Exponential University of applied sciences

# Short Module Manual

# Data Science and AI B.Sc.

XU Exponential University of Applied Science

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## SHORT FACTS

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| **Graduation** | Bachelor of Science BSc. | **Type of Study** | Full-time and Part-Time |
| **Scope** | 180 ECTS | **Total numbers of semesters** | 2 Semesters (60 ECTS)<br>3/6 Semesters (90 ECTS) |
| **Language** | English | **Matriculation Date** | April / October |

**Teaching method** Seminar discussion, individual work, group work, case studies

## Course and content of studies

SEMESTER 1

### DS 1 Introduction to Data Science — 5 ECTS

**Learning Objectives:**

- Understand the history and milestones of data science.
- Recognize key topics in data science and practical applications.
- Identify fundamental data science concepts, methods, and project structures.
- Define core terms such as data, information, algorithms, and big data.
- Differentiate between programming languages used in data science.
- Apply basic programming concepts and mathematical analysis methods.

### DS 2 Python Programming — 5 ECTS

**Learning Objectives:**

- Understand Python syntax and programming fundamentals.
- Implement control structures, functions, and modular programming.
- Manipulate strings, lists, dictionaries, and file I/O operations.
- Apply object-oriented programming (OOP) concepts.
- Use external libraries and frameworks for data science tasks.
- Develop Python programs for data analysis and machine learning.

### DS 3 Web Engineering — 5 ECTS

**Learning Objectives:**

- Understand algorithms and the significance of data structures.
- Analyze algorithms and optimize/debug programs.
- Apply resource-efficient programming methods.

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SEMESTER 1

- Learn the basics of web technologies and development frameworks.
- Implement Scrum and Agile methodologies in software development.

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| **QM 5** | **Quantitative Methods I** | **5 ECTS** |

**Learning Objectives:**

- Understand the principles of linear algebra.
- Apply mathematical analysis for data science applications.
- Solve systems of linear equations using computational techniques.
- Recognize applications of quantitative methods in computer science.

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| **IM 1** | **Digital Transformation for Sustainability** | **5 ECTS** |

**Learning Objectives:**

- Understand the impact of digital transformation on sustainability.
- Analyze technological and economic changes due to digitalization.
- Recognize the role of digital solutions in sustainable development.
- Apply sustainability-driven innovations in businesses.

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| **SK 1** | **Academic Skills** | **5 ECTS** |

**Learning Objectives:**

- Develop critical thinking and research skills.
- Understand academic writing conventions and ethics.
- Apply citation and referencing techniques.
- Conduct independent academic research.

SEMESTER 2

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| **DS 4** | **Databases** | **5 ECTS** |

**Learning Objectives:**

- Understand database management system (DBMS) concepts.
- Design relational databases using ER diagrams.
- Write and optimize SQL queries.
- Recognize NoSQL databases and their applications.
- Implement indexing, hashing, and normalization techniques.
- Develop database schemas and integrate them into applications.

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SEMESTER 2

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| **DS 5** | **Data Visualization** | **5 ECTS** |

**Learning Objectives:**

- Understand data acquisition and cleaning methods.
- Evaluate the quality of statistical graphics and visualizations.
- Implement visualization techniques using R and Python.
- Identify misleading visualization techniques and correct errors.
- Use tools like Tableau for interactive data storytelling.

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| **DS 6** | **Data Mining** | **5 ECTS** |

**Learning Objectives:**

- Differentiate between data mining, big data, and machine learning.
- Understand relational theory and correlation techniques.
- Learn and apply association rules and clustering techniques.
- Implement decision trees and classification algorithms in Python.
- Identify and mitigate errors in data mining processes.

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| **QM 6** | **Quantitative Methods II** | **5 ECTS** |

**Learning Objectives:**

- Understand discrete mathematics and graph theory.
- Apply graph-based algorithms in data science.
- Recognize relationships between statistics and software development.
- Use mathematical modeling techniques for problem-solving.

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| **IM 2** | **Green Interaction Design (UI/UX for Sustainability)** | **5 ECTS** |

**Learning Objectives:**

- Understand sustainable design principles.
- Evaluate the environmental impact of digital design.
- Apply UI/UX techniques for eco-friendly digital experiences.
- Develop user-friendly interfaces while considering sustainability factors.

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| **SK2** | **Professional Skills** | **5 ECTS** |

**Learning Objectives:**

- Develop effective communication and presentation skills.

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- Apply project management and teamwork techniques.
- Understand leadership and collaboration strategies.
- Enhance problem-solving and decision-making abilities.

SEMESTER 3

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| **DS 7** | **Data Analysis** | **5 ECTS** |

**Learning Objectives:**

- Define and explain data analysis concepts.
- Understand information and data quality evaluation techniques.
- Apply statistical hypothesis testing.
- Implement regression analysis using Python or R.
- Conduct data analysis projects with real-world datasets.

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| **DS 8** | **Algorithms and Data Structures** | **5 ECTS** |

**Learning Objectives:**

- Analyze and optimize algorithms for efficiency.
- Debug and implement resource-efficient programs.
- Understand sorting, searching, and recursion methods.
- Develop algorithmic solutions for computational problems.

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| **DS 14** | **Smart Data and Big Data** | **5 ECTS** |

**Learning Objectives:**

- Understand big data concepts and storage methods.
- Apply big data analytics techniques for large datasets.
- Use distributed computing frameworks like Hadoop and Spark.
- Evaluate big data solutions for real-world applications.

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| **QM 7** | **Quantitative Methods III** | **5 ECTS** |

**Learning Objectives:**

- Understand probability theory and its applications.
- Apply statistical inference techniques in real-world data analysis.
- Use hypothesis testing and confidence intervals.
- Recognize stochastic processes and their significance in data science.

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## SEMESTER 3

### IM 5 Innovation — 5 ECTS

**Learning Objectives:**

- Understand the role of innovation in technology businesses.
- Analyze different innovation management strategies.
- Apply various innovation techniques in business models.
- Recognize future technological trends and their implications.

### EIT 1 Start-Up Campus — 5 ECTS

**Learning Objectives:**

- Develop an entrepreneurial mindset and business concepts.
- Understand the fundamentals of start-up creation and management.
- Apply lean start-up methodologies to business development.
- Evaluate business opportunities and market potential.

### EIT 2 Business Model Innovation & Research — 5 ECTS

**Learning Objectives:**

- Understand business model frameworks and innovation strategies.
- Apply design thinking and prototyping methods.
- Conduct market research and data-driven decision-making.
- Develop and present innovative business ideas.

## SEMESTER 4

### SA1 Study Abroad / Entrepreneurship Semester — 20 ECTS

The students can:

- Act and work academically in different cultural contexts.
- Use the opportunities offered by a new academic environment to further develop their personal and professional skills.
- Classify and apply knowledge about local and international contexts and specifics of their respective subject areas.
- Work together with fellow students in a new (academic) environment.
- Apply and deepen their language skills.

### SA2 Internship — 10 ECTS

The students can:

- Apply for suitable internships independently, if necessary with the support of the internship supervisor.
- Combine the theoretical knowledge acquired during their studies with professional practice and solve professional problems based on the skills they have learned.

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SEMESTER 4

## EIT 1 Start-Up Campus — 5 ECTS

**LV EIT 1.1 Start-Up Campus Input**

- Students will learn how to think and act like an entrepreneur.
- Students will familiarize themselves with the self-understanding and the basics ( concepts, types, etc.) of entrepreneurship research and will be able to differentiate between them.
- Students will learn to apply and evaluate entrepreneurial concepts in practice (e.g., Lean Start-up Method).

**LV EIT 1.2 Start-Up Campus Project**

- Students will learn to develop innovative business concepts with a focus on digital and environmentally sustainable business models (Business Model Canvas).
- Students will learn to collaborate in interdisciplinary teams on the development of their own business plans and the renewal of business models.
- Students will learn to present, discuss, and evaluate their business concept internally and with external experts.

## EIT 2 Business Model Innovation & Research — 5 ECTS

**LV EIT 2, 2.1 Business Model Innovation & Research Input**

- Students will learn to understand, follow, and apply the development and use of Design Thinking methods for business creation and the genesis of entrepreneurial innovation.
- Students will learn to identify qualitative and quantitative customer and market research methods and apply them for evidence-based business decisions and business development.
- Students will learn to understand and apply techniques in prototype development.

**LV EIT 2, 2.2 Business Model Innovation & Research Project**

- Students will learn to successfully develop innovative business ideas, products, or services with a focus on the digital, environmentally sustainable transformation of the economy, using the methods and techniques described above.
- Students will be able to present their own business concept and prototype attractively and competently, both internally and to external experts.

## EIT 3 Start-up Management & Scaling — 5 ECTS

**LV EIT 3, 3.1 Start-up Management & Scaling Input**

- Students will learn the basics of competency- and profile-based matching and successful collaboration in autonomous, self-responsible, interdisciplinary teams and will be able to apply them.
- Students will learn the basics of employee-centered leadership and conflict management and will be able to apply them.
- Students will learn to identify and name the phases and success factors in the lifecycle of companies, particularly start-ups.
- Students will learn the basics of strategic organizational development.
- Students will learn how to recognize trends early and simulate scenarios to capitalize on entrepreneurial opportunities.
- Students will learn the basics of agile methods and start-up management and will be able to apply them.

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SEMESTER 4

**LV EIT 3, 3.2 Start-up Management & Scaling Project**

- Students will learn how to exchange ideas and reach agreements in interdisciplinary teams regarding motivation, motives, direction, task design, and work distribution.
- Students will learn how to recognize conflicts within the team and resolve them purposefully.
- Students will learn to apply agile methods to work effectively and efficiently in autonomous, self-responsible, interdisciplinary teams.
- Students will learn how to handle entrepreneurial uncertainties and prepare growth, merging, and exit strategies to react to different realities.
- Students will be able to communicate their start-up management and scaling strategy effectively, both orally and in writing, to their team and external stakeholders.

## EIT 4 International and Intercultural Management — 5 ECTS

Students will be able to

- Distinguish between the basic types of international companies and organizations.
- Assess the impact of globalization and cross-border connectivity on business strategies and innovative management techniques.
- Describe the theoretical, structural, and integrative connections between topics and concepts of international management.
- Describe the application areas of international management approaches.
- Identify key socioeconomic topics, concepts, and challenges of doing business in an international environment, as well as approaches for their regulation.
- Describe and reflect on the implications of technological developments for approaches and topics in international management.

**LV EIT 4.2: Intercultural Management**

Students will be able to

- Recognize and describe different cultural dimensions.
- Identify and describe types of companies and organizations with regard to cultural specifics.
- Identify and interpret intercultural competencies for decision-makers in internationally operating companies and organizations.
- Apply management techniques to address issues based on their knowledge of the requirements for international leaders.
- Recognize and critically reflect on stereotypes in international and intercultural management.
- Describe and reflect on the implications of technological developments for approaches and topics in intercultural management.

SEMESTER 5

## DS 11 Machine Learning and AI II — 5 ECTS

**Learning Objectives:**

- Understand deep learning and neural networks.
- Design and implement different types of neural networks.
- Apply optimization techniques for deep learning models.
- Use AI applications in various domains like NLP and robotics.

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## SEMESTER 5

### DS 12 Data Ethics and Law — 5 ECTS

**Learning Objectives:**

- Understand ethical considerations in data science.
- Recognize privacy and data protection laws.
- Apply ethical frameworks for AI and data-driven decision-making.
- Discuss bias and fairness in machine learning models.

### IM 6 Organization — 5 ECTS

**Learning Objectives:**

- Understand organizational agility and innovation.
- Apply change management approaches in organizations.
- Recognize agile methodologies in business transformation.
- Analyze corporate culture as a foundation for organizational change.

### DS 13 Cloud Computing — 5 ECTS

**Learning Objectives:**

- Understand cloud computing concepts and architectures.
- Differentiate between service models (IaaS, PaaS, SaaS).
- Deploy applications using cloud technologies.
- Evaluate security and compliance in cloud computing.

## SEMESTER 6

### DS 14 Smart Data and Big Data — 5 ECTS

**Learning Objectives:**

- Understand big data storage and analytics techniques.
- Apply scalable data processing methods.
- Use big data frameworks such as Hadoop and Spark.
- Analyze and interpret large-scale datasets effectively.

### BT 1 Bachelor Thesis Set-Up — 5 ECTS

**Learning Objectives:**

- Formulate research questions and thesis structures.
- Understand qualitative and quantitative research methods.
- Apply scientific ethics in academic writing.
- Develop a structured research plan for thesis execution.

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## SEMESTER 6

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| **BT 2** | **Bachelor Thesis** | **10 ECTS** |

**Learning Objectives:**

- Conduct independent research on a selected topic.
- Integrate academic knowledge and practical experience.
- Write and present a structured academic thesis.
- Defend research findings in an oral presentation.

## Semester 5 and 6

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| **Specialization** | | **10 ECTS** |

### DSC 1 Web Technologies

- Develop dynamic and scalable web applications.
- Understand front-end and back-end web development.
- Apply frameworks and technologies for web-based solutions.
- Ensure security and performance optimization in web applications.

### DSC 2 Data Security

- Understand cybersecurity principles and data protection.
- Apply encryption and access control mechanisms.
- Identify vulnerabilities in data security frameworks.
- Develop secure data management strategies.

### DSC 3 Computational Intelligence

- Understand principles of artificial intelligence and neural networks.
- Apply intelligent algorithms to solve computational problems.
- Analyze and optimize machine learning models.
- Explore applications of computational intelligence in real-world scenarios.

**2 Electives in the above specialisation, 5 ECTS per elective module

Selected elective module beyond the chosen Areas of Concentration; Can be freely chosen from the bachelor's programs at XU Exponential University; Prerequisites for participation and execution according to the specifications of the respective elective module.

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| **IN TOTAL** | **180 ECTS** |

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August-Bebel-Straße 26-53
14482 Potsdam (De)

T +49 30 959 999 991
study(at)xu-university.com
www.xu-university.com