Module description: Python: Basics & Application in Data Science

Module Code	w.BA.XX.WPM-PGA.XX
ECTS Credits	3
Language of Instruction/Examination	English
Module Description	In recent years, Python has gained popularity and has become more widely spread as an object-oriented, multipurpose programming language and is, therefore, becoming increasingly important. Although the use of Python in procedural form (e.g., as script) is very widespread, there is often a lack of basic understanding of the object-oriented code structure and its optimization possibilities in terms of resources. This module aims to fill this gap by providing a systematic introduction to the use of Python and focuses on its application in the field of data science. Students receive code templates for common applications, methods, scripts, and models. They also learn to use their knowledge of Python to do their own projects and become familiar with methods and tools to develop their knowledge independently in various related areas.
Organizational Unit	Research Labs / Competences
Module Coordinator	Maria H. M. Pelli
Deputy Module Coordinator	Mario Gellrich
Program and Specialization	• Business Information Technology - Specialization in Business Information Systems • International Management
Legal Framework	Academic Regulations BSc dated 29.01.2009, for the degree programs in Business Administration, International Management, Business Information Technology, Business Law, Business Law and Applied Law, first adopted on 12.05.2009

Module Category	**Module Type** Compulsory Elective	**Program Phase** Main Study Period

Prerequisite Knowledge	Knowledge of basic data formats (such as strings, lists, dictionaries) in Python and the libraries NumPy, Pandas, and Matplotlib is required. Prior experience in the application of Python in procedural form (e.g., scripting) is an advantage.
Contribution to Program Learning Objectives (by the concerned Module)	• Professional Competence • Methodological Competence • Social Competence • Self-Competence
Contribution to Program Learning Objectives	**Professional Competence** • Knowing and Understanding Content of Theoretical and Practical Relevance • Apply, Analyze, and Synthesize Content of Theoretical and Practical Relevance • Evaluate Content of Theoretical and Practical Relevance **Methodological Competence** • Problem-Solving & Critical Thinking • Scientific Methodology • Work Methods, Techniques, and Procedures • Information Literacy • Creativity & Innovation **Social Competence** • Written Communication • Oral Communication • Teamwork & Conflict Management • Intercultural Insight & Ability to Change Perspective **Self-Competence** • Self-Management & Self-Reflection • Ethical & Social Responsibility • Learning & Change

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Module Learning Objectives	Students... • know and understand the basic principles and areas of application of Python. • know the differences in the basic structure of procedural as well as object-oriented Python codes and are able to translate procedural into object-orientied code. • are able to optimize Python codes with regard to different notations. • are able to create control structures and functions in an efficient manner. • are able to choose and apply a suitable library (such as Pandas, Numpy, MatPlotLib, and Seaborn) depending on the task and the most optimal use of resources. • are able to design efficient pipelines in Python for the basic processes of data ingestion, transformation, storage, serving, modeling (supervised and unsupervised) and apply them to specific problems independently. • are able to identify and evaluate Python-based solutions for questions of data science. • are able to develop simple prototypes using Python. • are enabled to further develop their knowledge in the related areas.
Module Content	• Introduction to Python and its applications in data science • Basic structure of a Python program and its elements • Control structures, functions, methods, and attributes • Object-oriented programming versus scripting in Python • Data types and formats, data frames, and series • Code optimization methods (including list comprehension, alternatives for loops, functions, and built-ins) • Exploratory data analysis (EDA) and visualization of data (including Pandas, MatPlotLib, and Seaborn) • Import and export of data and data streams (including Pandas) • Data storage for structured, semi-structured, and unstructured data (including SQLite, MySQL, MariaDB, and optional PyMongo) • Filtering, sorting, linking, and aggregtion (including Pandas) • Duplicates, doublets, missing data, coding, and imputation (including Pandas, NumPy, and Scikit-Learn) • Descriptive, univariate, and multivariate analysis, outliers, validating data (including Pandas, NumPy, and Scikit-Learn) • Feature engineering of categorial and quantitative variables (including Pandas and Scikit-Learn) • Standardization of distributions, normalization to value ranges, hyperparameters, and quantification (including Pandas, NumPy, Scikit-Learn, and Tensorflow) • Supervised learning (including Scikit-Learn and Tensorflow) • Explainable AI-methods (including SHAP) • Prototyping and deployment approaches (including Widgets, Dash, and Flask)
Links to other modules	This module is linked to the following modules:
Digital Learning Resources	• Practice and Application Exercises (with Key) • Case Studies (with Key) • Example codes in Python
Methods of Instruction	• Literature Review • Exercises • Lecture • Project Work Social Settings Used: • Group Work

Type of Instruction

	Classroom Instruction	Guided Self-Study	Autonomous Self-Study
Large Class	-	-	
Small Class	28 h	-	
Group Instruction	-	-	
Practical Work	-	-	
Seminar	-	-	
Total	**28 h**	**0 h**	**62 h**

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Performance Assessment	End-of-module exam		Form	Length (min.)	Weighting
	-				
	Permitted Resources				

	Others	Assessment	Format	Length (min.)	Weighting
	Project work	Grade	Gruppenarbeit	0	100.00

Classroom Attendance Requirement	Other
	Attendance in the final two weeks is mandatory.

Compulsory Reading	• Ernesti, J. & Kaiser, P. (2017). Python 3. Bonn: Reinwerk Computing. ISBN 978-3-8362-5864-7.

Recommended Reading	

Comments	Students need to have a notebook and a Google Colab account.