Master's degree program

Data science

Choice of Electives:

- Natural Language Processing
- Process Analytics
- Finance
- Medical Imaging
- Marketing Analytics
- Trustworthy AI
- Renewable Energies
- Smart Maintenance
- Data Warehouse & BI
- Smart City
- Big Data Analytics

General Information

Course Director

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Public accessibility

Subway: U6 – Dresdnerstrasse station
Tram: 2, 31, 33 Höchstädtplatz station
Bus: 37A – Höchstädtplatz station, or 5A – Dresdnerstraße station.
Express train: Handelskai or Traisengasse station

What is the aim of the study program?

“Data Scientist: The Sexiest Job of the 21st Century”
(Harvard Business Review)

Data is the gold of the 21st century - as part of this study program you will learn to mine for it! However, the requirements for today's data scientist are significantly more extensive than were previously required for “data mining”.

The most important task of data scientists is *data engineering.* Data has become significantly more complex and extensive – relevant data sources are increasingly less structured tables from databases, but rather often unstructured data from the Internet (web content, texts from forums, social networks), and generally language, text, image and video information. The scope and speed are also constantly growing - sensor data increasingly have to be processed in real time and predictions must be made in fractions of a second (e.g. stock market prices, energy requirements of households, maintenance requirements of machines in industrial production, detection of obstacles in self-driving vehicles, etc.). You will therefore not only learn to deal with relational and non-relational database systems (NoSQL) and standard tools for data preparation (e.g. R TidyVerse, Python Pandas), but also to master Big Data technologies (Hadoop, Spark, Kafka, etc.) .

A second core task is *solution engineering,* aiming at the creation of analytical applications, such as a forecast model, or an innovative, interactive visualization of the data for exploratory purposes. This requires knowledge not only of classic multivariate statistics, but also of modern machine learning methods such as tree methods, artificial neural networks, support vector machines, etc. Clearly, artificial intelligence methods are key as well - both data-driven (deep learning methods) and logic-based. The various analysis components are usually controlled using scripting languages such as R and Python; the finished solution is often integrated in an existing IT landscape using programmatic APIs or web services. Basic programming knowledge is therefore required; scripting with R and Python is used throughout.

Successful data scientists not only need technical knowledge of statistics and computer science, but also project-specific *domain knowledge*. Data scientists must therefore be able to quickly familiarize themselves with the requirements of different areas and also have good communication skills. Successful data science solutions are created in mixed teams. As part of the electives, different problem areas (e.g. marketing, healthcare, finance) are worked on in a team. Finally, you will learn to present the added value for companies and sell your innovative solution accordingly.

Which career fields are covered?

Industry sectors:

There is currently a glaring lack of trained experts for the various areas of data analysis across virtually all industries: banking and insurance, retail, information and consulting sectors; manufacturing, medical care … to name just a few.

Data scientists have the best career prospects and can expect an unusually broad range of work in a wide variety of industries and positions. The following job profiles are therefore only examples:

Typical job profiles:

Analytics Consultant

- collects, understands and sharpens the data analysis requirements of the departments
- supports internal stakeholders in assessing big data use cases and projects
- has a basic understanding of all areas of activity in the analytics lifecycle and acts as an interface between the analytics lifecycle and departments
- is responsible for and designs administrative tasks of the analytics lifecycle
- takes on the role of project manager during the various phases of the analytics lifecycle, knows the typical problems and challenges of the roles involved

Data scientist

- analyzes data, checks data quality and suitability
- develops and sharpens natural language, technical problems into mathematically-solvable problems
- develops statistical-mathematical models and self-learning algorithms
- visualizes results and makes them understandable for the department
- develops a technical understanding of the environment of the analytics use case

Data engineer

- prepares data for (one-time) use in analytics projects and/or creates (persistent) data governance structures
- understands, models and optimizes data flows and data integration (for batch and real-time)
- applies methods and tools to improve data quality
- develops a comprehensive understanding of the operational data and system landscape, including technical release processes

Analytics Architect

- designs technical platforms and systems as a basis for high-performance storage, processing and evaluation of large structured and unstructured data sources and implements them based on customer requirements (if necessary also together with internal/external development teams).
- creates technical requirements for connecting existing systems as data sources
- supports and advises stakeholders in the conception and development of Big Data & Analytics applications and professionalization of analytics use cases
- evaluates, tests and communicates new technological developments in the context of the system landscape of the organization in question, plans and communicates the analytics technology strategy
- evaluates and implements technical security measures

Analytics Developer

- make models or algorithms usable by data scientists in standard software
- operationalizes results of algorithms by integrating them into automated processes and applying them to new data
- optimizes the performance of algorithms by professionalizing the technical implementation and use of design patterns
- designs and implements service infrastructures to provide analytics models for subsequent processors and end users

Which requirements have to be met for studying?

The technical entry requirement for a master's degree program at the UAS Technikum Wien is a completed, subject-relevant bachelor's degree program or the completion of an equivalent degree from a recognized domestic or foreign post-secondary educational institution. The degree is subject-relevant if at least 60 ECTS have been accumulated in the following three core subject areas:

Core subject area
Computer science methods (**at least:** structured and object-oriented programming [5 ECTS], databases (SQL) [3 ECTS], operating systems and network technology [3 ECTS], Python; additionally: algorithms and data structures, web technologies (HTML, Javascript)).
Mathematics & Statistics (**at least:** probability [2 ECTS], applied statistics with R [3 ECTS], linear algebra [2 ECTS], analysis [3 ECTS])
as well as economic subjects (e.g. business administration, controlling…)

Fluency in **Python** is mandatory, but can also be proven by certificates and professional experience.

If only selected courses are missing, they can be completed until the beginning of the studies. Online courses on Databases and Operating Systems/Network Technologies are offered in Spring and Summer.

During the 1st semester, the following courses can be completed as part of the compensation module (amounting up to 5 ECTS):

- Probability
- Applied Statistics
- Linear Algebra
- Analysis

How is the study program organized?

Length

2 years master's degree

Structure

The course has a modular structure and is divided into semester halves. This allows students to balance their workload.

The 4th semester is entirely reserved for the master's thesis, which is typically written in cooperation with a company or in the context of a research project.

Academic degree

The training ends with the award of the academic degree Master of Science in Engineering (MSc).

Number of study places

55 study places per academic year.

Study period

The academic year starts beginning of September and ends end of June.

Class times

TUE, WED, THU: 5:50 p.m. - 9:00 p.m
(with exceptions, such as block events FR SA, lecture cancellations, public holidays, etc.)
All courses are on-site, attendance is mandatory.

Study fees

- € 363,36 per semester for EU students (and for non-EU students resident in Austria for at least 5 years) .
- € 3.000,- per semester for non-EU students (not already resident in Austria).

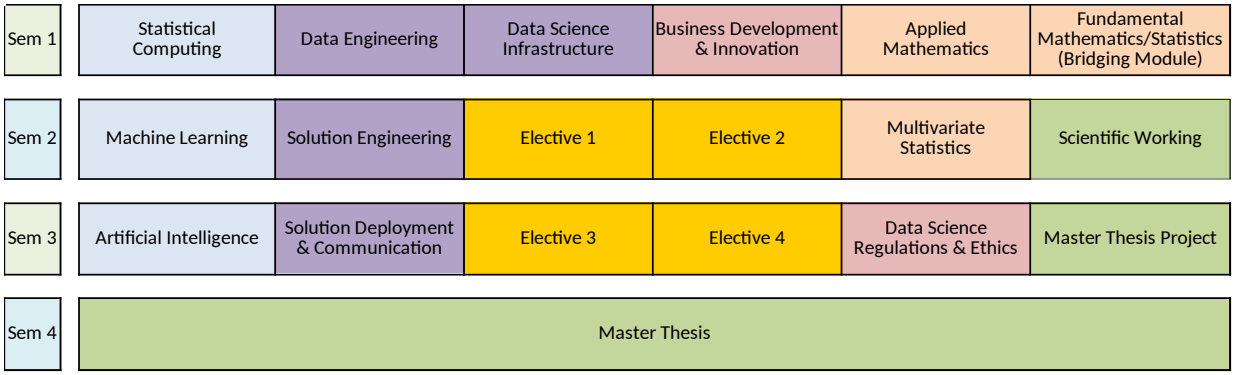
Is it possible to study abroad?

It is possible to complete a semester abroad in the 3rd or 4th semester.

Courses attended as part of a semester abroad are credited based on a previously agreed learning agreement.

How is the program structured?

The following diagram gives an overview on the course modules in the four semesters:



The core of the study program is based on the typical work process of data scientists – the "data science pipeline". First, data must be prepared and explored (**Data Engineering**), then analytical models are adapted and compared (**Solution Engineering**), and finally integrated into the existing IT landscape of a company, and communicated to the users and the management (**Solution Deployment**).

During the courses in the first semester, students learn the necessary basic skills. **Analysis** and **Linear Algebra** form the foundation for **Applied Mathematics**, in turn the basis for machine learning models in the second semester. The basic principles of **Probability** and **Applied Statistics** build grounds for **Statistical Computing**, which focuses on the R programming language, applied to statistical modeling. Both R and Python are then used in the **Data Engineering** course – the first, important stage of the "data science pipeline". The students process different data sources such as structured data from databases, but also image and video data. **Data Science Infrastructure** provides an overview of the relevant tool landscape beyond these programmatic tools and also looks at the topic of big data and high-performance-computing. As a cross-disciplinary topic, **Business Development & Innovation** complements the technical basics from a management perspective: how can innovative, data-driven business models be developed?

The mathematical foundations of the first semester lead to **Machine Learning** and **Multivariate Statistics**, two core topics of the second semester. Together with data engineering and IT infrastructure from the 1st semester, these form the basis for **Solution Engineering**, the central project course of the course, in which the first realistic projects are worked on and where the all basic skills taught so far are combined and applied. **Scientific Working** lays the foundation for the scientific preparatory work for the master's thesis.

The third semester deepens the previous subjects. **Artificial Intelligence** addresses symbolic AI, deep learning and reinforcement learning. **Solution Deployment** concludes the "Data Science Pipeline" with the important areas of integration and communication. The **Master**

Thesis Project already focuses on the practical part of the master thesis. **Data law** and **Ethics** deal with important regulatory framework conditions for daily work.

In the 2nd and 3rd semesters, students choose two **elective subjects** that introduce the specifics of different application domains or methodologies (see below). After an introduction to the domain, typical questions are worked on in a project based on commonly used data and methods.

The 4th semester is exclusively dedicated to the master thesis project, which begins in the third semester. Topics may be chosen from a business context or research projects.

Which electives are available?

The range of electives is constantly being adapted. The following are currently available:

- Elective 1 (2nd semester)
  - **Smart City:** Collection & evaluation of sensor data, application to optimization of urban development (e.g., detection of heat hot spots, smart metering etc.)
  - **Process Analytics:** Process analysis, process improvement, process effectiveness, adherence to specifications/compliance
  - **Data Warehouse & BI:** Star Scheme, ETL-Process, Reporting, OLAP

- Elective 2 (2nd semester)
  - **Natural Language Processing:** text transformation, preprocessing, supervised and unsupervised models, sentiment analysis, generative AI
  - **Finance:** Dealing with financial time series, ARIMA models, tools in R
  - **Big Data Analytics:** Storage & processing of very large amounts of data, parallel processing with Hadoop ecosystem, analyzes with Spark/Kafka

- Elective 3 (3rd semester)
  - **Smart Maintenance:** Reliability Analysis, Time-to-Failure, Machine learning methods.
  - **Marketing Analytics:** Real-time behavior-based marketing, user profiling, pricing strategies, market simulation
  - **Trustworthy AI:** Data Bias, Fairness, Explainability, Model Robustness

- Elective 4 (3rd semester)
  - **Renewable Energies:** smart metering, prediction of demand curves, solar panel detection
  - **Medical Imaging:** Treatment of medical data, image recognition processes using deep learning methods (e.g. tumor detection), U-Net Architecture
  - **Security & Privacy in AI:** Anonymization, Federated Learning; Attacks, Model Robustness, Adversarial examples & defense

How can candidates apply?

Application time

The regular registration deadline for applicants from EU countries ends on May 30th and on March 31th for applicants from outside the EU.

A grace period is possible depending on the availability of study places and may still offer an opportunity for those who decide late.

Application mode

The non-binding registration for the course takes place via the homepage of the FH Technikum Wien: www.technikum-wien.at. In addition to proof of fulfillment of the entry requirements (bachelor's degree, list of courses completed), a CV must also be uploaded. If the entry requirements are met, applicants will be invited to take the ranking test.

A (refundable) deposit of €250,- is due:

- **for EU-applicants *after* a study seat has been granted**
- **for non-EU applicants *before* the application is processed**

Admission procedure

The admission process consists of a ranking test (online multiple choice, approx. 60 minutes) and an admission interview (approx. 20 minutes). The admission process takes place in two stages: only those candidates who have achieved at least 20% of the achievable points in the ranking test are invited to the interview.

The **test** covers the following areas:

1. Programming (Python)

2. Databases (relational scheme, normal forms, SQL)

3. IT Infrastructure

- Operating Systems (in particular, Linux, file systems, shell etc.)
- Computer Networks (e.g., TCP/IP, SSH etc.)

4. Mathematics

- Analysis:
  - Functions
  - Derivatives, integral calculus
  - Extreme values, local minima/maxima

- Linear Algebra:
  - Vectors, Inner Product
  - Matrix calculus
  - Analytical geometry

5. Statistics

- Combinatorics
- Probability
- Random Variables
- Distributions

- Descriptive statistics
- Statistical tests
- Confidence intervals

- correlation
- Linear regression
- Time Series Analysis

The **interview** will cover motivation and previous knowledge, especially professional experience, and will in particular include questions regarding the topics of the ranking test.