Neufassung der Modulbeschreibungen für den Masterstudiengang Geospatial Technologies
vom
12. November 2009

Module description

Module 1: Mathematics and Statistics (ISEGI)

0	Overall goals	Learning basic concepts needed for a structured understanding of the fundamental concepts of inferential and descriptive statistics, also needed for professional skills
1	**Educational goals and content of the module** **1.1 Courses**	7,5 of 15 credit points: Mathematical statistics (lecture and practical/2 semester hours per week/7,5 CP) Descriptive statistics (lecture and practical/2 semester hours per week/7,5 CP)
1	**1.2 Contents, sub-goals, competences**	**Contents:** The mathematical statistics course starts with the specification problem followed by the concepts of sampling and sampling distributions. Next the course deals with inferential statistics: estimation (properties and methods; confidence intervals; significance tests; and hypothesis testing. This course introduces the most relevant methods and concepts related with exploratory data analysis. Elementary concepts such as tables and graphics are explored. Measures of central tendency, dispersion, skewness and kurtosis are also studied. Concepts of correlation and regression, several index and time series are studied. **Sub-goals:** Provide the students with an adequate understanding of the major tools and concepts in classical inferential statistics and methods and concepts available in exploratory data analysis. **Mediated competences:** Methodological competences: Writing, presenting, research methods, publishing Social competences: teamwork Expertise: Understanding of mathematical and statistical concepts, its relevance in GI analysis and application context Methodological competences: writing, software handling Learning competences (key qualifications): problem solving Social competences: teamwork
1	**1.3 Integration into preparation of professional careers**	The fulfilment of the requirements of future employers for solid understanding of quantitative fields closely

		related with many applications of GI technology.
2	**Forms of teaching, learning, and exams**	Teaching and learning: Practical, Lecture Exams: Written exams and practical exams and/or individual project
3	**Requirements for participation**	-
4	**Use of module**	International Master program, Master Program in Statistics and Information Management

5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	7,5 credit points
		Mathematical Statistics	1	7,5
		Descriptive Statistics	1	7,5
		National grading system: 20-10 pass; 9-0 Fail Can be transferred to other national grading systems and ECTS		

6	**Duration and frequency of module offer**	Each Fall semester
7	**Teachers**	Prof. Beatriz Lacomba
8	**In charge of module**	Prof. Beatriz Lacomba

Module description

Module 2: Data Modelling (ISEGI)

0	Overall goals	Provide the students with fundamental modelling and analysis skills, focused on problem solving and making use of a wide range of methods and tools available for diagnosis and prediction in a GI context.
1	**Educational goals and content of the module** **1.1 Courses**	7,5 of 22,5 credit points: Data Analysis (lecture and practical/2 semester hours per week/7,5 CP) Data Mining lecture and practical/2 semester hours per week/7,5 CP) Data Bases (lecture and practical/2 semester hours per week/7,5 CP)
1	**1.2 Contents, sub-goals, competences**	**Contents:** The objective of this module is to cover all the major themes related with data modelling and analysis. The fundamental idea is to provide the students a thorough understanding of the concepts and methods available today to tackle the growing complexity of the current data bases. At the root of this module is the concept of transforming data into information and information into knowledge, taming complexity and supporting a more efficient decision making process **Sub-goals:** This module emphasises the relations and links between GI and data modelling techniques, providing critical assessment of the special features of GI and its impact on data modelling. **Mediated competences:** Methodological competences: Writing, presenting, project planning, controlling, research methods, publishing Social competences: teamwork Expertise: Understanding the different facets of data modelling in the context of GI, problem solving capabilities and innovative approaches to complex analysis problems Methodological competences: writing, software handling Learning competences (key qualifications): problem solving Social competences: teamwork
1	**1.3 Integration into preparation of professional careers**	The fulfilment of the requirements of future employers for solid understanding of modelling and analysis tools and software handling facilitates the career chances of the graduates.

2	Forms of teaching, learning, and exams	Teaching and learning: Practical, Lecture		
		Exams: Written exams and practical exams and/or individual project		
3	Requirements for participation	-		
4	Use of module	International Master program, Master Program in Statistics and Information Management		
5	Workload, requirements for awarding credit points, grading system	Course name	Exam	7,5 credit points
		Data Analysis	1	7,5
		Data Mining	1	7,5
		Data Bases	1	7,5
		National grading system: 20-10 pass; 9-0 Fail		
		Can be transferred to other national grading systems and ECTS		
6	Duration and frequency of module offer	Each Spring semester		
7	Teachers	Prof. Dr. Fernando Bação, Profª. Drª. Rosário Martins, Prof. Dr. João Garrot		
8	In charge of module	Prof. Dr. Fernando Bação		

Module description

Module 3: GI basics (ISEGI)

0	Overall goals	Learning basic concepts needed for a structured understanding of the GI field, also needed for professional skills
1	**Educational goals and content of the module** **1.1 Courses**	15 of 30 credit points: Geographic Information Systems (lecture and practical / 2 semester hours per week / 7,5 ECTS) Geosoftware I (practical / 2 semester hour per week / 7,5 CP) Remote Sensing (lecture and practical / 2 semester hours per week / 7,5 CP) Geostatistics (lecture and practical / 2 semester hours per week / 7,5 CP)
1	**1.2 Contents, sub-goals, competences**	**Contents:** The course covers the fundamental interdisciplinary concepts that are the basis of GIS development. It includes topics such as: GIS definition; relationships between GIS and other information systems; historic development; spatial representation, GIS functionality, GI accuracy, and GIS implementation, and hands-on GI software. It also covers important topics in the GI data cycle including acquiring data through remote sensing and data analysis throught geostatisics. **Sub-goals:** It emphasizes the potential of the technology and analytical methods for problem solving as well as many of the issues raised during GIS implementation. **Mediated competences:** Expertise: Understanding of GI technology, social context and functionality; apply research tools Methodological competences: writing, software handling, research methods, analytical skills Social competences: teamwork Learning competences (key qualifications): problem solving, group learning. Social competences: teamwork
1	**1.3 Integration into preparation of professional careers**	The fulfillment of the requirements of future employers for solid understanding of GI as well as software handling and analytical tools facilitates the career chances of the graduates.
2	**Forms of teaching, learning, and exams**	Teaching and learning: Practical, Lecture Exams: Written exams and practical exams and/or individual project
3	**Requirements for participation**	,
4	**Use of module**	International Master program, Master Program in Statistics

		and Information Management		
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	15 credit points
		Geographic Information Systems	1	7,5
		Remote Sensing	1	7,5
		Geostatistics	1	7,5
		Geosoftware	1	7,5
		National grading system: 20-10 pass; 9-0 Fail Can be transferred to other national grading systems and ECTS		
6	**Duration and frequency of module offer**	Each Fall semester		
7	**Teachers**	Prof. Dr. Marco Painho, Prof. Dr. Mário Caetano, Profª. Dr. Ana Costa and Eng Roberto Henriques		
8	**In charge of module**	Prof. Dr. Marco Painho		

Module description

Module 1: Informatics and Mathematics (UJI)

0	**Overall goals**	Provide students with those basic maths and programming skills needed to later successfully complete the Master.
1	**Educational goals and content of the module** **1.1 Courses**	• Programming (lecture and laboratory, 4 credits) • Databases (lecture and laboratory, 4 credits) • Software engineering (lecture and laboratory, 2 credits) • Applied mathematics (lecture and laboratory, 2 credits)
1	**1.2 Contents, sub-goals, competences**	**Contents:** Fundamental informatics and technical skills necessary to pass from user to analyst and developer of geospatial technologies. **Sub-goals:** Description of problems in form of algorithms and UML diagrams. Implement algorithms in a high level programming language. Design and implement relational databases. Learn fundamental mathematics for Geographic Information : linear algebra, geometry, topology, statistics **Mediated competences:** Expertise: Programming, database management and Methodological competences: Java, Oracle, Postgres. UML modelling. Statistical analysis. Learning competences (key qualifications): GI technician, programmer, customization of his/her own platform. Social competences: team building via group projects.
1	**1.3 Integration into preparation of professional careers**	Provides concrete technical competence in areas of high demand in European labour market.
2	**Forms of teaching, learning, and exams**	Mix of lecture and laboratory sessions. Exams based on lecture and graded exercises based on lab work.
3	**Requirements for participation**	None
4	**Use of module**	International Master program,
5	**Workload, requirements for awarding credit points, grading system**	<table><tr><td>Course name</td><td>Exam</td><td>12 credit points</td></tr><tr><td>Programming</td><td>1</td><td>4</td></tr><tr><td>Databases</td><td>1</td><td>4</td></tr><tr><td>Software engineering</td><td>1</td><td>2</td></tr></table>

		Applied math	1	2
		National grading system: 0 (min) -10 (max), with 5,0 being a passing grade. Can be transferred to other national grading systems and ECTS		
6	**Duration and frequency of module offer**	Offered annually during the UJI semester.		
7	**Teachers**	Mateu, Belmonte, Aramburu, Berlanga		
8	**In charge of module**	Prof. R. Berlanga		

Module description

Module 2: New technologies (UJI)

0	Overall goals	Provide background in related and supporting new technologies to GI.		
1	**Educational goals and content of the module** **1.1 Courses**	• Computer graphics including terrain models (lecture and laboratory, 4 credits) • Multimedia (lecture and labs, 3 credits) • Image processing (lecture and labs. 3 credits) • Networks (lectures and labs, 2 credits)		
1	**1.2 Contents, sub-goals, competences**	**Contents:** Computer graphics programming in OpenGL and applications to terrain models. Multimedia content production and reformatting. Satellite image processing. Networking fundamentals including wireless networks. **Sub-goals:** following on module 1, continued computing skills in new technology areas related to GI. **Mediated competences:** Expertise: Computer graphics and vision. Methodological competences: OpenGL programming. Creation of terrain models. Image segmentation and classification. Wired and wireless networking. Multimedia creation. Learning competences (key qualifications): problem solving Social competences: group work, work within tight guidelines and due dates		
1	**1.3 Integration into preparation of professional careers**	Courses teach a series of methods in high demand across Europe.		
2	**Forms of teaching, learning, and exams**	Lecture and laboratory. Exams for lecture part; exercises for laboratory part.		
3	**Requirements for participation**	None		
4	**Use of module**	International Master program,		
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	12 credit points
		Computer graphics	1	4
		Image processing	1	3
		Multimedia	1	3
		Networks	1	2

		National grading system: 0-10 (5=passing)
		Can be transferred to other national grading systems and ECTS
6	**Duration and frequency of module offer**	Annually during UJI semester.
7	**Teachers**	Belmonte, Gould, Huerta, Quirós, Pla
8	**In charge of module**	Prof. M. Gould

Module description

Module 3: GI basics (UJI)

0	**Overall goals**	Introduce students to GI topics in preparation for advanced topics at U. Münster.
1	**Educational goals and content of the module** **1.1 Courses**	- GIS I (lecture and laboratory, 3 credits) - Spatial analysis (lecture and laboratory, 2 credits) - Spatial Data Infrastructures (1 credit; distance learning)
1	**1.2 Contents, sub-goals, competences**	**Contents:** Basic operation of GIS software. Statistical analysis of point data. Basic components and working of SDI. **Sub-goals:** Learn fundamentals GIS concepts as implemented in various GIS software packages Lear to use point pattern analysis software in examples using social health data Use and create basic components of Spatial Data Infrastructures (SDI) **Mediated competences:** Expertise: understand working of raster and vector GIS. Analysis of point pattern data; geo statistics Methodological competences: composition and working of SDI modules. Learning competences (key qualifications): problem solving, group learning Social competences: group work (except for distance learning course)
1	**1.3 Integration into preparation of professional careers**	Provides well rounded understanding of GI topics; SDI is a key application in Information Society.
2	**Forms of teaching, learning, and exams**	Lecture, laboratories and distance learning.
3	**Requirements for participation**	N/A
4	**Use of module**	International Master program
5	**Workload, requirements for awarding credit points, grading system**	Course name / Exam / 6 credit points (see table below)

Course name	Exam	6 credit points
GIS I	1	3
Spatial analysis	1	2
SDI	1	1

		National grading system: 0-10 (5=passing)
		Can be transferred to other national grading systems and ECTS
6	**Duration and frequency of module offer**	Annually during UJI semester.
7	**Teachers**	Gould, Mateu
8	**In charge of module**	Prof. M Gould

Module description

Module 4: Fundamentals of Geographic Information Science (ifgi)

0	**Overall goals**	Familiarize the students with the fundamental theoretical and practical notions of geographic information science and technologies.
1	**Educational goals and content of the module** **1.1 Courses**	• Introduction to Geographic Information Science (lecture, 2 semester hours, 2 CP) • Introduction to Digital Cartography (lecture and labs, 2 semester hours each, 5 CP total) • Reference Systems for Geographic Information (lecture and labs, 2 semester hours each, 5 CP total)

1	**1.2 Contents, sub-goals, competences**	**Contents:** Basic notions of geographic information, its visualization in thematic maps, and its referencing.

Sub-goals:
- understand the basic scientific and technological questions underlying geospatial technologies
- learn to produce thematic maps that communicate geographic information well
- understand and apply the fundamentals of spatial and semantic reference systems.

Mediated competences:

Expertise: apply GIS and related software to visualize, reference, and transform geodata.

Methodological competences: master the fundamental methods of mapping geospatial information and of dealing with coordinate systems.

Learning competences (key qualifications): learn to solve larger spatial analysis and presentation tasks in small groups; apply computational methods to coordinates and related geospatial data.

Social competences: small team work; cope with larger computational challenges in various tools under strict time constraints.

1	**1.3 Integration into preparation of professional careers**	Producing maps in usable form, and dealing with coordinate systems is a fundamental ability of any user and designer of geospatial technologies. An understanding of basic GIScience notions is indispensable for these tasks.
2	**Forms of teaching, learning, and exams**	Interactive lectures with extensive self study and class discussions; small group (2 people) labs, e-learning (part of Digital Cartography) Exams:

- Intro to GIScience: graded presentation

- Intro to Digital Cartography: graded weekly labs and 25-minute online test for e-learning part

- Intro do Reference Systems: graded bi-weekly labs and 25-minute online test on spatial and temporal reference systems

3	**Requirements for participation**	-

4	**Use of module**	International Master program	
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	12 credit points

Course name	Exam	12 credit points
Intro to GIScience	Presentation	2 CP (28 contact hours, 24 hours self-studying, 8 h exam preparation)
Intro to Digital Cartography	Weekly labs and online test	5 CP (28 contact hours, 16 hours exam preparation, 46 hours self-studying)
Intro to Reference Systems	Weekly labs and online test	5 CP (56 contact hours,, 16 hours exam preparation, 28 hours self-studying))

National grading system:

Can be transferred to other national grading systems and ECTS

6	**Duration and frequency of module offer**	Each summer semester
7	**Teachers**	All faculty at IfGI
8	**In charge of module**	Prof. Kuhn

Module description

Module 5: Advanced topics in Geographic Information Science (ifgi)

0	Overall goals	Build on the fundamental notions of module 4 to deepen understanding, knowledge, and skills in selected areas of geospatial technology applications.
1	**Educational goals and content of the module** **1.1 Courses**	• Selected topics in GI (lecture and labs/ 2 semester hours per week/ 3 credit points) • Seminar in GI (seminar/2 semester hours per week/3 credit points) • Applications of GI (mixed/3 semester hours per week/ 4 credit points) • Geoinformatics Forum (lecture and discussion group 2 semester hours per week /2 credit points)
1	**1.2 Contents, sub-goals, competences**	**Contents:** Students come from very different backgrounds (any GI application area), and consequently their interests and goals differ widely. Therefore, specialization in topical areas are selected by students from the broad range of specializations taught by ifgi- and visiting professors (interoperability, usability, visualization, cognitive engineering, space-time modelling etc.) **Sub-goals:** Depending on topics and classes chosen **Mediated competences:** Expertise: select appropriate specialization area and become involved in solving problems in it. Methodological competences: apply methods described in the scientific and standards literature. Learning competences (key qualifications): self-motivated acquisition of essential methodological knowledge and skills in self-selected areas. Social competences: rapid knowledge acquisition, succinct oral presentations, written reports, team work depending on classes.
1	**1.3 Integration into preparation of professional careers**	Essential topical knowledge for applying GI in any professional field; necessarily limited in breadth.
2	**Forms of teaching, learning, and exams**	Mixed, depending on classes chosen. Typically, specialized courses of visiting professors are taught as two-week block courses. Geoinformatics Forum: Presentations of invited scientists and discussion group meetings for preparing the forum events. Exams: • Selected Topics and GI, Seminar in GI, and Application of GI: written exam (1 h) or oral exam (30 min.) or presentation (20 min.) or written reports/elaborations (max. 10 pages) or excercises – depending on the specialized course (conditions will be announced in the pre-semester course descriptions) • Geoinformatics Forum: no exam, but presentation (20 min.) for

		passing - not graded		
3	**Requirements for participation**	Module 4 successfully completed or ongoing.		
4	**Use of module**	International Master program		
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	12 credit points
		Selected Topics in GI	Yes	3 (28 contact hours, 62 hours self-studying and exam preparation)
		Seminar in GI	Yes	3 (28 contact hours, 62 hours self-studying and exam preparation)
		Application of GI	Yes	4 (28 contact hours, 92 hours self-studying and exam preparation)
		Geoinformatics Forum	No	2 (20 contact hours, 40 hours self-studying)
		National grading system: 1 (very good) – 4 (sufficienct), and failed Can be transferred to other national grading systems and ECTS		
6	**Duration and frequency of module offer**	Each summer semester. Continual and broad choice of course offerings		
7	**Teachers**	All faculty at IfGI, visiting professors		
8	**In charge of module**	Prof. Kuhn		

Module description

Module 6: Core competences

0	**Overall goals**	Learningsoft skills needed in professional GI careers

1	**Educational goals and content of the module**	
	1.1 Courses	• Project management in GI projects (practical/2 semester hours per week/3 credit points) • Research methods in GI Science (practical/2 semester hours per week/3 credit points)

1	**1.2 Contents, sub-goals, competences**	**Contents:** The following aspects of project management are mediated: Project acquisition, project planning, budgeting, controlling, documentation, evaluation. Emphasis lies on the practical execution of a GI project, where students working groups are responsible for different project phases. Mediated research methods are tools of scientific research, scientific writing, presenting, and publishing. **Sub-goals:** Sub-goals are to learncompetencies in project management and research methods. These key competencies are required for GI professionals in private companies as well as in research institutions. Thus, essential qualifications are mediated for a successful career start. **Mediated competences:** Expertise: Project management, research tools Methodological competences: Writing, presenting, project planning, controlling, budgeting, research methods, publishing Learning competences: self-learning, group learning, problem solving Social competences: teamwork
1	**1.3 Integration into preparation of professional careers**	The fulfillment of the requirements of future employers for soft skills facilitates the career chances of the graduates.
2	**Forms of teaching, learning, and exams**	Teaching and learning: Practical, group work, presentations,, partly e-learning (project management)Exams: • Research methods: thesis proposal (max. 10 pages) • Project management: online exam (1 hour, 25 % of the overall grade), final report in working groups (max. 20 pages per working group, 75 % of the overall grade)
3	**Requirements for participation**	-
4	**Use of module**	International Master program

5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	6 credit points
		Research methods in GI Science	Thesis proposal	3 (28 contact hours, 47 hours self-studying, 15 hours preparation of thesis proposal)
		Project management in GI projects	Online exam and written report	3 (40 hours, e-learning incl. preparation for online exam) and practical part (50 hours, distributed to 14 hours classroom meetings, 26 hours self-studying and 10 hours for final report)

National grading system: 1 (very good) – 4 (sufficienct), and failed

Can be transferred to other national grading systems and ECTS

6	**Duration and frequency of module offer**	Each summer semester
7	**Teachers**	Dr. Brox, Prof. Dr. Pebesma,
8	**In charge of module**	Dr. Brox

Module description

Module 7: Summer School (optional, ifgi, ISEGI, UJI)

0	**Overall goals**	Mediating GI contents in a multicultural environment of international students, and teachers with different GI backgrounds		
1	**Educational goals and content of the module** **1.1 Courses**	Depending on event, to be recognized as courses of modules 1-6 Options for execution are the Vespucci Summer School (www.vespucci.org), and joint or single events, e.g., the ifgi Fall School 2004, see http://ifgi.uni-muenster.de).		
1	**1.2 Contents, sub-goals, competences**			
1	**1.3 Integration into preparation of professional careers**			
2	**Forms of teaching, learning, and exams**			
3	**Requirements for participation**			
4	**Use of module**	International Master program, national programs of partners		
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	Xx credit points

		National grading system: dependent on location
		Can be transferred to other national grading systems and ECTS
6	**Duration and frequency of module offer**	Optional
7	**Teachers**	
8	**In charge of module**	Prof. Gould, Prof. Kuhn, Prof. Painho

Module description

Master thesis (ifgi, ISEGI, UJI)

0	Overall goals	Independent work on a GI topic using scientific methods and presentation of results		
1	**Educational goals and content of the module** **1.1 Courses**	• Master thesis including its defense (30 CP)		
1	**1.2 Contents, sub-goals, competences**	**Contents:** Depending on topic **Sub-goals:** Depending on topic **Mediated competences:** Expertise: Basic research questions and research methods in GI Methodological competences: Solving GI problems (dependent on topic) Learning competences: Scientific writing, independent working, literature review Social competences: Communication with supervisor and co-researchers		
1	**1.3 Integration into preparation of professional careers**	Treating a GI topic / Solving a GI problem within a defined schedule and quality		
2	**Forms of teaching, learning, and exams**	Teaching and learning: Literature and Internet review, others dependent on topic Exam: Master thesis including its defense		
3	**Requirements for participation**	Recognition of 60 credit points of this Master program		
4	**Use of module**	International Master program		
5	**Workload, requirements for awarding credit points, grading system**	Course name	Exam	30 credit points
		-	thesis	30
		National grading system: Can be transferred to other national grading systems and ECTS		
6	**Duration and frequency of module offer**	ongoing		
7	**Teachers**	Prof. Gould, Prof. Kuhn, Prof. Painho, N.N.		
8	**In charge of module**	Prof. Gould, Prof. Kuhn, Prof. Painho		

Ausgefertigt aufgrund des in Wahrnehmung seiner Eilkompetenz gefassten Beschlusses des Dekans des Fachbereichs Geowissenschaften vom 02.10.2009.

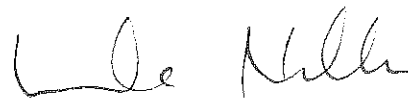Münster, den 12.11.2009   Die Rektorin

Prof. Dr. Ursula Nelles

Die vorstehende Ordnung wird gemäß der Ordnung der Westfälischen Wilhelms-Universität über die Verkündung von Ordnungen, die Veröffentlichung von Beschlüssen sowie die Bekanntmachung von Satzungen vom 08. Februar 1991 (AB Uni 91/1), geändert am 23. Dezember 1998 (AB Uni 99/4), hiermit verkündet.

Münster, den 12.11.2009   Die Rektorin

Prof. Dr. Ursula Nelles