Curriculum for the Master of Science Programme in Data Science at the IT University of Copenhagen

Curriculum of 1 August 2021

Revision of 1 August 2022
Revision of 29 January 2024

Content

Background

This curriculum for the Master of Science Programme in Data Science, has been drawn up by the Board of Studies at the IT University of Copenhagen (henceforth referred to as the IT University). The curriculum has been drawn up in compliance with the current legislation governing bachelor's and master's (Candidatus) programmes at the universities.

Students enrolled in the above MSc study programmes with study start from autumn of 2021 study according to this curriculum.

Chapter 1

Programme Title and Objectives

Programme Title

Section 1. A student who has completed the programme, has the right to use the title candidatus/candidata scientiarum (cand.scient.) i datavidenskab.

Subsection 2. The title in English is Master of Science (MSc) in Data Science.

Programme Objectives

Section 2. The purpose of this programme is to provide students with the scientific qualifications to identify, formulate, solve and reflect on complex problems relating to data science.

Subsection 2. The programme prioritises the student's ability to assess, apply and develop the underlying technology and the scientific theories, methods and tools upon which it is based.

Subsection 3. The student must have the ability to independently initiate and carry out collaborative work in professional and multidisciplinary settings. Furthermore, the student must have the ability to engage in global and distributed interaction, drawing on research-based perspectives.

Subsection 4. On the background of the student's preceding bachelor's programme, the programme provides the student with the qualifications to define his or her own academic profile within the field of data science and to take independent responsibility for his or her own professional development and specialisation.

Subsection 5. Within the framework of the programme, the student can acquire the necessary individual qualifications for specialised posts in business, industry, the public sector, and for research training programmes (PhD programme) in data science.

Objectives for Learning Output

Section 3 The graduate will develop research-based *knowledge and understanding of, and will be able to reflect on*:

- Theory and practice within data-science specific areas of mathematics (principles of advanced statistical analysis, inference and calculus).
- Theory and practice within data-science specific areas of scalable computing and data analytics (e.g., algorithm design, advanced visualization, data acquisition, learning from heterogeneous including unstructured data sources) and its applications to real-world scenarios.
- Principles of ethics and fairness within Data Science.

- Theory, scientific methodology and scientific issues within data science in the above areas at the highest international research level.

Subsection 2. The graduate will develop the following research-based *skills*:

- The graduate can master a state-of-the-art modern programming language and tools/frameworks to implement and develop software for data analysis.
- The graduate can apply, assess and develop fundamental processes and practices to solve problems in data science. This includes the evaluation of theoretical issues of problems in data science to select, apply, implement and design scalable algorithms for fundamental data analysis (e.g., in machine learning and statistical inference) and their adequate empirical validation.
- The graduate is able to communicate, visualise and discuss the acquired data-driven knowledge with both academic peers and non-specialists.

Subsection 3. The graduate will develop the following research based *competences*:

- The graduate can design and develop new solutions to enhance existing complex data systems, and combine and select different analysis methods in complex and unpredictable settings.
- The graduate can independently initiate collaboration and work professionally with both data science peers and others in complex and inter-disciplinary contexts.
- The graduate can independently take responsibility for own professional development based on theoretical knowledge and practical experience to advance and adapt own competencies to future needs.

Chapter 2

Programme Structure, Content and Programme Language

Programme Structure

Section 4. The Master of Science programme requires passes in study activities corresponding to 120 ECTS points comprising a mandatory backbone, optional modules and a master's thesis.

Subsection 2. The study activities of the programme are composed of modules corresponding to 90 ECTS points and a concluding master’s thesis corresponding to 30 ECTS points.

Subsection 3. A visualisation of the programme structure is available at the IT University’s online student handbook.

Programme Content

Section 5. The mandatory backbone of the MSc study programme in Data Science consists of modules corresponding to 60 ECTS points within the first three terms.

The content of the mandatory backbone focuses on advanced techniques for solving real-world problems using data-driven, scientific methods. In detail, modules contain techniques for collecting, preparing, visualizing data, as well as designing and implementing efficient, correct and fair algorithms and solutions. This process includes different scales and types of data problems, ethical considerations and project organisation in heterogeneous working environments.

Subsection 2. The optional modules comprise 30 ECTS points within the second and third term.

Programme Language

Section 7. The MSc Data Science study programme is conducted in English.

Section 8. The thesis is worth 30 ECTS points and must document skills in applying scientific theories and methods while working within the study programme's subject area.

Subsection 2. The thesis is placed on the final year of the programme. The student must have obtained 60 ECTS of the programme before writing the thesis.

Subsection 3. The abstract must be written in English or Danish.

Subsection 4. Intended learning outcomes for the Master thesis in Data Science:

- To identify, define, and delimit a relevant research problem within Data Science
- To identify, justify, and describe relevant means for addressing the research problem. These include academic theories, methods, literature, and tools
- To analyze and relate the selected means to the current state of the art
- To combine the selected means, develop them further if necessary, and apply them in a concerted effort
- To report clearly the achieved results using appropriate scientific terminology and methods
- To discuss the achieved results and
- relate them to the current state of the art

Chapter 3

General Rules and Miscellaneous Regulation

Admission Requirements

Section 9. To apply for the MSc in Data Science you need:

- A university bachelor's degree or a professional bachelor's degree relating to data science. It must include specific skills in certain areas.
  You find the specific requirements below.

- English proficiency corresponding to B-level with a minimum of 3,0 in grade point average.

- If you hold another comparable degree (e.g. an international education), which is comparable to a university or professional bachelor's degree, the ITU will make an individual assessment of the education in question.

Subsection 2. Programmes that automatically meet the specific requirements:
ITU compiled a list of Danish bachelor programmes that automatically meet the specific admission requirements for the MSc in Data Science.

- Data Science (AAU)
- Data Science (AU)
- Machine Learning and Data Science (KU)
- Artificial Intelligence and Data (DTU)

If your bachelor programme is not shown above, you will be asked to explain how you meet the specific requirements.

Specific Requirements

Section 10. To apply you need to have a bachelor that covers these areas:

Requirements	ECTS
1: Linear algebra	5
Vectors and matrices, vector and matrix operations incl. eigenvalues and eigenvectors Course example: Linear Algebra and Optimization BSLIALO1KU (7,5 ECTS)	
2: Algorithms and data structures	5
Big-O notation, basic analysis of algorithm correctness and complexity, hashing, basic data structures including graphs Course example: Algorithms and Data Structures BSALDAS1KU (7,5 ECTS)	
3: Introduction to machine learning	5
E.g., linear regression, logistic regression, kernel methods, neural networks, unsupervised learning Course example: Machine Learning BSMALEA1KU (15 ECTS)	
4: Probability theory and statistics	10
E.g., random variables, transformation of variables, joint and conditional distributions, independence, estimation, sampling, hypothesis testing Course example: Introduction to Probability BSFOPRO1KU (7,5 ECTS) and Applied Statistics BSAPSTA2KU (15 ECTS)	
5: Introduction to programming	10

At least Python or similar Course example: Introduction to Data Science and Programming BSINDSP1KU (15 ECTS)	
6: Introduction to database design and systems	5
Design and use of relational databases, basic data analytics, basic SQL Course example: Introduction to Database System BSINDBS2KU (7,5 ECTS)	

Section 11. Furthermore, please refer to the IT University's rules and regulation, appendix to this curriculum.

Chapter 4

Date of Commencement and Transitional Regulations

Section 12. This curriculum comes into force 29 January 2024 and applies to all students admitted to the programme from autumn 2025.

Subsection 2. When a new curriculum is published, or in the event of significant changes to this curriculum, transitional regulations will be set out in the curriculum as appendix.

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