Short Module Manual
Data Science (B.Sc.)

XU Exponential University
of Applied Science

SHORT FACTS

Graduation	Bachelor of Science	**Type of Study**	Full-time
Scope	180 ECTS	**Total numbers of semesters**	6 semesters
Language	English	**Matriculation Date**	Every Semester

Teaching method Seminars in small groups, additional excursions, case studies, integration into practice

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, concept 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 to 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 1
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 — portfolio exam

- **Disruptive Innovations:** Basic terms, challenges and requirements of transformation, digital future markets, Internet of Things (IoT), human communication, generations of digitization
- **Digital Solutions:** economy – new business models, technology – new applications, -hardware and -software, communication – new approaches to interaction/communication and collaboration, work and life – forms/structures and processes

SK 1 — Academic Skills
5 ECTS — portfolio exam

- **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 Excel

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

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SEMESTER 2

IM 2 — Cooperation (Cooperation and Communication)
5 ECTS — presentation

- **Collaboration Tools:** Work and organization design in industry 4.0, concepts and conditions of cooperation, tools and platforms
- **Communication Tools – Effective Corporate Networks:** communication media on the internet, social media, referral marketing

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 — term paper

- **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.)

DS 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 — term paper

- **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

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SEMESTER 3

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
term paper

- **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, Dara Mining procedures, classification, association analysis, cluster procedures

DS 11 — Data Warehouse
5 ECTS
term paper

- **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

QM 8 — Innovation Project
5 ECTS
term paper

- **Data Science Research and Development Project:** Introduction to the basics and methodology of scientific research

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SEMESTER 5

BT 1 — Bachelor Thesis Set-up
5 ECTS
presentation

- **Preparation Bachelor Thesis:** Literature vs. empirical work, scientific-ethical quality criteria, scientific fields, subject, planning and implementation, material research, -selection and -evaluation, revision of formal requirements and -citation methods
- **Bachelor Thesis Reflection /Coaching:** Professional support throughout the planning and development of the thesis, advice on all scientific formalities and related matters, concept presentation

SEMESTER 6

DS 12 — Text Mining and Information Retrieval
5 ECTS
term paper

- **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**

SEMESTER 5/6

ELECTIVE MODULES IN 5th AND 6th SEMESTER

2 specializations must be selected. The realization of the elective modules depends on a minimum number of participants

EL 55/56	**Programming and Optimization I & II**	per 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**	per 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**	per 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

SEMESTER 5/6

EL 61/62 Security I & II

per 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

per 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

EL 65/66 Team Management I & II

per 5 ECTS
respective term paper

- **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

IN TOTAL : **180 ECTS**