Curriculum for the study program "Geographic Information Systems (UNIGIS professional)"

Curriculum version 2016W

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Contents

The curriculum for the study program “Geographic Information Systems (UNIGIS professional)” has been proposed by the Curriculum Commission for geography of the University of Salzburg in its meeting on the 18.1.2016 and adopted by the Senate of the Paris Lodron University of Salzburg in the presented version on 21.06.2016.

The legal bases are the Federal Act no. 120/2002 on the Organisation of Universities and their Studies (Universitätsgesetz 2002) and the Statute of the University of Salzburg in its current version.

Preliminary remarks

University courses in Geoinformatics have been offered at Paris Lodron-University Salzburg since 1994. This curriculum serves the further development on the basis of professional and technical progress, educational experiences, current legal conditions and the requirements of the European higher education area.

This study program foresees a flexible format including variable and open forms of study. It therefore allows organisational diversity. In particular it aims at distributed, in-service, continuing education and therefore learning materials, mentoring, communication media and organisation are designed to support a distance learning approach.

Within the existing international network of partner universities “UNIGIS International Association”, UNIGIS study programs are subject to continuous development and quality assurance under its established world-wide brand.

§ 1 General information

(1) In total, the “Geographic Information Systems (UNIGIS professional)” study program amounts to 60 ECTS credits. It is typically a part-time study, which comprises 2 semesters. The program director considers specific didactic and organisational affordances to frame scheduling and operative implementations of the study program. Graduates of the study program “UNIGIS professional” are awarded the title “Akademischer Geoinformatikerin” / “Akademischer Geoinformatiker”. A translation into additional foreign language terms is admissible.

(2) The workload is described in terms of European Credit Transfer System (ECTS) points. One ECTS point corresponds to a workload of approximately 25 hours and describes the average workload that is required to achieve the expected learning outcomes. The workload of an academic year equates to 1500 hours of student workload and thus is worth 60 ECTS credits.

(3) In accordance with the demand and the organizational capacities, the course is offered to cohorts of students. The program director is responsible to set starting dates in a suitable frequency. Due to the character of an in-service study program, semester-oriented regulations do not apply. Instead, flexible part time schedules are set by the program director.

(4) The programcan be offered in German and English as well as in mixed language forms, where professional requirements and prior knowledge of students must be taken into account. Further, the course materials or tutoring can be offered in other languages if required. This can also be done in collaboration with appropriate partners.

(5) Students with disabilities and/or chronic disease shall not be discriminated by the design of the university course. The legal framework of the UN “Convention on the rights of persons with disabilities”, the Equality Act, as well as the principle of disadvantage compensation are applied.

§ 2 Entry requirements

(1) The admission requirement to the university course “Geographic Information Systems (UNIGIS professional)” is a general university entry qualification for an Austrian university or a university of applied sciences (“Fachhochschule”) and a minimum age of 20. The program director decides for the admission of the candidates to the university course “UNIGIS professional”.

(2) Equivalent qualifications to §2 (1) can be accepted by the program director based on several years of professional experience in the field of geoinformatics.

(3) Proof of sufficient language skills may be requested by the program director.

§ 3 Qualifications profile, professional fields and target groups

(1) Objectives of the study program

Geoinformatics is a method-oriented interdisciplinary domain. It focusses on spatial concepts and methods that can be applied to and in cooperation with numerous application fields (e.g. planning, resource management, logistics, mobility, conservation and environmental protection, geosciences, archaeology, marketing, security etc.).

This study program aims at the continuing or supplementary education of the graduates of secondary and graduates or students of post-secondary study programmes through a flexibly structured and in-service study programme.

UNIGIS professional provides application-oriented knowledge of geoinformatics to develop innovative solutions based on relevant concepts and methods. While the compulsory modules focus on the fundamentals of geoinformatics, the elective subjects enhance expert and technical qualifications.

(2) Qualifications profile and competencies (learning outcomes)

Graduates of the university course “UNIGIS professional" have the key qualification of processing explicitly spatial information. Graduates are particularly

- skilled in the acquisition, survey and documentation of appropriate spatial data,
- able to identify the spatial entities and attributes that are relevant to a specific purpose and context, to model heterogeneous data sets and build an appropriate geo-database,
- trained to think spatially; this enables them to select suitable analysis methods to extract and interpret the relevant spatial information for solving complex problems,
- qualified to develop their own applications and scripts in order to expand effectively existing GI-systems or to automate processes,
- familiar with the cartographic principles to be applied for the visualisation and communication of spatial information.

Furthermore, graduates have acquired specialised knowledge, expertise and skills in application-specific or technology-oriented disciplines of their choice.

Modern GI software are used to combine the conceptual-methodological content with application scenarios; this results not only in the critical comprehension of the theory, but also in acquiring expert skills for solving complex, real-world problems. The study programme involves expert thinking and techniques, analytical methodological well as management skills in key areas of geoinformatics. Student-centred learning and communication methods aim at establishing a solid foundation for "life-long learning".

The study programme is compliant with the level 6 of the European Qualifications Framework.

(3) Relevance of the university course to society and market demands

The study program "Geographic Information Systems (UNIGIS professional)" meets the increasing needs for qualified professionals in several fields of industry and public administration. In-depth expertise in geoinformatics is often a carrer-crucial additional qualification in all disciplines of relevance to spatial data; e.g. spatial planning, energy and resource industry, conservation and environmental management, geosciences, logistics, security management, software development, marketing, surveying or archaeology.

Graduates of the University course "UNIGIS professional" can apply to following vocational fields, especially as additional qualification to their professional domain of origin:

- Geoinformatics (or related names)
- Geodata acquisition and management
- Data analysis and data visualisation
- Geo-application development

(4) Target groups

The study program addresses:

- Persons from different spatially oriented disciplines, who work with spatial data and want to efficiently acquire, manage, analyze and visualize it.
- Users of geoinformatics applications who want to advance and update their sectoral and/or autodidactic acquired knowledge aiming at developing individual solutions for complex problems, as well as
- everyone from different application disciplines aspiring to improve their professional qualifications

§ 4 Organisation and structure of the study program

The study program " UNIGIS professional" consists of eight modules for which a total of 60 ECTS will be awarded.

	ECTS
M 01 Introduction to Geoinformatics	6
M 02 Data Modelling and Data Structures	6
M 03 Data Acquisition and Data Sources	6

M 04 Geo-DBMS	6
M 05 Visualisation and Cartography	6
M 06 Application Development	6
M 07 Spatial Analysis	6
WM 01 Elective Subjects	18
Total ECTS	60

§ 5 Types of courses

In this university course the following types of modules are offered:

Lecture with lab (VU): the theoretical introduction to a field is combined with hands-on elements. A lecture with lab has no compulsory attendance. This type of course can be taken as supervised self-study distance learning unit.

§ 6 Study content and scheduling

In the following the modules and courses of UNIGIS professional are listed. The association with a semester is a recommendation, where the sequence of courses ensures an optimal learning pathway.

The detailed description of the modules together with the intended learning outcomes, teaching methods and acquired competences can be found in "Annex I: Modules Description".

Study program "Geographic information systems (UNIGIS professional)"						
Module	Course	hrs / week	Type	ECTS	Semester with ECTS	
					I	II
(1) Compulsory Modules						
Module M 01: Introduction to Geoinformatics						
M 01.1 Introduction to Geoinformatics		3	VU	6	6	
Subtotal Module M 01		3		6	6	
Module M 02: Data Modelling and Data Structures						
M 02.1 Data Modelling and Data Structures		3	VU	6	6	
Subtotal module M 02		3		6	6	
Module M 03: Data Acquisition and Data Sources						
M 03.1 Data Acquisition and Data Sources		3	VU	6	6	
Subtotal module M 03		3		6	6	

Module M 04: Geo-database Management					
M 04.1 Geo-DBMS	3	VU	6	6	
Subtotal module M 04	3		6	6	

Module M 05: Visualisation and Cartography					
M 05.1 Visualisation and Cartography	3	VU	6		6
Subtotal module M 05	3		6		6

Module M 06: Application Development					
One of the following courses must be completed (alternative equivalent courses can be offered in general)					
M 06.1.1 Application Development (using Java)	3	VU	6		6
M 06.1.2 Geoapplikationen mit VB.NET	3	VU	6		6
M 06.1.3 Geoprozessierung mit Python	3	VU	6		6
Subtotal module M 06	3		6		6

Module M 07: Spatial Analysis					
M 07.1 Spatial Analysis	3	VU	6		6
Subtotal module M 07	3		6		6

Total Compulsory Modules	21		42	24	18

(2) Elective modules according to § 7

Module WM 01 “Elective Subjects”					
A total of 18 ECTS must be completed for “Elective Subjects” (WM 01). The courses offered in “Elective Subjects” are based on current, professional qualification requirements, are subject to ongoing adjustment and are determined by the Curriculum Commission. The required ECTS for the “Elective Subjects” can also be covered according to the regulations in §7 (1).					
WM 01.1 Application Development (using Java)	3	VU	6		
WM 01.2 ArcGIS for Server	3	VU	6		

WM 01.3 Developing Applications with OSM	3	VU	6		
WM 01.4 EuroGIS	3	VU	6		
WM 01.5 Geoapplikationen mit VB.NET	3	VU	6		
WM 01.6 Geomarketing	3	VU	6		
WM 01.7 Geoptozessierung mit Python	3	VU	6		
WM 01.8 Landschaftsanalyse mit GIS	3	VU	6		
WM 01.9 Oracle Spatial	3	VU	6		
WM 01.10 Photogrammetrie im Dienste der Geoinformatik	3	VU	6		
WM 01.11 Remote Sensing	3	VU	6		
WM 01.12 Spatial Simulation	3	VU	6		
WM 01.13 Visualisieren von Geodaten mit SVG	3	VU	6		
Subtotal Module WM 01	6		18	6	12
Total “Electives Subjects”	9		18	6	12
Sum total	30		60	30	30

§ 7 Catalogue of “Electives Subjects” and/or bound “Elective Subjects”

(1) Complementary to the aforementioned courses, credits for the module “Elective Subjects” (Module WM 01) can also be covered by external courses (e.g. courses on special and in-depth topics, Summer Schools). Credits can be given for practice-oriented and professionally relevant training and educational courses provided that they are successfully completed (required certificate should include individual performance assessment, i.e. grading) at other accredited post-secondary educational institutions and that they advance and/or complement skills and knowledge acquired at UNIGIS compulsory modules. Credits can be awarded also for equivalent, scientific activities (e.g. publications).

(2) “Elective Subjects” can be covered entirely or partially by a project work; for the project work a workload of a minimum of 12 ECTS is required.

(3) All courses can be offered as distance learning units. Project work is offered in the format of a term paper.

(4) A subset of at least 12 ECTS within the Elective Subjects can be highlighted as individual specialisation, if their contents are coherent. The student can apply for and suggest an adequate label.

§ 8 Assessment of student performance and Exams

(1) The provisions of §§ 72-79 UG 2002 and the section on study affairs of the Statute of the University of Salzburg apply.

§ 9 Tuition fees

(1) Students of the study program have to pay a tuition fee.

(2) Tuition fees may vary due to study form, study organisation or due to cooperation with other universities. The Vice Rector for teaching is in charge to decide on fee levels.

§ 10 Evaluation

The study program is subject to continuous evaluation involving students, faculty and the program director.

§ 11 Coming into effect

The curriculum shall come into effect starting at the first day of the third month after its announcement.

§ 12 Transitional regulations

(1) Students who are enrolled in the study program “Geographic Information Systems (UNIGIS professional)”at the Paris Lodron-University of Salzburg (Version 2009, Bulletin - special issue 146. of July 15, 2009) at the time when this curriculum comes into effect are entitled to complete their studies at the latest by 31.1.2019.

(2) Students are entitled to change to this curriculum on voluntary basis at any time within the registration period. A relevant written irrevocable Declaration is to be directed to the Admissions Office.

Annex I: Module Descriptions

Module name	Introduction to Geoinformatics
Module code	M 01 (GISINTRO)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - understand the added value of the spatial dimension as an integrating reference framework. - have an overview of the basic components of typical GIS projects and can appreciate GIS functionalities in this broader context. - have an overview of the main fields of application of GIS, broadly outline its development and anticipate both current trends and future market potential. The latter facilitates also the effective evaluation of priorities for designing individual learning pathways. - can answer simple, practical problems, which include a spatial component, by means professional GIS software. - know the basic challenges of the spatial referencing and are capable of integrating spatial data of different geodetic data and projections into a single spatial reference system. - have acquired the knowledge to compare and evaluate reference systems in terms of their suitability for a specific application.
Module content	This introductory module has a special position as a first study component of the curriculum. It provides orientation and sets the frame for working with the subsequent modules. Specifically, it supports the development of a personal style working with the distance-learning materials. In addition to these objectives regarding the study format, the following domain-related content is offered: - Terminology and functional characteristics of geographic information systems - Typical applications of geographic information processing - Current trends in geoinformatics - Overview of secondary information resources for GIS in terms of life-long learning - Practical training to use professional GIS software - Competent use of coordinate systems and projections in the practical work of GIS
Courses	M 01.1 VU Introduction to Geoinformatics (6 ECTS)
Type of assessment	Assignment

Module name	Data Modelling and Data Structures
Module code	M 02 (DATAMODL)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - have a profound overview of common data structures in GIS software, - can effectively compare and evaluate geodata structures based on their requirements and characteristics; consequently, they can identify the appropriate data structures for a specific problem in a project. - are aware to the vagueness of day-to-day terminology and concepts in describing spatial relations and recognise the necessity of formal logical data models as alternative terminology in GIS. - comprehend the importance of interoperability as basis for distributed spatial information processing and spatial data infrastructures. - can interpret the parameters of key, OGC-compliant services and use them in order to integrate external resources to their own applications (local, in the cloud). - understand the approach, structure and use of markup languages, can verify XML instances regarding their syntax and validate them against XML schemas. They can interpret GML schema files and create simple GML files. - are capable to contrast GML with alternative formats of web-based data exchange and to identify the suitable technology.
Module content	This module provides a profound overview of common data structures and data models in GIS. It explores how the real world around us can be mapped (application- and goal-oriented) in all its complexity with automate processed structures. Specific module contents include: - Basics of a formal description of spatial phenomena and relationships - Modelling spatial information - Spatial models – data models - data structures - Vector model - Raster models (grid) - Representation of continuous space - Object-oriented data models - Interoperability, OGC and standardisation

	- WMS, WFS, WCS and OGC-CS - Standards (GML) and quasi-standards (GeoJSON) for structuring and communication of spatial data - In-service training in another professional GI software
Courses	M02. 1 VU Data Modelling and Data Structures (6 ECTS)
Type of assessment	Assignment

Module name	Data Acquisition and Data Sources
Module code	M 03 (DATSRCAQ)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - know the most common methods for geodata acquisition, understand their basic functioning and consequently roughly evaluate their suitability for practical application scenarios. - have the skills to collect and process primary data: for example they can acquire and process GNSS data, can apply digital image processing methods in order to extract thematic information from multispectral image data, use services for geocoding address data or digitise analogue data using automated processes. - are informed about the most important sources of national and international digital geospatial data and can use them for their practical work. - can integrate heterogeneous datasets of various formats and sources into a homogenous geodatabase. - are aware of the importance of data documentation and familiar with the appropriate metadata standards. - know about national and international spatial data infrastructures.
Module content	The third module applies to the practical aspects of the 'population' of spatial data structures with real-world information. It gives an overview of the diversity of primary and secondary acquisition methods and thereby provides insights in the genesis and the related suitability for use of spatial data for specific use cases. A substantial part of the access record and listing of important digital resources as well as development of geographic information by standards-compliant documentation. It will also focus on the management of GI projects. Specific module contents include: - Identification of required data bases from the application and user perspective - Data quality and cost

	- Surveying - Global navigation satellite systems - Photogrammetry - LiDAR - Optical sensors and radar - Remote sensing platforms (satellite, aircraft, UAV) - Secondary acquisition methods: digitizing, scanning, vectorizing - Address data and geocoding - Data access, interfaces and formats - Metadata, metadata standards - GDI, data catalogs, INSPIRE - Global and national spatial data sources, open government data - Project management
Courses	M 03.1 VU Data Acquisition and Data Sources (6 ECTS)
Type of assessment	Assignment

Module name	Geo-database Management
Module code	M 04 (GEODBMS)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - can evaluate the range of database systems for managing geographical data and contrast them with other forms of data storage. - know the typical phases of the data modelling process and can automatically perform this process on the basis of simple, practical application scenarios. - can check existing ER models on efficiency and consistency, as well as develop ER diagrams for their own use cases. - can create simple databases, including a graphical representation of the data model and defining types for attribute and geometry data. - can perform and optimise queries using SQL statements. This applies to attribute queries as well as to simple spatial queries.
Module content	In this module, the conceptual foundations of conventional database systems are introduced by working on hands-on examples. On this basis, the knowledge is transferred to spatial data management and geodatabase systems. Specific module contents include: - Architecture of database management systems

	- Database design and documentation - Relational data modelling - Normalization - Solid basics of SQL query language as a universal language for data definition, data control and data management - Practical work with a SQL front end - Glossary of terms and specifications of GeoDBMS - Spatial models in DBMS - Spatial SQL operations according to OGC
Courses	M 04.1 VU Geo-DBMS (6 ECTS)
Type of assessment	Assignment

Module name	Visualisation and Cartography
Module code	M 05 (VISCARTO)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - can apply cartographic data representation methods efficiently and profitably in various project phases, from data exploration to the presentation of results and data analysis. - can develop media- and purpose-oriented representations of spatial data that are appropriate to the respective target audience. Resulting maps take into account data inherent characteristics (level of data, data distribution, standardization), perception-psychological conditions (gestalt perception, color) as well as (carto-)graphic conventions. - can draw on classical cartographic concepts such as generalisation or classification as well as use new visualisation techniques such as 3D visualisation and animation. - are capable of critically reflecting on cartographic products, identifying room for improvement and contributing substantially in the discourse on cartographic work.
Module content	Knowledge on the visual communication of spatial issues is essential, because virtually every GI professional actively design maps. This module aims at professionals from different domains to take advantage of cartographic data processing for their respective tasks. Specific module contents related to conventional as well as digital publication forms (Web mapping, mobile mapping) include: - Cartographic application fields and paradigms

	- Cartographic design process - Generalisation and classification - Perception of forms and Visual Variables - Colour models and colour use (including consideration of colour vision deficiency) - Development of map symbols and interaction - Map annotation and text - Thematic maps, diagrams and diagram maps - Map design and layout - Reproduction and digital devices and output formats - 2.5D/3D visualization - Web mapping technologies and APIs - Dynamic visualisation
Courses	M 05.1 VU Visualisation and Cartography (6 ECTS)
Type of assessment	Assignment

Module name	Application Development
Module code	M 06 (APPLDEV)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - have a structured understanding of software development, which allows them to work as a GIS expert in development teams or to communicate with developers. - understand the basic structures of procedural and object-oriented programming and can use this knowledge for their own programming tasks. - are qualified for developing simple applications, adapting existing applications and automating workflows.
Module content	This module serves as introduction to GIS programming. There are different courses available for this topic, on the one hand in order to cover the wide range of technology and software architectures; on the other hand to enable students to choose one based on the professional context and the resulting practical requirements. The specific module contents depend on the selected technology and platform that will be used. However, each course meets all aforementioned learning outcomes.
Courses	One of the following courses must be completed (or alternative equivalent): M 06.1 VU Application Development (using Java) (6 ECTS)

	M 06.2 VU Geoapplikationen mit VB.NET (6 ECTS) M 06.3 VU Geoprozessierung mit Python (6 ECTS)
Type of assessment	Assignment

Module name	Spatial Analysis
Module code	M 07 (GEOGANAL)
Total workload	6 ECTS
Learning outcomes	Graduates of the module - can identify the potential and limitations of spatial analysis to capture relationships and trends in spatial data and to support spatial decision-making processes. - are able to analyse complex, real-world problems by disserting them into methodically manageable sub-tasks and with common GIS software tools to process them further. - have a wide repertoire of analytical methods and techniques and can evaluate their suitability for a particular purpose. - know the advantages of graphical modelling tools for structuring extensive analysis procedures. - can assess the role and influence of alternative data models to the result of an analysis method and can analyse data irrespective underlying data model.
Module content	Spatial analysis methods are a central feature of all geographic information systems. This core area of geoinformatics aims at a transfer of domain issues towards an adequate use of analytical methods and tools of the geoinformatics, by adequate problem structuring and conceptualisation. This module introduces the fundamental methods and techniques of geographical analysis. Specific module contents include: - Approaches and motivation of spatial analysis. - Graphic modelling as a practical methodology for design and documentation of analysis processes - Map algebra as a scheme, appropriate operators - Spatial selection and aggregation, regionalisation. - Aggregate data, MAUP and ecological fallacy. - Distance scales and distance metrics, applications of distance-based methods - Cost surfaces - Spatial interpolation (deterministic, geostatistical) - Multi-thematic integration (intersection, assessment, multi-criteria method) - Decision support for optimising site locations

	- Route optimisation and allocation in networks - Terrain analysis (slope, exposure, radiation, visibility, hydrological runoff)
Courses	M 07.1 VU Spatial Analysis (6 ECTS)
Type of assessment	Assignment

Module name	Elective Subjects
Module code	WM 01
Total workload	18 ECTS
Learning outcomes	Graduates of the module - Deepen and broaden their competencies acquired through the core modules in accordance with their respective individual learning objectives.
Module content	The Elective Subjects build on the conceptual methodological and/or technical knowledge, acquired at the course of the core modules 1 to 7. A set of thematically interrelated courses on special topics are offered, from which students can choose to focus on their individual that can be also summarized under a suitable common title (see §7 (2)). Complementary to the courses available, other selected external courses can be also accredited (see §7 (1). Additionally a project work can be completed as part of the "Elective Subjects" (see §7 (2)): the main goal is the individual processing of a practice- or method-conceptual oriented GIS project. Although practice-oriented is the usual type of a project work, the students will follow the standard steps and analyse the problem, define the GIS approach, acquire and analyse the data, evaluate and present the results. The focus is on the documentation and argumentation of the decisions and should be supported by possible scientific literature. For Elective Subjects a number of courses is offered in German and English language. The offer is subject to ongoing adjustment and is determined by the curriculum Commission:
Courses	VU Application Development using Java (6 ECTS) VU ArcGIS for Server (6 ECTS) VU Developing Applications with OSM (6 ECTS) VU Environmental Monitoring (3 ECTS) VU EuroGIS - European Aspects of GIS (6 ECTS) VU Geoapplikationen mit VB.NET (6 ECTS) VU Geomarketing (3 ECTS)

	VU Geoprozierung mit Python (6 ECTS) VU Landschaftsanalyse mit GIS (6 ECTS) VU LiDAR Remote Sensing and Applications (3 ECTS) VU Oracle Spatial (6 ECTS) VU Photogrammetrie im Dienste der Geoinformatik (6 ECTS) VU QGIS: an open source desktop GIS (3 ECTS) VU Remote Sensing (6 ECTS) VU Spatial Simulation (6 ECTS) VU Visualisieren von Geodaten mit SVG (6 ECTS)
Type of assessment	According to selected courses

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Rector of Paris Lodron-University Salzburg
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A-5020 Salzburg

Remark

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