

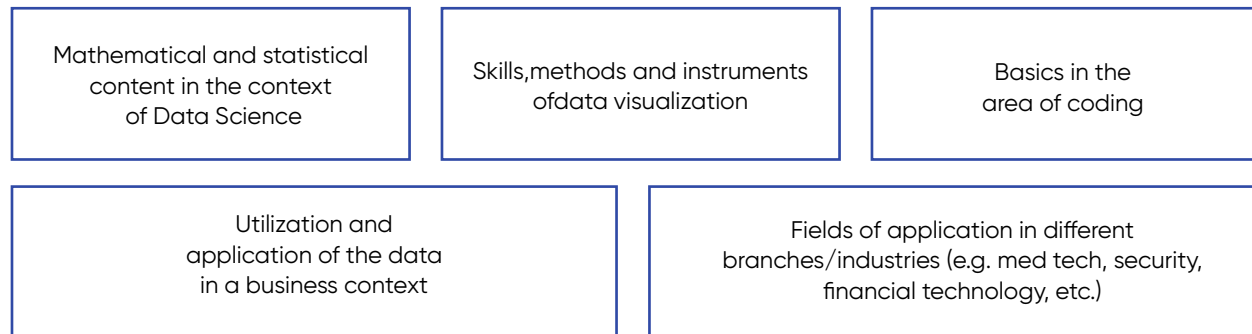
Short Module Manual **Data Science (B.Sc.)**

XU Exponential University
of Applied Science

SHORT FACTS

Graduation	Bachelor of Science (B.Sc.)	Type of study	Full-time
Scope	180 ECTS	Total number of semesters	6 semesters
Language	English	Matriculation date	Every winter semester
Teaching method	Seminars in small groups, additional excursions, case studies, integration into practice		

Fields of Focus



Qualification Profile Demarcation and definition of priorities

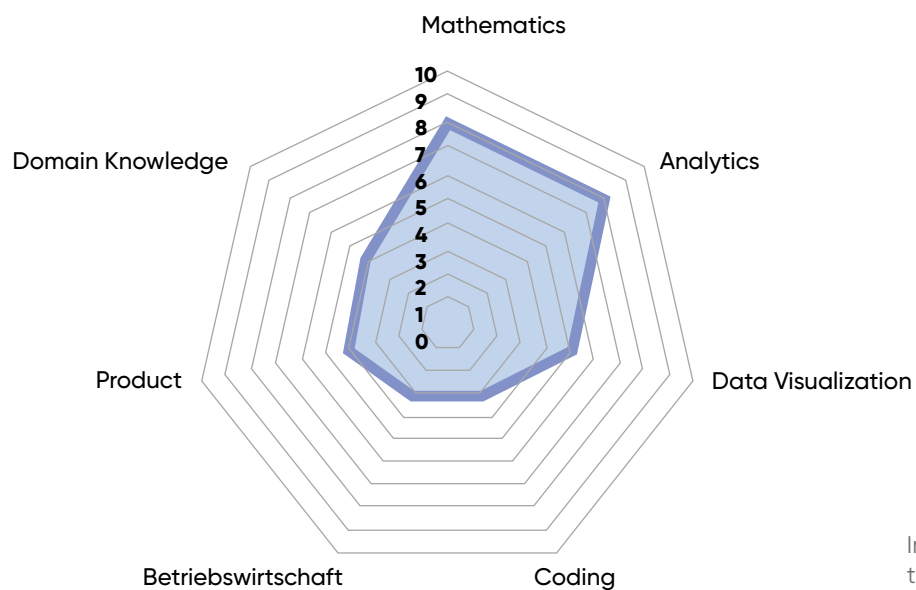


Image 1: Qualifications profile of the study

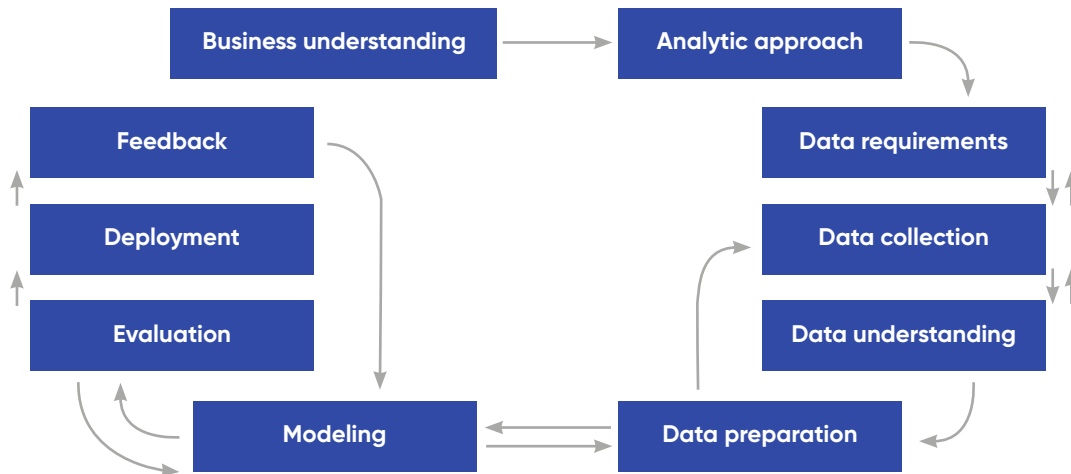


Image 2: Data Science workflow (Quelle: IBM: Big Data & Analytics Hub.
Source: www.ibmbigdatahub.com/blog/why-we-need-methodology-data-science)

Course and content of studies

SEMESTER 1	DS 1	Intro to Data Science	5 ECTS written exam
	• Introduction to Data Science: history, basic terms, tasks, questions, concepts and methods of data science, basics of programming and algorithms • Data Science Tools: Application of the basics in common software products: Excel, Tableau, Rapid Miner and Paterva Maltego, introduction IBM Watson		
	DS 2	Data Structures and Programming	5 ECTS term paper
	• Data Structures: Basic visualization algorithms, efficient algorithms, algorithm development, debugging and error identification • Programming Foundations in R: Setting up and handling programming environments in R, use of R (e.g. functions, libraries, graphs, diagrams, expressions)		
...	DS 3	Data Acquisition and Visualization	5 ECTS written exam
	• Acquiring and Cleaning Data: data collection and data cleansing (R) • Data and Information Visualization: Fundamentals of visual representation of quantitative information, visual analytics, visualization forms and diagrams		
...	QM 5	Quantitative Methods I	5 ECTS written exam
	• Discrete Mathematics: Fundamentals, relations and functions, sequences and series, combinatorics, recursion and growth of algorithms • Linear Algebra: Vector spaces, linear images and matrices, linear equations, linear optimization, Scalar product		

SEMESTER 1

IM 1	Digital Transformation	5 ECTS term paper
- Disruptive Innovations: Basic concepts, challenges and requirements of transformation, digital future markets, Internet of Things, generations of digitization - Digital Solutions: new business models, new applications in hardware and software, new approaches to communication and collaboration		
SK 1	Academic Skills	5 ECTS term paper
- Scientific Work: basics of scientific work, problem definition, structure, citation, data, literature - Text and Data Processing: formatting in Word, data processing in Excel, statistical work with SPSS and PSPP		

SEMESTER 2

DS 4	Data Modeling and Databases	5 ECTS code and documentation
- Basic Data Modeling: Basic concepts of data modeling, Entity-Relationship-Model, relations, Big Table and Document Databases, referential integrity, data modeling in the context of Big Data - Databases and Management Systems: database theory, database development and administration		
DS 5	Algorithms and Programming	5 ECTS code and documentation
- Data Algorithms: algorithm theory, properties, analysis, representation of different algorithms, algorithmic graph theory - Programming Foundations in Python: Programming Foundations of Python, Visualization and Plots with Python, Time Series		
DS 6	Data and Cyber Security	5 ECTS written exam
- Data Security: Fundamentals of data protection and data security, digital identity, data ethics - Cyber Security: Basic concepts and frameworks, threats, internet security, processes, risk management, cryptography, pentesting and hacking, blockchain and Bitcoin		
QM 6	Quantitative Methods II	5 ECTS written exam
- Graph Theory: Introduction, trees, search methods, design methods, colors, rivers, paths - Analysis: Basics, differential calculus I and II, integral calculus, Fournier series		
IM 2	Cooperation and Communication	5 ECTS presentation
- Collaboration Tools: Arbeits- und Organisationsgestaltung in der Industrie 4.0, Konzepte und Voraussetzungen der Zusammenarbeit, Tools und Plattformen - Communication Tools – Effective Corporate Networks: Kommunikationsmedien des Internets		
SK 2	Communication Skills	5 ECTS presentation
- Communication and Presentation: Basics, functions and types of communication, presentation basics - Moderation Workshop: Basics, preparation and follow-up of the moderation, implementation		

SEMESTER 3

DS 7	Machine Learning and AI	5 ECTS written exam
• Introduction to Machine Learning: Calculation of probability, similarity calculation, propositional logic to Machine Learning: Probability calculation, similarity calculation, propositional logic, frame aspects of ML, neural networks, introduction to fuzzy systems • Machine Learning Case Studies: Application in Case Studies (e.g. chat bots, biometrics, image recognition etc.)		
LS 8	Data Analysis	5 ECTS presentation
• Data Analysis: data analysis, information quality, data analysis processes • Data Analysis Project: data analysis project: project management, data collection, - modelling – presentation		
DS 9	Smart Data and Big Data	5 ECTS written exam
• Big Data Concepts: concepts, methods and approaches of Big Data, opportunities and risks, procedures and methods in the context of Big Data • Big Data Analysis: possible uses in the business context, Big Data Query Engines, Large-Scale Graphs		
QM 7	Quantitative Methods III	5 ECTS written exam
• Probability Theory: probabilities, random variables, probability distributions • Statistics: key figures of a sample, estimation methods, inspection methods		
IM 3	Innovation	5 ECTS oral exam
• Innovation management: types, significance and evaluation of innovations, anchoring of innovation management in companies • Innovation Techniques: Design Thinking, Lean Startup, Mind-Mapping, Sprint etc.		
SK 3	Project Management Skills	5 ECTS presentation
• Project Planning and Controlling: Basics of project management, classical and modern forms of project management • Field Project: Application of the project management basics to practical projects		

SEMESTER 4

Study Abroad Semester	20 ECTS
In accordance with the guidelines of the partner universities, there is the possibility of acquiring and deepening intercultural experience, setting professional priorities, and developing language and personal skills.	
Internship	10 ECTS internship report
Internship in a professionally appropriate field	

SEMESTER 5

DS 10 Data Mining

5 ECTS
written exam

- Data Mining Process: basics of data mining, relations, correlations and similarities, types of errors, missing values, fields of application
- Data Mining Methods and Techniques: CRISP-DM model, Data Mining procedures, classification, association analysis, cluster procedures

DS 11 Data Warehouse

5 ECTS
written exam

- Data Warehouse Architecture: Terminology, definition and components of the data warehouse, design of multidimensional data modelling, design of multidimensional information systems, OLAP, data mining in the context of data warehouses, areas of application
- Distributive Data Collection: benefit assessment of data warehouse projects, implementation procedures, data warehouse engineering

SEMESTER 6

DS 12 Text Mining and Information Retrieval

5 ECTS
written exam

- Introduction to Text Mining: Basics of text mining, process, databases, classification, pattern recognition
- Application Areas: Web Mining, topic tracking, information visualizing etc.

DS 13 Data Ethics and Law

5 ECTS
presentation

- Data Ethics: ethics concept in the context of data science, principles of ethical behavior, value-oriented application of Big Data, social consequences, risks of abuse
- Data Law: identity management, data protection, limits and future scenarios

BT 2 Bachelor Thesis

10 ECTS
thesis

- Independent preparation of the Bachelor Thesis

ELECTIVE MODULES in the 5th and 6th semester

Two must be elected – The realization of the election modules depends on a minimum number of participants.

SEMESTER 5 & 6

EL 55/56	Programming and Optimization I & II	5 ECTS respective term paper
• In-Depth Programming: optimization procedures, minimization of functions of a variable, method of least squares • Optimization Methods: Construction and improvement methods, Knapsack-Problem, Constraint Programming, Local Search, Linear Programming • Advanced Programming: Heuristic Branch-and Bound methods, mixed-integer programming, more complex approaches • Programming and Optimization Project: Group project for the programmatic implementation of a self-chosen optimization problem		
EL 57/58	Domain Specific Case Studies & Tools I & II	5 ECTS respective term paper
• Human Sciences: Basics in sports and Talent Analytics, Learning Analytics, Political Data Science • Web Infrastructure: OSINT and Social Data Science, Security Services, Network- and Foot-print-Analytics • Business Economics: Social Data Science, Industry 4.0, Insurance Fraud • Health Data Science: FACS, Health Analytics, BCI and Human Brain		
EL 59/60	Web Technologies I & II	5 ECTS respective term paper
• Introduction to Web Technologies: network technology, network protocols, basic structures of the WWW, web technologies and website creation • Semantic Web Technologies: Basics, knowledge representation and learning, RDF, ontologies, chat bots, future scenarios • Scaling Up: Introduction and basic concepts of social media, crowdsourcing, social media analytics, social media measurement • User Experience Creation Project: group project of a web project		
EL 61/62	Security I & II	5 ECTS respective term paper
• Information Security: Terms and principles of information security, basics, areas, • Cryptography: types of cryptography, data encryption, symmetric and asymmetric encryption, use of cryptography • Security Management: IT risk management from different perspectives • Security Case Studies Project: digital forensics, pentesting and forensics in different application areas		
EL 63/64	Computational Intelligence I&II	5 ECTS respective term paper
• Computational Learning: biological basics, methods, learning rules, network types, different types of neural networks • Deep Learning Algorithms: Basics and technologies of deep learning, neural networks in Python, applications of neural networks • AI Deep Learning: optimization algorithms, productivity and deep learning, Lambda • AI Applications: Use cases		

- Working in a Multidisciplinary Team: Work and success factors of multidisciplinary teams
- Employee Management: Personnel management and leadership, basics of corporate management
- Building a Data Science Team: roles, processes and project management in the Data Science Team