DATS2M - Introduction

Introduction

Introduction

The digitalization is at the origin of the considerable increase of available data. From then on, most of the actors of the society rely on an analysis of these data to objectify their decision-making and develop their disciplinary axes. From these specific needs, we attend to the emergence of new jobs oriented to "data".

The Master's degree in Data Science proposes a training in scientific methods and technological tools to answer societal or scientific questions by processing data that are often massive ("Big Data"). This discipline requires associating a model structured by the problem of interest, with computer sciences, statistics and mathematics to bring a rigorous, quantitative and operational solution to the asked question. An IT infrastructure and algorithms of complex calculations also complement these scientific methods to allow the data structuring and processing.

The fields of application of data sciences are extremely varied: the political and security decision taking, the real time on-line advertising, the e-commerce, the data processing of network, the processing of financial data or industrial production, the biomedical research based on o-mics data or of imaging.

Your profile

You hold an undergraduate diploma or a Master's degree and you have acquired solid skills and the taste for the three pillars of the sciences of the data: the mathematics, the statistics and the computing as well as a curiosity for the fields of application of these disciplines.

You master technical English and are capable of attending class, reading scientific documents, to draft reports and to express you orally in this language. You have general skills and necessary personal qualities to approach a diploma of scientific Master's degree such as of the autonomy, a critical mind, the rigor, a capacity of auto-apprenticeship and to look for or to deal with the information.

A block of additional courses (of maximum 60 credits) is proposed to students having no all these skills.

Your future job

Your diploma of Master's degree in Data Science, statistical orientation, prepares you for positions of "data scientist", "data analyst", "data and analytics manager" or simply "statistician" and prepares to set of responsibility in these domains.

Your programme

The Master's degree in Data Science, declined in two orientations, leans on the following four common pillars:

- Statistical inference and modelling.
- Learning theory, Data mining and visualization of large-dimension data.
- The industrial aspects and the business of data sciences and data analytics.

The "Statistical" orientation offered by the LSBA (Louvain School in statistics, biostatistics and actuarial sciences) proposes, in complement to these four common pillars, a training more specialized in useful statistical methods for data sciences and a strong opening towards the implementation of tools in various fields of application, in management, finance and human sciences.

The Louvain School of Engineering (EPL) offers a second orientation, which complements the four common pillars with a specialization in "Information technology" via two options in "Computer systems" and "Digital methods and optimization".

Your parcours

You will develop firstly interdisciplinary fundamental skills, solid and deepened to be capable of approaching a wide spectrum of problems in data science. You will also be able to bring to a successful conclusion projects or of to develop research in the domain.

Your program will offer you opportunities to discover, via projects, internships or applied courses, extremely varied scopes of data sciences: political and security decision-making, the real time online advertising, the e-commerce, the data processing of network, the data processing financiers or of industrial production, the biomedical research based on –omics data or of imaging...

DATS2M - Teaching profile

Learning outcomes

Acquire robust methodological bases in analysis and data processing and apply them in varied domains such as human sciences, engineering, marketing, finance, insurance, or scientific research.

After completing the training, the student will master the fundamental concepts in statistics, algorithmic, data mining, and machine learning that are necessary for the job of «data scientist». He will develop skills in communication and will be capable of analyzing a complex problem, of collaborating in a research project. According to the objectives aimed by the student, several elective modules are proposed: applied data, dated sciences in linguistics, algorithmic and computing, statistics and sampling, dated sciences applied to management.

On successful completion of this programme, each student is able to :

1.

Demonstrate the control of a robust corpus of knowledge in data sciences, allowing him(her) to solve the problems which are a matter of his(her) discipline

1.1

The structures of data and algorithms for the analysis of data.

1.2

The theories of the learning, the data mining and the visualization of large-dimension data.

1.3

The statistical inference, the modelling and statistical computing. The student in the orientation information technologies specializes via compulsory or electives courses.

1.4

The industrial and entrepreneurial aspects of data sciences.

1.5

The computer systems, including parallel computing, the networks and the safety(security).

1.6

Numerical methods and optimization, constrained optimization included, operational research, identification and applied mathematics.

2.

Organize and to lead to its term an initiative of development of a data operating system, fulfilling to complex needs of a customer.

2.1

Analyze the problem or solving the functional needs and to formulate the corresponding specifications.

2.2

Formalize and model the problem and design one or several original technical solutions answering these specifications.

2.3

Estimate, justify and classify the solutions with regard to all the criteria appearing in technical specifications: efficiency, feasibility, quality, relevance and security.

2.4

Implement, test and validate the selected solution and interpret the results.

2.5

Formulate recommendations to improve the operational features of the solution.

3.

Organize and lead to his term a research work to comprehend an unsolved problem bound to the exploitation of data according to a new methodology or in a new environment.

3.1

Document and summarize the state of the current knowledge in the considered domain.

3.2

Propose a modelling and/or an experimental plan allowing to simulate and to test hypotheses relative to the studied problem.

3.3

Shape a summary report to describe the methodology with rigor and clarify the theoretical and\or technical potentialities of innovation resulting from this research work.

4.

To contribute in team to the conduct of a project of data exploitation and to lead it to its term by taking into account objectives, assigned resources and constraints that characterize it.

4.1

To center and clarify the objectives of a project (by associating it performance indicators) considering the stakes and the constraints that characterize the environment of the project.

4.2

To be collectively committed on a work plan, a schedule and roles.

4.3

Work in a multidisciplinary environment, together with other actors having various points of view: manage points of disagreement or conflicts.

4.4

To make decisions in team when there are choices: whether it is on the technical solutions or on the organization of the work to run the project successfully.

5.

Communicate effectively orally and in writing to bring to a successful conclusion the projects which are entrusted to him (her) in his (her) working environment (in particular in English).

5.1

Identify clearly the needs for the "customer" or for the user: question, listen and understand all the dimensions of his request and not only the technical aspects.

5.2

Argue and to convince by adapting itself to the language of his (her) interlocutors: technicians, colleagues, customers, managers.

5.3

Communicate under graphic and schematic shape; interpret a plan, present the results of a work, structure information.

5.4

Read, to analyze and to exploit technical documents (diagrams, textbooks, projects specifications).

5.5

Draft written documents by taking into account contextual requirements and social conventions on the subject.

5.6

Make a convincing oral presentation by using the modern techniques of communication.

6.

Show at the same time rigorous, open, critical mind and ethics in its work.

6.1

Apply existing standards in the disciplines of data sciences (terminology, quality measures).

6.2

Find solutions which go beyond the strictly technical issues, by integrating the stakes in ethical dimension of a project (including the data privacy and the protection of the private life) and of sustainable development.

6.3

Show critical mind towards a technical solution to verify the robustness and to minimize the risks that a solution presents with regard to its implementation.

6.4

Make a self-assessment and to develop in an autonomous way the necessary knowledge to remain competent in his (her) domain.

Programme structure

The program of 120 credits of the Master's degree in Data Science, statistical orientation, consists of:

- • A common core syllabus from 52 to 90 credits including courses of
    - • statistical modelling,
    - • Machine learning and data mining,
    -

To the program of 120 credits, a module of additional teachings can be added for the student not possessing all the prerequisites of the Master's degree. This module is selected with the advisor of the program.

DATS2M Programme

Detailed programme by subject

CORE COURSES

- Mandatory
- Optional
- Not offered in 2024-2025
- Not offered in 2024-2025 but offered the following year
- Offered in 2024-2025 but not the following year
- Not offered in 2024-2025 or the following year
- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Year 1 2

Statistical modelling

LSTAT2120	Linear models	Christian Hafner	EN

Year
1 2

Statistical computing, data structures and algorithms for data analysis

LSTAT2020	Statistical softwares and basic statistical programming	Céline Bugli	FR [q1] [15h+15h] [4 Credits]	x

PROFESSIONAL FOCUS [30.0]

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- Activity with requisites
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- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Content:

				Year 1	Year 2
LDATS2840	Master thesis in data analytics		[FR] [q1 or q2] [] [20 Credits]		x
LDATS2350	Data Mining	Robin Van Oirbeek	[EN] [q2] [15h+15h] [5 Credits]	x	

Optionnal course

Choose 1 course among the 2 following.

LDATA2010	Information visualisation	John Lee	[EN] [q1] [30h+30h] [5 Credits] *> French-friendly*		x
LINFO2364	Mining Patterns in Data	Siegfried Nijssen	[EN] [q2] [30h+15h] [5 Credits] *> French-friendly*		x

OPTIONS

The student completes his program with elective courses reported in the list below. With the agreement of the restricted jury, the student can also complete his program by other courses that he would consider relevant and taught at the UCLouvain. The student may include a maximum of 5 language course credits in his or her program, provided that the level is appropriate and consistent with the student's and the program's profile.

> Data in action *[en-prog-2024-dats2m-ldats210o]*
> Data sciences en linguistique et Text Mining *[en-prog-2024-dats2m-ldats211o]*
> Algorithme, informatique, optimisation, recherche opérationnelle *[en-prog-2024-dats2m-ldats220o]*
> Stage *[en-prog-2024-dats2m-ldats240o]*
> Data Sciences appliquées à la gestion *[en-prog-2024-dats2m-ldats250o]*
> Optional courses *[en-prog-2024-dats2m-lsc100o]*

DATA IN ACTION

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- Activity with requisites
- Open to incoming exchange students
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Click on the course title to see detailed informations (objectives, methods, evaluation...)

Year
1 2

				Year 1	2
⊠ MLSMM2153	Web Mining	François Fouss Corentin Vande Kerckhove	FR [q1] [30h] [5 Credits]	x	x
⊠ MLSMM2156	Recommender Systems	Corentin Vande Kerckhove			

The student is invited to meet the program advisor to decide which courses should be followed. The restricted jury must next approve his program.

- Mandatory
- Optional
- Not offered in 2024-2025
- Not offered in 2024-2025 but offered the following year
- Offered in 2024-2025 but not the following year
- Not offered in 2024-2025 or the following year
- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Mathématique - Analyse et algèbre linéaire

Each of the following three modules allows acquiring similar skills:

Module 1

LINFO1111	Analysis	Pierre-Antoine Absil François Glineur	FR [q1] [45h+37.5h] [7 Credits]
LINFO1112	Algebra	Christophe Craeye Enrico Vitale	FR [q2] [30h+30h] [5 Credits]

Module 2

LINGE1114		Heiner Olbermann	FR [q1] [30h+30h] [5 Credits]
LINGE1121	Mathematics II: algebra and matrix calculus	Cécile Coyette (compensates	

Other pre-requisite activities

The teaching units below may be added to the student's program if they are admitted on a case-by-case basis. The choice of these units will be made in consultation with the study advisor.

⊠ LSTAT2011	Éléments de mathématiques pour la statistique	Nathan Uyttendaele (compensates Catherine Legrand)	FR [q1] [15h+15h] [3 Credits]
⊠ LMAFY1101	Data exploration and introduction to statiscal inference	Anouar El Ghouch	FR [q2] [30h+30h] [5 Credits]
⊠ LPSP1209	Statistics, inference on one or two variables	Eugen Pircalabelu	FR [q1] [22.5h+15h] [4 Credits]
⊠ LPSP1306	Statistics: descriptive analysis and GLM multivariate data modeling	Aurélie Bertrand Céline Bugli Nathalie Lefèvre	FR [q2] [30h+15h] [4 Credits]
⊠ LINGE1222	Multivariate Statistical Analysis	Antoine Soetewey	FR [q2] [30h+15h] [4 Credits]
⊠ LANGL1330	English intermediate level - 1st part	Stéphanie Brabant Charline Coduti (compensates Anne-Julie Toubeau) Estelle Dagneaux Jean-Luc Delghust Aurélie Deneumoustier Fanny Desterbecq Marie Duelz Claudine Grommersch Adrien Kefer Sandrine Mulkers (coord.) Yannick Paquin (compensates Anne-Julie Toubeau) Marc Piwnik (coord.) Françoise Stas	EN [q1 or q2] [20h] [3 Credits]

⊠ Other EU to be determined with the Study Advisor

Depending on his / her previous academic background, the student (in consultation with the study advisor) can add other UEs in order to acquire the necessary prerequisites for the program.

Course prerequisites

The **table** below lists the activities (course units, or CUs) for which there are one or more prerequisites within the programme, i.e. the programme CU for which the learning outcomes must be certified and the corresponding credits awarded by the jury before registering for that CU.

These activities are also identified **in the detailed programme**: their title is followed by a yellow square.

Prerequisites and student's annual programme

As the prerequisite is for CU registration puposes only, there are no prerequisites within a programme year. Prerequisites are defined

DATS2M - Information

Access Requirements

Master course admission requirements are defined by the French Community of Belgium Decree of 7 November 2013 defining the higher education landscape and the academic organisation of courses.

General and specific admission requirements for this programme must be satisfied at the time of enrolling at the university.

Unless explicitly mentioned, the bachelor's, master's and licentiate degrees listed in this table or on this page are to be understood as those issued by an institution of the French, Flemish or German-speaking Community, or by the Royal Military Academy.

In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.

SUMMARY

Specific access requirements

In addition to the access conditions described below, candidates will have to provide proof of a sufficient command of the French language (level B1 of the CEFR, Common European Framework of Reference for Languages).

Students who wish to be admitted on the basis of a dossier (see tables below) are invited to consult the criteria for the evaluation of application.

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
Bachelor in Engineering		Direct access	
Bachelor : Business Engineering (Louvain-la-Neuve)		Direct access	
Bachelor : Business Engineering (Mons)		Direct access	
Bachelor : Business Engineering (Bruxelles Saint-Louis)		Direct access	
Bachelor : Business Engineering (French-English) (Bruxelles Saint-Louis)		Direct access	
Bachelor : Business Engineering (French-Dutch-English) (Bruxelles Saint-Louis)		Direct access	
Bachelor of Science in Business Engineering (Bruxelles Saint-Louis)		Direct access	
Bachelor in Computer Science (Louvain-la-Neuve)		Direct access	
Bachelor in Computer Science (Charleroi)		Direct access	
Bachelor in Mathematics		Direct access	
Bachelor in Physics		Direct access	
Other Bachelor	with Minor in Computer Sciences or Minor in Statistics, Actuarial Sciences and Data Sciences	Direct access	In some cases, the UCLouvain Enrolment Office, after reviewing their online enrolment or re-enrolment application, will ask the students concerned to provide an enrolment

			authorisation from the faculty/ school.
Bachelor in Economics and Management Bachelor in Bioengineering Bachelor in Management		Access with additional training	Straight access, but the program is completed with an additional training of maximum 10C
Other Bachelor	if no minor in computer sciences / statistics and data sciences	Access based on application	

Masters		
Master degree from the French community of Belgium: Civil engineer Computer sciences Engineer in management Actuarial sciences Mathematical sciences Statistics Biostatistics Physical sciences	Direct access	Subject to the acceptance of the file by the jury, a student can be exempted from maximum 60 credits of activity and possibly realize the Master's degree in sciences of the data in a single year.
Other master degrees	Access based on application	Subject to the acceptance of the file by the jury, a student can be exempted from maximum 60 credits of activity and possibly realize the Master's degree in sciences of the data in a single year

Holders of a non-University 2nd cycle degree

Access based on validation of professional experience

> It is possible, under certain conditions, to use one's personal and professional experience to enter a university course without having the required qualifications. However, validation of prior experience does not automatically apply to all courses. Find out more about Validation of priori experience.

Access based on application

Access based on application : access may be granted either directly or on the condition of completing additional courses of a maximum of 60 ECTS credits, or refused.

Foreign students who have succeeded an university education (minimum 3 years) with strong quantitative connotation and who have obtained at least 70% (or 14/20) of average for all successful university years in their home university, without fail in mathematics/ statistics/probability, have the possibility to apply for admission to the master's program in Data Science (120 ECTS).

Students who wish to be admitted on the basis of a dossier are invited to consult the criteria for the evaluation of application.

Admission and Enrolment Procedures for general registration

Teaching method

By its professional vocation, the teaching is completed by numerous practical class having for objective the implementation of methods of analysis on real data. On the other hand, the student also has the possibility of including in his program, a company internship to develop the methodological aspects of the report there. Certain projects will also require working in multidisciplinary teams, what contributes to the development of a stimulating and friendly spirit of collaboration among the students of the program.

The majority of the courses distributed by the teachers are accompanied by an intranet site on the platform "moodle". These sites propose tools of e-learning and serve as forum to the students.

Certificates

The LSBA also proposes diverse programs of continuous training (certified or not), as the university certificate in statistics and data