCO Simone, ssd INF/01
BISSIRI Pier Giovanni, ssd SECS-S/01
CESARINI Mirko, ssd ING-INF/05

CHICCO Davide, ssd INF/01
CIAVOTTA Michele, ssd INF/01
DELLA VEDOVA Gianluca, ssd INF/01
DI DOMENICA Nico, ssd SECS-P/08
FATTORE Marco, ssd SECS-S/03
FERRETTI Claudio, ssd INF/01
FERSINI Elisabetta, ssd INF/01
FORTE Gianfranco, ssd SECS-P/11
GIANINI Gabriele, ssd INF/01
GUERZONI Marco, ssd SECS-P/06
MAURINO Andrea, ssd INF/01
MERCORIO Fabio, ssd INF/01
MESSINA Vincenzina, ssd MAT/09
MONTI Gianna Serafina, ssd SECS-S/01
MORETTO Enrico, ssd SECS-S/06
NAPOLETANO Paolo, ssd INF/01
PAGANONI Marco, ssd FIS/01
PALMONARI Matteo, ssd INF/01
PASI Gabriella, ssd INF/01
PELAGATTI Matteo, ssd SECS-S/03
PENNONI Fulvia, ssd SECS-S/01
PESCINI Dario, ssd INF/01
PRESOTTO Luca, ssd FIS/07
REBORA Paola, ssd MED/01
STELLA Fabio Antonio, ssd MAT/09
VIVIANI Marco, ssd INF/01

Art.12 Other information

Course location: Department of Computer Science, Systems and Communications President of the Teaching Coordination Council: prof. Andrea Maurino Teaching Services Office: Viale Sarca 336 - 20126 Milan (Abacus U14 building)

Email addresses:
segreteria.didattica@disco.unimib.it orientamento.datascience@disco.unimib.it

website: www.disco.unimib.it

A Joint Teacher-Student Commission has been established at the Department, with the task of expressing opinions and evaluations on the progress of the Study Course and of formulating proposals for improving teaching https://www.unimib.it/ateneo/organi/commissioni-paritetiche
For the procedures and deadlines of the University regarding registrations, enrolments, transfers and the presentation of Study Plans, consult the website www.unimib.it
Subject to approval by the competent bodies, any adjustments to the training activities envisaged by the present Teaching Regulations.

Class/Study path

Class	Data science (LM Data)
Study path	Common path

Framework of teaching activities

Core subjects				
Disciplinary Area	**CFU**	**Range of CFU from RAD**	**SSD**	**Teaching Activities**
Mathematical/statistical	18	15 - 30	MAT/09	FDS01Q003M - DECISION MODELS, 6 CFU (Module of complete teaching: MACHINE LEARNING AND DECISION MODELS (FDS01Q002))
			SECS-S/01	FDS01Q004M - DATA SCIENCE LAB, 6 CFU FDS01Q040 - STATISTICAL MODELLING, 6 CFU

Computer and information sciences	36	24 - 42	INF/01	FDS01Q001M - DATA MANAGEMENT, 6 CFU (Module of complete teaching: DATA MANAGEMENT AND VISUALIZATION (FDS01Q001) FDS01Q002M - MACHINE LEARNING, 6 CFU (Module of complete teaching: MACHINE LEARNING AND DECISION MODELS (FDS01Q002)) FDS01Q010M - FOUNDATIONS OF COMPUTER SCIENCE, 6 CFU FDS01Q011M - DATA SEMANTICS, 6 CFU FDS01Q012M - NATURAL LANGUAGE PROCESSING, 6 CFU FDS01Q013M - FOUNDATIONS OF DEEP LEARNING, 6 CFU FDS01Q014M - TEXT MINING AND SEARCH, 6 CFU

				FDS01Q015M - CYBERSECURITY FOR DATA SCIENCE, 6 CFU FDS01Q016M - TECHNOLOGICAL INFRASTRUCTURES FOR DATA SCIENCE, 6 CFU FDS01Q017M - DIGITAL SIGNAL AND IMAGE MANAGEMENT, 6 CFU FDS01Q018M - SOCIAL MEDIA ANALYTICS, 6 CFU FDS01Q036M - DATA VISUALIZATION, 6 CFU (Module of complete teaching: DATA MANAGEMENT AND VISUALIZATION (FDS01Q001) FDS01Q037M - BUSINESS INTELLIGENCE AND BIG DATA ANALYTICS, 6 CFU FDS01Q041 - GREEN COMPUTING, 6 CFU FDS01Q042 - REINFORCEMENT LEARNING, 6 CFU
			ING-INF/05	FDS01Q019M - SERVICE SCIENCE, 6 CFU
Legal, Business, Language and Social	6	6 - 12	IUS/09	FDS01Q006M - JURIDICAL AND SOCIAL ISSUES IN INFORMATION SOCIETY, 6 CFU
Total Core subjects	60	45 - 84		

Related/Complementary

Disciplinary Area	CFU	Range of CFU from RAD	SSD	Teaching Activities
Related or Integrative Educational Activities	18	12 - 24	BIO/05	FDS01Q028M - MAKING SENSE OF BIOLOGICAL DATA, 3 CFU ((Module of complete teaching: DATA SCIENCE LAB IN BIOSCIENCES (FDS01Q025)

			FIS/01	FDS01Q026M - BIG DATA MANAGEMENT AND ANALYSIS IN PHYSICS RESEARCH, 3 CFU ((Module of complete teaching: DATA SCIENCE LAB IN

				ENVIRONMENT AND PHYSICS (FDS01Q024))
			GEO/04	FDS01Q025M - BIG DATA IN GEOGRAPHIC INFORMATION SYSTEMS, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN ENVIRONMENT AND PHYSICS (FDS01Q024))
			INF/01	FDS01Q027M - BIG DATA IN BIOTECHNOLOGY & BIOSCIENCES, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN BIOSCIENCES (FDS01Q025)) FDS01Q038M - SMART MOBILITY, 3 CFU (Module of complete teaching DATA SCIENCE LAB ON SMART CITIES (FDS01Q038)) FDS01Q04302 - DATA IN PUBLIC AND SOCIAL SERVICES, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN PUBLIC POLICIES AND SERVICES (FDS01Q043))
			ING-INF/06	FDS01Q030M - MEDICAL IMAGING & BIG DATA, 3 CFU Module of complete teaching DATA SCIENCE LAB IN MEDICINE (FDS01Q026))
			M-PSI/03	FDS01Q032M - BIG DATA IN BEHAVIOURAL PSYCHOLOGY, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN BUSINESS AND MARKETING (FDS01Q039))
			MED/01	FDS01Q029M - BIG DATA IN HEALTH CARE, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN MEDICINE (FDS01Q026)) FDS01Q04301 - BIG DATA IN PUBLIC HEALTH, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN PUBLIC POLICIES AND SERVICES (FDS01Q043))
			SECS-P/06	FDS01Q021M - BIG DATA IN

				ECONOMICS, 3 CFU (Module of complete teaching ECONOMICS FOR DATA SCIENCE (FDS01Q021)) FDS01Q022M - DIGITAL ECONOMY, 3 CFU (Module of complete teaching ECONOMICS FOR DATA SCIENCE (FDS01Q021))
			SECS-P/08	FDS01Q009M - MARKETING ANALYTICS, 6 CFU
			SECS-S/01	FDS01Q007M - FOUNDATIONS OF PROBABILITY AND STATISTICS, 6 CFU FDS01Q008M - FINANCIAL MARKETS ANALYTICS, 6 CFU
			SECS-S/03	FDS01Q023M - HIGH DIMENSIONAL DATA ANALYSIS, 6 CFU FDS01Q024M - STREAMING DATA MANAGEMENT AND TIME SERIES ANALYSIS, 6 CFU
			SECS-S/06	FDS01Q040M - BIG DATA IN BUSINESS, ECONOMICS AND SOCIETY, 3 CFU (Module of complete teaching DATA SCIENCE LAB IN BUSINESS AND MARKETING (FDS01Q039))
			SPS/09	FDS01Q039M - POLICIES FOR SMART CITIES, 3 CFU (Module of complete teaching DATA SCIENCE LAB ON SMART CITIES (FDS01Q038))
Totale Related/Complementary	18	12 - 24		

Student's selection				
Disciplinary area	**CFU**	**Range of CFU from RAD**	**SSD**	**Teaching Activities**

Student-selected activities	12	8 - 15	NN	FDS01Q300 - CHOSEN ACTIVITIES TAKEN DURING THE ERASMUS PERIOD, 12 CFU FDS01Q302 - CHOSEN ACTIVITIES TAKEN DURING THE ERASMUS PERIOD, 4 CFU FDS01Q301 - CHOSEN ACTIVITIES TAKEN DURING

				THE ERASMUS PERIOD, 8 CFU
Total Student-selected activities	12	8 - 15		

Language/Final test				
Disciplinary Area	**CFU**	**Range of CFU from RAD**	**SSD**	**Attività Formative**
For final exam	21	21 - 30	PROFIN_S	FDS01Q014 - FINAL EXAMINATION, 21 CFU
Total Language/Final test	21	21 - 30		

Other				
Disciplinary Area	**CFU**	**Range of CFU from RAD**	**SSD**	**Attività Formative**
Further language knowledge	3	0 - 3	NN	FDS01Q032 - FURTHER LINGUISTIC KNOWLEDGE - GERMAN - B2 LEVEL (OR HIGHER), 3 CFU FDS01Q034 - FURTHER LINGUISTIC KNOWLEDGE - SPANISH - B2 LEVEL (OR HIGHER), 3 CFU FDS01Q030 - FURTHER LINGUISTIC KNOWLEDGE - ENGLISH - C1 LEVEL (OR HIGHER), 3 CFU FDS01Q033 - FURTHER LINGUISTIC KNOWLEDGE - ITALIAN – A2 LEVEL (OR HIGHER), 3 CFU FDS01Q031 - FURTHER LINGUISTIC KNOWLEDGE - FRENCH - B2 LEVEL (OR HIGHER), 3 CFU
Stage and orientation activities	6	6 - 12	NN	FDS01Q036 - STAGE, 6 CFU
Other Skills Useful for Employment	3	0 - 3	NN	FDS01Q035 - FURTHER SKILLS FOR JOB PLACEMENT, 3 CFU
Total Other	9	6 - 18		
Total	120	92 - 171		