University of Debrecen
Faculty of Science and Technology
Institute of Earth Sciences

GEOINFORMATICS MSC PROGRAM

2024

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DEAN`S WELCOME

Welcome to the Faculty of Science and Technology!

This is an exciting time for you, and I encourage you to take advantage of all that the Faculty of Science and Technology UD offers you during your bachelor's or master's studies. I hope that your time here will be both academically productive and personally rewarding

Being a regional centre for research, development and innovation, our Faculty has always regarded training highly qualified professionals as a priority. Since the establishment of the Faculty in 1949, we have traditionally been teaching and working in all aspects of Science and have been preparing students for the challenges of teaching. Our internationally renowned research teams guarantee that all students gain a high quality of expertise and knowledge. Students can also take part in research and development work, guided by professors with vast international experience.

While proud of our traditions, we seek continuous improvement, keeping in tune with the challenges of the modern age. To meet the demand of the job market for professionals, we offer engineering courses with a strong scientific basis, thus expanding our training spectrum in the field of technology. Based on the fruitful collaboration with our industrial partners, recently, we successfully introduced dual-track training programmes in our constantly evolving engineering courses.

We are committed to providing our students with valuable knowledge and professional work experience, so that they can enter the job market with competitive degrees. To ensure this, we maintain a close relationship with the most important national and international companies. The basis for our network of industrial relationships are in our off-site departments at various different companies, through which market participants - future employers - are also included in the development and training of our students.

Prof. dr. Ferenc Kun
Dean

UNIVERSITY OF DEBRECEN

Date of foundation: 1912 Hungarian Royal University of Sciences, 2000 University of Debrecen

Legal predecessors: Debrecen University of Agricultural Sciences; Debrecen Medical University; Wargha István College of Education, Hajdúböszörmény; Kossuth Lajos University of Arts and Sciences

Number of Faculties at the University of Debrecen: 13

Faculty of Agricultural and Food Sciences and Environmental Management

Faculty of Child and Special Needs Education

Faculty of Dentistry

Faculty of Economics and Business

Faculty of Engineering

Faculty of Health

Faculty of Humanities

Faculty of Informatics

Faculty of Law

Faculty of Medicine

Faculty of Music

Faculty of Pharmacy

Faculty of Science and Technology

Number of students at the University of Debrecen: 30,899

Full time teachers of the University of Debrecen: 1,597

210 full university professors and 1,262 lecturers with a PhD.

FACULTY OF SCIENCE AND TECHNOLOGY

The Faculty of Science and Technology is currently one of the largest faculties of the University of Debrecen with about 2,500 students and more than 200 staff members. The Faculty has got 6 institutes: Institute of Biology and Ecology, Institute of Biotechnology, Institute of Chemistry, Institute of Earth Sciences, Institute of Physics and Institute of Mathematics. The Faculty has a very wide scope of education dominated by science and technology (12 Bachelor programs and 14 Master programs), additionally it has a significant variety of teachers' training programs. Our teaching activities are based on a strong academic and industrial background, where highly qualified teachers with a scientific degree involve student in research and development projects as part of their curriculum. We are proud of our scientific excellence and of the application-oriented teaching programs with a strong industrial support. The number of international students of our faculty is continuously growing (currently ~ 760 students). The attractiveness of our education is indicated by the popularity of the Faculty in terms of incoming Erasmus students, as well.

THE ORGANIZATIONAL STRUCTURE OF THE FACULTY

Dean: Prof. Dr. Ferenc Kun, Full Professor
E-mail: ttkdekan@science.unideb.hu

Vice Dean for Educational Affairs: Prof. Dr. Gábor Kozma, Full Professor
E-mail: kozma.gabor@science.unideb.hu

Vice Dean for Scientific Affairs: Prof. Dr. Sándor Kéki, Full Professor
E-mail: keki.sandor@science.unideb.hu

Consultant on External Relationships: Prof. Dr. Attila Bérczes, Full Professor
E-mail: berczesa@science.unideb.hu

Consultant on Talent Management Programme: Prof. dr. Tibor Magura, Full Professor
E-mail: magura.tibor@science.unideb.hu

Dean's Office
Head of Dean's Office: Mrs. Katalin Kozma-Tóth
E-mail: toth.katalin@science.unideb.hu

English Program Officer: Mrs. Alexandra Csatáry
Address: 4032 Egyetem tér 1., Chemistry Building, A/101, E-mail: acsatary@science.unideb.hu

DEPARTMENTS OF INSTITUTE OF EARTH SCIENCES

Department of Meteorology (home page: https://meteo.unideb.hu)
4032 Debrecen, Egyetem tér 1, Geomathematics Building

Name	Position	E-mail	room
Mr. Dr. Sándor Szegedi, PhD, habil	Associate Professor, Head of Department	szegedi.sandor@science.unideb.hu	126
Mr. Dr. István Lázár, PhD	Assistant Professor	lazar.istvan@science.unideb.hu	128
Mr. Dr. Tamás Tóth, PhD	Assistant Professor	toth.tamas@science.unideb.hu	127
Mr. Dr. Ferenc Wantuch, PhD	Assistant Professor	wantuch.ferenc@nkh.gov.hu	127

Department of Mineralogy and Geology (home page: https://zafir.min.unideb.hu)
4032 Debrecen, Egyetem tér 1, Chemistry Building

Name	Position	E-mail	room
Mr. Zsolt Benkó, PhD, habil	Associate Professor, Head of Department	benko.zsolt@atomki.hu	A/25
Mr. Dr. Tamás Buday, PhD	Assistant Professor	buday.tamas@science.unideb.hu	A/4
Mr. Dr. Árpád Csámer, PhD	Assistant Professor	csamera@unideb.hu	A/6
Mr. Dr. Richárd William McIntosh, PhD	Assistant Professor	mcintosh.richard@science.unideb.hu	A/5
Mr. István Simon	Technical Assistant	simon.istvan@science.unideb.hu	A/9
Ms. Judit Vanka	Technical Assistant	vanka.judit@science.unideb.hu	A/8

Department of Landscape Protection and Environmental Geography (home page: https://tajvedelem.unideb.hu)
4032 Debrecen, Egyetem tér 1, Geomathematics Building

Name	Position	E-mail	room
Mr. Dr. György Szabó, PhD, habil	Full Professor, Head of Department	szabo.gyorgy@science.unideb.hu	218
Mr. Prof. Dr. Péter Csorba, PhD, habil, DSc	Professor Emeritus	csorba.peter@science.unideb.hu	217
Mrs. Dr. Beáta Babka, PhD	Assisstant Professor	babkabeata@science.unideb.hu	221
Mr. Dr. István Fazekas, PhD	Assistant Professor	fazekas.istvan@science.unideb.hu	219
Mr. Tamás Mester	Assistant Professor	mester.tamas@science.unideb.hu	220
Mrs. Dr. Mária Vasvári	Assistant Professor	vasvari.maria@science.unideb.hu	220
Mrs. Dr. Borbála Halasi-Kovácsné Benkhard, PhD	Assistant Professor	benkhard.borbala@science.unideb.hu	220
Mrs. Gézáné Inczefi	Secretary	inczefi.gezane@science.unideb.hu	216

Department of Social Geography and Regional Development Planning (home page: https://human.geo.science.unideb.hu)
4032 Debrecen, Egyetem tér 1, Geomathematics Building

Name	Position	E-mail	room
Mr. Prof. Dr. Gábor Kozma, PhD, habil, DSc	Full Professor, Head of Department	kozma.gabor@science.unideb.hu	123
Mr. Dr. János Pénzes, PhD, habil	Associate Professor	penzes.janos@science.unideb.hu	118
Mr. Dr. Károly Teperics, PhD, habil	Associate Professor	teperics.karoly@science.unideb.hu	119
Mr. Dr. Ernő Molnár, PhD	Associate Professor	molnar.erno@science.unideb.hu	118
Mr. Dr. István Pásztor, PhD	Assistant Professor	pasztor.istvan@kossuth-gimnazium.unideb.hu	116
Mr. Dr. Zsolt Radics, PhD	Assistant Professor	radics.zsolt@science.unideb.hu	119
Mrs. Dr. Klára Czimre, PhD	Assistant Professor	czimre.klara@science.unideb.hu	120
Mr. Gábor Németh	Informatician	nemeth.gabor@science.unideb.hu	120
Mrs. Erika Nagy	Assistant Professor	nagye@rkk.hu	113

Department of Physical Geography and Geoinformatics (home page: https://geogis.unideb.hu)
4032 Debrecen, Egyetem tér 1, Geomathematics Building

Name	Position	E-mail	room
Mr. Prof. Dr. Szilárd Szabó, PhD, habil, DSc	Full Professor, Head of Department Head of Institute	szabo.szilard@science.unideb.hu	223
Mr. Prof. Dr. József Lóki, PhD, habil, DSc	Professor Emeritus	loki.jozsef@science.unideb.hu	226
Mr. Prof. Dr. József Szabó, PhD, habil, DSc	Professor Emeritus		
Mr. Dr. Gergely Szabó, PhD, habil	Associate Professor	szabo.gergely@science.unideb.hu	222
Mrs. Dr. Boglárka Bertalanné Balogh, PhD	Assistant Professor	balazs.boglarka@science.unideb.hu	222
Mr. Dr. Gábor Négyesi, PhD	Associate Professor	negyesi.gabor@science.unideb.hu	227
Mr. Dr. Zoltán Krisztián Túri, PhD	Assistant Professor	turi.zoltan@science.unideb.hu	228
Mr. Dr. László Bertalan, PhD	Assistant Professor	bertalan@science.unideb.hu	227
Mr. Lóránd Szabó	Assistant Professor	szabo.lorand@science.unideb.hu	202
Mrs. Krisztina Sósné Mező	Technical Assistant	mezo.krisztina@science.unideb.hu	A/P-6
Ms. Csilla Tóth	Technical Assistant	toth.csilla@science.unideb.hu	A/P-6*
Ms. Oktávia Szabó	Secretary	szabo.oktavia@science.unideb.hu	224

***** - Chemistry Building

ACADEMIC CALENDAR

General structure of the academic semester (2 semesters/year):

Study period	1st week	Registration*	1 week
	2nd – 15th week	Teaching period	14 weeks
Exam period	directly after the study period	Exams	7 weeks

*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

For further information please check the following link:

https://www.edu.unideb.hu/tartalom/downloads/University_Calendars_2024_25/University_calendar_2024-2025-Faculty_of_Science_and_Technology.pdf

THE GEOINFORMATICS MASTER PROGRAM

Information about the Program

Name of MSc Program:	Geoinformatics MSc Program
Specialization available:	-
Field, branch:	Science
Qualification:	Expert in Geoinformatics
Mode of attendance:	Full-time
Faculty, Institute:	Faculty of Science and Technology Institute of Earth Sciences
Program coordinator:	Prof. Dr. Szilárd Szabó, Full Professor
Duration:	4 semesters
ECTS Credits:	120

Objectives of the MSc program:

The aim of the MSc programme in geoinformatics is to train geoinformatics researchers and analysts being able to creatively work in the science of geoinformatics based on their basic and practical knowledge of natural sciences, mathematics, and informatics. Geoinformaticians are qualified to interpret spatial phenomena, processes and information related to geographic locations, and to perform problem-solving, design, development, operation, management and consultancy tasks in the operation of geoinformatics systems, decision support systems and expert systems. They are prepared to continue their studies at doctoral level.

Professional competences to be acquired

A geoinformatics student:

a) Knowledge:

- Students will have a complex knowledge of the general geographic, cartographic, planning, mathematical and informatics principles, rules and contexts necessary for the operation of the discipline of geoinformatics, in particular in the following topics: geographic and spatial data collection at different scales, use of cartographic procedures, knowledge of geographic and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modelling, visualisation, geoinformatics system building.
- Knowledge of current theories, models and literature based on scientific findings in the field of geoinformatics. You are aware of the possible directions and limits of development in the field of geoinformatics.
- Comprehensive knowledge and understanding of the most relevant concepts and concepts in the field of geoinformatics, in particular in the following areas: geospatial data collection technologies, 2- and 3-dimensional geospatial modelling, geovisualisation, spatial data infrastructures,

geoinformatics programming and application development, vector geomatics, raster geomatics, digital image processing, web-based geospatial solutions, geoinformatics databases, applied geographic information systems.
- Comprehensive knowledge of the principles, methodologies and procedures for the design, development and operation of geoinformatics, in particular in the following areas: database management, Big Data - data mining, primary and secondary data collection, earth observation, spatial and temporal data analysis, process modelling and simulation, network analysis, 3-dimensional modelling, geovisualisation, geostatistical solutions, web geoinformatics services, spatial services development, geoinformatics programming, geospatial applications development, open source geoinformatics.
- Knowledge of specific tools in the field of geoinformatics, ability to apply field survey procedures, data management and analysis, and visualisation solutions. Knowledge and use of spatial data collection technologies, available databases and geospatial software, open source and commercial geoinformatics software, cloud-based geoinformatics solutions.
- Understand, know and apply the mobile field, laboratory and practical materials, tools and methods of geoinformatics.
- Students will have basic management and leadership skills, enabling you to carry out tasks related to your area of expertise.
- Students will know the possibilities, principles and problems of geoinformatics for public (e-government) and market applications.
- Students will have knowledge of Industry 4.0-based operations and technological knowledge, cyber-physical systems, self-organising mechanisms and the consequences of digitalisation and automation on the labour market, inducing structural changes in manufacturing and supply chains, and in the organisation of production processes.
- Confidently use the concepts and terminology describing natural processes in their mother tongue and integrate them into the conceptual framework of geoinformatics.
- Knowledge of environmental, accident, occupational and consumer protection.

b) Abilities:
- Ability to interpret complex professional problems in the field of geoinformatics, to identify the necessary theoretical and practical background and to solve problems.
- The ability to interpret geospatial phenomena, processes and information, and to plan, organise, manage and control processes in the field of geoinformatics.
- Ability to collect and organise spatial data into a database and to organise data using geoinformatics tools. Ability to perform operations and model building with the independently organised databases.
- Ability to design value-added services, with a special focus on land monitoring.
- The ability to process, evaluate, interpret, analyse and draw conclusions from measurement results in a creative and systematic way.
- Ability to work proactively, in projects and teams with experts in co-disciplines and other related disciplines (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, computer science, mathematics, statistics, archaeology).
- Ability to proactively collaborate with design and development professionals and end users of geoinformatics outputs.

- Ability to assess the business, market and innovative value of designed and implemented geoinformation systems, and their ability to meet user and societal needs.
- Ability to recognise and apply new problem-solving methods and procedures in their field and to apply what they have learned in a diverse, multidisciplinary environment.
- Ability to understand, design and implement quality management systems for project-level tasks in the field of geoinformatics.
- Ability to consult on and run a geoinformatics applications business.
- Ability to use the professional vocabulary of geoinformatics in your mother tongue and in English.
- Ability to create geoinformation systems to support and assist decision makers.
- Ability to manage processes and projects related to geoinformatics at a management level.
- Ability to perform problem-solving, design, development, operation, management and consulting tasks in the operation of geographic information systems, decision support systems and expert systems. Ability to interact with decision makers.

c) Attitude:
- Monitor professional and technological developments in the field of geoinformatics and labour market trends.
- Open and committed to critical feedback and evaluation based on self-reflection.
- In the field and in the laboratory, he is committed to environmentally responsible behaviour.
- Accept and enforce the ethical principles of work and organisational culture, with particular regard to the copyright environment related to spatial computing.
- Students can shares their knowledge and considers it important to communicate the professional results of geoinformatics. He is open to professional collaboration with professionals in related fields.
- It considers it important to promote environmental awareness and sustainable development, and uses geoinformatics to support this.
- Committed to meeting and enforcing quality requirements.

d) Autonomy and responsibility:
- Independent in thinking through and developing professional issues and processes.
- A sense of responsibility to meet and enforce deadlines. Is accountable for his/her own work and that of his/her colleagues working under his/her supervision and those working with him/her (on a project).
- With his/her knowledge and skills in geoinformatics, he/she is able to work responsibly with professionals from other disciplines.
- Students will be given development and operational responsibility for the operation of geoinformation systems commensurate with their professional competence.

Completion of the MSc Program

The Credit System

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).
ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programs and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programs.
Regarding each major the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

For the Geoinformatics Master Program the following professional fields define the training:

- general environmental knowledge (e.g. modelling, simulation, geomathematics): 10 credits
- management skills (e.g. data protection, managemenet): 12 credits
- geoinformatics core themes: 67 credits

Credit points assigned to optional subjects: 6
Credit points assigned to thesis: 20
Credits total: 120
During the program students have to complete a total amount of 120 credit points. It means approximately 30 credits per semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing subjects which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects/semesters in chapter “Model Curriculum of Geoinformatics MSc Program”.

	Semesters				Credits	exam/ practice
	1.	2.	3.	4.		
Basic science						
1. New geographical research methods *Szilárd Szabó*	28 lec /3 cr				3+0	exam
2. Environmental system – environmental geography György Szabó	28 lec /3 cr 14 prac /1 cr				3+1	exam+ prac
3. Applied geomathematics, modelling, simulation Sándor Szegedi	14 lec /1 cr 28 prac /2 cr				1+2	prac
4. Geostatistics István Lázár			14 lec /1 cr 14 prac /1 cr		1+1	prac
Economic, legal and human science						
1. Management skills András Kun	28 lec /3 cr				3+0	exam
2. Data protection, data security Péter Takács	28 lec /3 cr				3+0	exam
3. Space and Society János Pénzes		14ea /1kr 28sz /2kr			1+2	prac
4. Project management, lecture Gábor Kozma	14 lec / 3cr				1+0	exam
5. Project management, practice Gábor Kozma	28 prac /2 cr				0+2	prac
Data collection and data analysis						
1. Data mining in geosciences Szilárd Szabó			14 lec /1 cr 14 prac /1 cr		1+1	exam
2. Spatial data analysis János Pénzes				28 prac / 2 cr	0+2	prac

3. Data collection techniques Zoltán Túri Krisztián		28 lec /3 cr			3+0	exam
4. Database management, lecture László Bertalan		14 lec /3 cr			1+0	exam
5. Database management, practice László Bertalan		28 prac /2 cr			0+2	gyj
Remote sensing						
1. Hyperspectral remote sensing Loránd Szabó		14 lec /1 cr 28 prac /2 cr			1+2	prac
2. Multispectral remote sensing Zoltán Krisztián Túri	14 lec /1 cr 28 prac /2 cr				1+2	prac
3. Remote sensing with uncrewed aerial vehicles László Bertalan		14 lec /1 cr 28 prac /2 cr			1+2	prac
4. Photogrammetry Gergely Szabó	14 lec /1 cr 28 prac /2 cr				1+2	prac
Computer science and programming						
1. GIS-specific programming Dávid Abriha		42 lec /4 cr 28 prac/2 cr			4+2	exam
2. Technical informatics, lecture László Bertalan		28 lec /3 cr			3+0	exam
3. Technical informatics, practice László Bertalan		28 prac/2 cr			0+2	prac
Specific applications						
1. Applied agriculture informatics Zoltán Krisztián Túri			28 prac /2 cr		0+2	prac
2. Applied GIS in regional development János Pénzes			14 lec /1 cr 28 prac /2 cr		1+2	prac
3. Open source GIS Szilárd Szabó				28 prac /2 cr	0+2	prac
4. CAD-system Gergely Szabó		14 lec /1 cr 14 prac/1 cr			1+1	prac

5. Environmental informatics Zoltán Krisztián Túri	14 lec /1 cr 28 prac /2 cr				1+2	prac
Geovisualisation and modelling						
1. Maps on WEB Dávid Abriha			28 lec /3 cr 14 prac/1 cr		3+1	exam
2. Models in GIS, lecture Boglárka Bertalanné Balázs				14 lec /1 cr	1+0	exam
3. Models in geoinformatics, practice Boglárka Bertalanné Balázs				28 prac /2 cr	0+2	prac
4. Geovisualisation Gábor Négyesi			28 prac /2 cr		0+2	prac
Applied analysis						
1. GIS software Zoltán Krisztián Túri				14 lec /1 cr 28 lec/2 cr	1+2	prac
2. Raster analysis Szilárd Szabó	28 prac /2 cr				0+2	prac
3. Point cloud processing László Bertalan			14 lec /1 cr 14 prac/1 cr		1+1	prac
4. GIS fieldwork Boglárka Bertalanné Balázs			1 week /4 cr			prac
Total	182 lec 182 gy	168 lec 182 prac	84 lec 140 prac	28 lec 112 prac	89 cr	14 exam 21 prac
	30 cr	28 cr	21 cr	10 cr		

Thesis I.			30 cons/10 cr		10 cr	prac
Thesis II.				30 cons/10 cr	10 cr	prac

optional course 1					3 cr	exam
optional course 2					3 cr	exam

Internship Gergely Szabó		6 weeks/5 cr			5 cr	prac

total	**182 lec 182 prac**	**168 lec 182 prac**	**84 lec 140 prac, 30 cons**	**28 lec 112 prac 30 cons**	**120 cr**	**16 exam 24 prac**

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.
Registration in the Neptun system by the subject: MUNKAVEDELEM (Safety)
Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on webpage of the Faculty.

Internship

Students majoring in the Geoinformatics MSc have to carry out a 6 weeks internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (2^{th} semester). Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

Objective of the internship, competences
Students get acquainted with professional work in conformity with their major at the company or institution and join in the daily working process. They have to resolve tasks independently assigned by their supervisor and gain experiences may be utilized later in the labour market. During the internship common and professional competences may be acquired. Common competences: precise working on schedule either individually or in team, talk shop applying correct technical terms. Professional competences: applying the professional skill gained during the training and acquiring new knowledge.

Places suitable for internship
All the organizations, institutions and companies in Hungary or abroad, provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of operation, repairing technology, installation, management and development of different machines and vehicles, may be a suitable place.

Physical Education

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in one semester during his/her Master's training. Our University offers a wide range of facilities to complete them.

Pre-degree Certification

A pre-degree certificate is issued by the Faculty after completion of the master's (MSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education as set out in Section 10 in Rules and Regulations, internship (mandatory) – with the exception of preparing thesis – and gained the necessary credit points (120). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the final exam.

Thesis

A Thesis is the creative elaboration of a professional task in written form. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal supervisor (referee). By a completed dissertation and its successful defence geoinformatics student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed work and its results in a professional way, to solve the tasks related to his/her topic creatively and to complete individual professional work. By preparing and defending a thesis a student who completes the Geoinformatics Master Program proves that he/she is capable of the practical applications of the acquired skills, summarizing the work done and its results in a professional way, creatively solving the tasks related to the topic and doing individual professional work.

The student can choose any topic for a thesis suggested by the institute or in occasional cases individual topics acknowledged by the head of the department. The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program.

The formal requirements of the thesis are detailed in the "manual for writing thesis" which is available on the official home page of institute.

A thesis can be submitted only if it is supported both by the internal supervisor. If a thesis is evaluated with a fail mark by the referee and the department the student is not allowed to take the final exam and is supposed to prepare a new or modified thesis. The student has to be informed about it. Conditions on resubmitting the thesis are defined by the program coordinator of the particular specialization.

Final Exam

Students had obtained the pre-degree certificate will finish their studies by taking the final exam of Geoinformatics Master Program. A final exam is the evaluation and control of the knowledge and skills acquired. The candidate has to certify that he/she is able to apply the obtained

knowledge in practice. A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. A final exam has to be taken in front of the Final Exam Board. If a candidate does not pass his/her final exam by the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing requirements on the rules of the final exam.
The Final Exam consists of 2 parts:
- presentation of the thesis and its defence
- oral exam
  - 2 core material question.

Final Exam Board
Board chair and its members are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The board consists of – besides the chair – at least two members (one of them is an external expert), and questioners as required. The mandate of a Final Exam Board lasts for one year.

Repeating a failed Final Exam
If any part of the final exam is failed it can be repeated according to the rules and regulations. A final exam can be retaken in the forthcoming final exam period. If the Board qualified the Thesis unsatisfactory a student cannot take the final exam and he has to make a new thesis. A repeated final exam can be taken twice on each subject.

Diploma

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Geoinformatics Master Program. It contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the rector's (or vice-rector's) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

In Geoinformatics Master Program the diploma grade is calculated as the average grade of the results of the followings:

- Weighted average of the overall studies at the program (A)
- Average of grades of the thesis and its defense given by the Final Exam Board (B)
- Average of the grades received at the Final Exam for the two subjects (C)

Diploma grade = (A + B + C)/3

Classification of the award on the bases of the calculated average:

Excellent	4.81 – 5.00
Very good	4.51 – 4.80
Good	3.51 – 4.50
Satisfactory	2.51 – 3.50
Pass	2.00 – 2.50

Course Descriptions of Geoinformatics MSc Program

Basic science

Title of course: New geographical research methods **Code: TTGME7001_EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 2 hours/week - practice: - - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 32 hours Total: 60 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course
The aim of the course is to provide a comprehensive knowledge of new developments in the various fields of geography and to familiarise the students with the latest research methods. The course covers the following topics: the role of drones in our everyday life and in science; methods of geological dating (14 C, K-Ar, U-Th,137 Cs) and their applications; the possibilities of ground and airborne laser scanning in surveys, the methodology, advantages and limitations of laser scanning, its applicability in surveys; methods of geo-ecological mapping, modern tools for vegetation and soil survey; WRB soil classification, modern diagnostic-based soil classification systems used worldwide; environmental risk assessment, environmental remediation, steps and methods for remediation of environmental contamination; the concept of urban climate, its characteristics, effects on human comfort, methods for monitoring; modelling of climate change at different spatial scales, types of climate models, their characteristics, methods for spatial scaling; main rock survey methods and instruments; main geophysical methods (ground penetrating radar, geophone, ERT, etc.); applied volcanology; trends in the new economic geography, the main theories of the new economic geography school, which is playing an increasingly important role in today's economic geography; the main characteristics of modern cities - the processes taking place in today's cities and the factors behind them; the role of critical geography in today's social geography.
Literature
Compulsory: - Acocella, V. 2022. Volcano-Tectonic Processes (Advances in Volcanology), Springer, ISBN: 978-3030659707 - Förstner, W., Wrobel, BP. 2016. Photogrammetric Computer Vision: Statistics, Geometry, Orientation and Reconstruction, Springer, ISBN: 978-3319791708

Requirements:
- for a signature
Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester.
The students must choose one of the topics offered by the teacher to plan a project, write an essay and prepare a presentation.
The students must take a written exam at the end of the semester.
- for a grade
The course ends in an **examination**.:
Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-64	pass (2)
65-74	satisfactory (3)
75-85	good (4)
86-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Prof. Dr. Szilárd Szabó, university professor, DSc

Lecturer:
Prof. Dr. Szilárd Szabó, university professor, DSc
Dr. Gergely Szabó, associate professor, PhD
Prof. Dr. Gábor Kozma, university professor, DSc

Title of course: Environmental systems - Environmental Geography **Code: TTGME6001_EN**	**ECTS Credit points: 4**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: 1 hours/week
- laboratory: -

Evaluation: exam, mid-semester grade

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: 14 hours
- laboratory: -
- home assignment: 28 hours
- preparation for the exam: 50 hours

Total: 120 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Environmental science and environmental geography as sciences of environmental systems. Basic systems theory, types of systems, how they work. Feedbacks. Chaos theory, basics of network science. Qualitative and quantitative changes in the global earth system. Material flows within the Earth and their surface effects on society. Fluxes of matter in geospheres coupled with air and water movements: water cycle, carbon cycle, oxygen cycle, nitrogen cycle and ozone shield thinning. Climate system functioning, natural and anthropogenic climate change. Opportunities and constraints of society in the Earth system.

Literature

Vallero, D. 2021. Environmental Systems Science, Elsevier, ISBN: 9780128219539
Duram, LA. Environmental Geography: People and the Environment 2018. ABC-CLIO, ISBN: 978-1440856105G.

Requirements:

Attendance at **lectures** is recommended, but not compulsory.
Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented.
During the semester there is one test: the end-term test in the 13th week. Students write an essay on the freely choosen subject and elaborate a presentation which will be presented for the students of the course. They will get a rating for the essay and the presentation. The average of the three grades will be a practical grade.
The final grade will be the average of the practical grade and the examination grade.
The minimum requirement for the end-term test and the examination respectively is 51%. Based on the score of the tests separately, the grade for the end-term tests and the examination is given according to the following table:

Score	Grade
0-50%	fail (1)
51-60%	pass (2)
61-70%	satisfactory (3)
71-85%	good (4)
86-100%	excellent (5)

If the score of any test is below 51%, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. György Szabó, full professor, PhD

Lecturer: Dr. Tamás Mester, assistant professor, PhD

Title of course: Applied geomathematics, modelling, simulation **Code: TTGMG5501_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: -
- laboratory: 2 hours/week

Evaluation: mid-semester grade

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory:
- home assignment: 48 hours
- preparation for the exam: -

Total: 90 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The course aims to familiarise students with the methods of geomathematical analysis and evaluation used in geography. Course content and topics: introduction, online database management, data interpretation, conversion to a common unit of measurement, filtering out erroneous data, use of functions, function types, graphical representation of data: graph types, their optimisation, histograms, ray diagrams, correlation and regression analysis, modelling solar radiation intensity.

Literature

Ott, L.,Longnecker, MT. 2015. An Introduction to Statistical Methods and Data Analysis, Cengage Learning, ISBN: 978-1305269477
Hothhorn, T., Everitt, BS. A Handbook of Statistical Analyses using R, Routledge, ISBN: 978-1482204582

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.
- for a grade
The course ends in a **practice grade**.
The minimum requirement is 50%. the grade for the tests and the examination is given according to the following table:

%	Grade
0-49	fail (1)
50-64	pass (2)
65-79	satisfactory (3)

80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Sándor Szegedi, associate professor, PhD

Lecturer: Dr. István Lázár, assistant professor, PhD

Title of course: Geostatitics **Code: TTGMG7040_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 14 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 2nd year, 3rd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to introduce students to the various mathematical and statistical methods used in the field of earth sciences. These methods of analysis and evaluation provide the basis for various spatial interpolation techniques closely related to other disciplines.
Interpolation methods can be used to create a continuous data surface, to estimate the value of a given property in areas where no sampling has been done, and thus to calculate the value of points that are not directly measured (e.g. soil property, elevation or other parameters).
The course will cover the following topics: spatial data analysis, sampling method selection, simple systematic sampling; exploratory data analysis, outlier analysis, box-plot visualization, frequency histogram analysis, normality analysis, data transformation procedures; introduction to spatial interpolation procedures, their classification and application in earth sciences; Deterministic interpolation methods, introduction to IDW, Spline, Natural Neighbor, Nearest Neighbor, Radial Basis Function interpolation; stochastic interpolation methods, introduction to kriging, stochastic simulation; basic requirements of kriging, stationarity, autocorrelation, detrending; grouping of kriging: simple, conventional, indicator, universal, lognormal, cocorrelation, regression kriging; stochastic simulation methods, presentation and classification, stochastic Gaussian simulation, stochastic indicator simulation; variogram analysis, special properties of semivariogram, anisotropy, trend in semivariogram analysis; grouping and characteristics of variogram models, determination of effect distance, threshold level, cluster effect, stochastic, structural factors; determination and characterization of uncertainty in estimated interpolated maps; kriging, practical application of simulation in geoinformatics.

Literature

- Chilés, J-P, DElfiner, P. 2012. Geostatistics: Modeling Spatial Uncertainty, Wiley ISBN: 978-0-470-18315-1
- Heingl, T.2009. A Practical Guide to Geostatistical Mapping, ISBN 978-90-9024981-0 http://spatial-analyst.net/book/system/files/Hengl_2009_GEOSTATe2c1w.pdf

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. István Lázár, PhD, Assistant Professor

Lecturer:

Economic, legal and human science

Title of course: Management skills **Code: TTGME7041_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to familiarise students with the basic characteristics and rules of the operation of business organisations and to enable them to apply them when becoming managers or researchers. The course briefly introduces the economic fundamentals and the market conditions surrounding organisations to which management must adapt, with an emphasis on the interplay between economic and management knowledge. For the majority of the course, however, we will look directly at the key areas of management of business organisations, bringing them together in an integrated, comprehensive picture. The aim is to provide students, as future managers, with an overview of the whole of organisational functioning, to place the management sub-areas in their respective contexts, and to understand their interdependence and interdependence. The aim is also to provide knowledge adapted to the specific needs of the management jobs that electrical engineering students will have in the future.

Literature

- Ebert, Ronald J., Griffin, Ricky W. (2017) Business Essentials, Global Edition, 11/E, Pearson, London.
- Massingham, P. 2019. Knowledge Management: Theory in Practice, SAGE Publishing, ISBN: 9781473948204

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. András Kun, PhD, Associate Professor

Lecturer:

Title of course: Data protection, data security **Code: TTGME7042_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The basic objective of the course is to introduce the basic concepts of data protection and data security and their practical implementation. The student should be familiar with the most common activities and procedures, regulations and legal frameworks involved. The following topics will be covered: the need and purpose of data protection; classification of data. the threats to computers and networks; data security regulation: Hungarian laws (personal data, sensitive data, data of public interest, data protection commissioner, data protection register), the EU General Data Protection Regulation; cryptography basics - basic concepts: cryptography, cryptanalysis, encryption and decryption, encryption and decryption, encryption and decryption, key, active and passive attack, authentication, access control, integrity, non-repudiation, cryptographic protocols

Literature

- Salomon, D. 2003. Data Privacy and Security, Springer, ISBN: 978-0-387-00311-5
- Alazab, M., Guota, M. 2022. Trust, Security and Privacy for Big Data, CRC Press, ISBN: 9781032047508

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in a writing examination.

The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Péter Takács, PhD, College Professor

Lecturer:

Title of course: Space and society **Code: TTGME6507_EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 1 hours/week - practice: 2 hours/week - laboratory: -	
Evaluation: by two written tests covering the practical lessons (60%), by one written test covering the theoretical lessons (30%) and by the short essay and homework	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: 28 hours - laboratory: - - home assignment: 18 - preparation for the exam: 30 hours Total: 90 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s):	
Further courses built on it: -	

Topics of course

The aim of the course is to familiarise students with some of the research trends and methods of spatiality in society, mainly based on quantitative methods, with special attention to the theoretical background of spatial inequalities and the possibilities of analysing the problem. Multivariate statistical and spatial computational methods used in social research will be strongly emphasised in the practical sessions.

Literature

Coulter, Philip B. 1989: Measuring inequality. A methodological handbook. – Westview Press, London. 204 p. (ISBN 9780813377261)

Haggett, Peter 2001: Geography: A Global Synthesis. – Prentice Hall. 864 p. (ISBN 978-0582320307)

Fotheringham, Stewart – Brunsdon, Chris – Charlton, Martin 2000: Quantitative Geography: Perspectives on Spatial Data Analysis. – SAGE Publications Ltd., 288 p. (ISBN 978-0761959472)

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
Home tasks are required in order to practice which is included in the evaluation of the final grade. During the semester there are two tests for the practice (the mid-term test in the 7th week and the end-term test in the 14th week) and one end-term test in the 14th week for the theory.
The subject matters are basing on the lectures and the additional supplements provided.
Score Grade

0-49	fail (1)
50-62	pass (2)
63-74	satisfactory (3)
75-87	good (4)
88-100	excellent (5)

The minimum requirement for the mid-term and end-term tests respectively is 50%. The final grade is the weighted average of them (each test 30%; evaluation of home tasks 10%).

Person responsible for course: Dr. János Pénzes, PhD, Associate Professor

Lecturer:

Title of course: Project management, lecture **Code: TTGME6501_EN**	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Conceptual issues of innovation. The beginnings of innovation research. Models of innovation. Types of innovation. Properties of innovations. Stages in the innovation adoption process and characteristics of each stage. Typification of innovation adopters. Consequences of innovations. Innovations in organisations. Methods of accounting for R&D activity. Spatial diffusion of innovations. R&D policy in the European Union. R&D policy in Hungary

Literature

Watt, A. 2014. Project Management, BCcampus, ISBN: 9781774200131
https://open.umn.edu/opentextbooks/formats/1723
Hanschke, I. (2010). Strategic IT Management :A Toolkit for Enterprise Architecture Management. Ber-lin, Heidelberg: Springer Berlin Heidelberg

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
During the semester students have to write an essay dealing with a selected subject of course.
The course ends in a written **examination**. Based on the result of examination and the quality of essay, the final grade is calculated as an average of them:

- the quality of the essay (15%)
- the result of the examination (85%)

The grade for the course is given according to the following table:

Score	Grade
0-50	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-87	good (4)
88-100	excellent (5)

If the score of student result is below 50, students can take a new written examination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:

Person responsible for course: Prof. dr. Gábor Kozma, PhD, DSc, Full Professor

Lecturer:

Title of course: Project management, practice **Code: TTGMG6502_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: -
- practice: 2 hours/week
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 22
- preparation for the exam: 10

Total: 60 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Collect the elements of the project concept using brainstorming techniques. The 4 phases of projects. Different definition phases. Grouping of projects. Income and capital projects. Project

planning cycles, models. Organisational culture of the project. Process actors, contributors. Project manager. Selection of project team members: using a skills database. Elements of the project process: goal planning. Phases of the project process: conceptual design. Elements of the project process: detailed design. Project documentation forms, feasibility study. Project effectiveness indicators. Sources, process and methods of financing. Project budget. Monitoring.

Literature

Kogon, K., Blakemore, S., Wood, J. 2015. Project Management for the Unofficial Project Manager, BenBella Books, ISBN: 978-1941631102
Watt, A. 2014. Project Management, BCcampus, ISBN: 9781774200131
https://open.umn.edu/opentextbooks/formats/1723

Requirements:
- for a signature
Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the instructor. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented.
Besides everybody has to select a project from their country and has to make a presentation about it.
- for a grade
Everybody has to take two mid-term examinations during the semester at the end of the modules. The minimum requirement for the mid-term examinations is 50%.
Based on the result of mid-term examination and the quality of presentation, the final grade is calculated as an average of them:

- the quality of the presentation (35%)
- the result of the examinations (70%)

The grade for the course is given according to the following table:

Score	Grade
0-50	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-87	good (4)
88-100	excellent (5)

If the score of student result is below 50, students can take a new written examination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:

Person responsible for course: Prof. dr.Gábor Kozma, PhD, DSc, Full Professor

Lecturer:

Data collection and data analysis

Title of course: Data mining in geosciences **Code: TTGME7043_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 14 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 2nd year, 3rd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Data mining is one of today's most important data analysis techniques, which goes beyond basic statistics and models by applying statistical models to process nominal and scalar variables. The goal is to automatically extract useful information from large databases. One of the main groups is classification, in which students classify binary or multiclass data into classes, similar to image classification. The other group is estimation of scale-type data using a variety of algorithms. Big Data theory and practice and data mining methods.
Topics covered in the theoretical part of the course: the theoretical background of multivariate data analysis, Big Data theory; model-fitting parameters, number of elements, conditions of statistical models; ANOVA, 2-factor ANOVA; multivariate linear analysis, GLM; robust regression methods MA, RMA; robust regression methods: lasso, ridge, elastic net; dimension reduction with ordination methods: PCA; dimension reduction with ordination procedures: CA, MCA; application of Partial Least Square in regression; cluster analysis (hierarchical procedures); clustering (k-means clustering, optimal cluster number, connectivity, Dunn Index, silhouette width); Random Forest as a regression and as a classification algorithm; Variable Importance.
Topics covered in the practical part of the course include: preparing the correct data matrix in Excel for multivariate analysis; introduction to the R software environment (language, commands, working library, data import, dataframe, vector, array, matrix); defining basic statistics in R (familiarization with scripting); using linear models in R (lm function): Hypothesis testing and regression; 2-factor ANOVA in R; Running and interpreting GLM models in R; Packages in R (lmodel2), applying robust regression: MA, RMA, SMA; Packages in R (glmnet), applying robust regression: lasso, ridge, elastic net; Running and interpreting PCA in R; Random Forest regression; Random Forest classification

Literature

- Islam S. 2018. Hands-on: geospatial analysis with R and QGIS. Packt Publishing, Birmingham, 347 p.
- Cuesta, H. 2013 Practical Data Analysis, Packt Publishing, Birmingham, 360 p.
- Barna I. - Székelyi M. 2004. Survival kit for SPSS. Typotex Publisher, 453 p.
- Kabakoff, R.I. (2011) R in Action: Data Analysis and Graphics with R. Manning Publications

Requirements:
- for a signature

Attendance is compulsory, lectures and practices have a strong logical relation.
- *for a grade*
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Prof. dr. Szilárd Szabó, PhD, DSc, Full Professor

Lecturer:

Title of course: Spatial data analysis **Code: TTGMG7044_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: -
- practice: - 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 2nd year, 4th semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to demonstrate the possibilities of geospatial analysis through socio-economic phenomena. Beyond simple visualisation, it aims to present the related methodology through practical exercises in vector datasets and specific analysis techniques for larger attribute sets. This includes a strong emphasis on hot spot analysis, spatial clustering, autocorrelation studies, the use of grid networks, and network analysis methods. The following topics will be covered: socio-economic spatial data and their management I - overview of data types, socio-economic measures, spatial data; socio-economic spatial data and their management II. - data

types, socio-economic measures, spatial data analysis; aggregation and disaggregation operations in QGIS and ArcGIS, operations using grid networks; point density analysis, hotspot analysis in QGIS and ArcGIS; spatial regression and spatial autocorrelation studies in ArcGIS and GeoDa software; spatial clustering operations, application and spatial representation of multivariate methods in QGIS and ArcGIS; using Network Analyst, basics of graph analysis, network analysis features, some metrics; using Network Analyst, calculation of accessibility metrics, attractiveness studies, facility location issues; using Network Analyst, community-detection issues based on commuting matrix.

Literature

- Netrdová, P. – Nosek, N. – Hurbánek, P. (2020): Using Areal Interpolation to Deal with Differing Regional Structures in International Research. International Journal of Geo-Information 9 (126): 1–14. https://doi.org/10.3390/ijgi9020126
- https://desktop.arcgis.com/en/arcmap/latest/tools/spatial-statistics-toolbox/cluster-and-outlier-analysis-anselin-local-moran-s.htm
- Anselin, L. (1995): Local Indicators of Spatial Association-LISA. Geographical Analysis 27 (2): 93–115. https://doi.org/10.1111/j.1538-4632.1995.tb00338.x

Requirements:
- for a signature
Attendance at **lectures** is highly recommended.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. János Pénzes, PhD, Associate Professor

Lecturer:

Title of course: Data collection techniques **Code: TTGME7007_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to familiarise students with direct and indirect spatial data collection methods, the principles and theoretical background of data collection tools. The course provides an insight into the theory of data collection using conventional geodetic instruments, RTK GNSS systems and remote sensing.
The course covers the following topics: geodetic basics: the main features of the Unified National Horizontal and Elevation Datum Network (EOVA and EOMA), methods of horizontal and elevation point fixation; the principle of operation of traditional geodetic data collectors; sources of geodetic data acquisition in Hungary; the principle and advantages of satellite positioning, the signals and codes transmitted by satellites, methods of determining the satellite-receiver distance: Code measurement, phase measurement; sources of error in satellite positioning; measurement techniques for satellite positioning; Real-Time Kinematic (RTK) technology, its advantages, theory of conventional and networked RTK measurements; physical basis of remote sensing, electromagnetic spectrum; characteristics of remotely sensed data and their classification (spectral, radiometric, geometric and temporal resolution); grouping and characteristics of remote sensing platforms and sensors; properties of laser light, laser wavelengths used in remote sensing, methods of laser telemetry; LiDAR operation, range, drawbacks and applications; theory of satellite data collection, available remote sensing databases.

Literature

- Lemmens, M (2011): Geo-information: Technologies, Applications and the Environment, Springer, ISBN 978-94-007-1666-7
- Weitkamp, Claus (2005): Lidar. Range-Resolved Optical Remote Sensing of the Atmosphere, Springer
- Takashi Fujii, Tetsuo Fukuchi 2005: Laser Remote Sensing, CRC Press, p. 912.

Requirements:
- *for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester.
The students must choose one of the topics offered by the teacher to plan a project, write an essay and prepare a presentation.
The students must take a written exam at the end of the semester.
- *for a grade*

The course ends in an **examination**:
Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-64	pass (2)

65-74	satisfactory (3)
75-85	good (4)
86-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Prof. Dr. Szilárd Szabó, university professor, DSc

Lecturer: Prof. Dr. Szilárd Szabó, full professor, DSc

Title of course: Database management, lecture **Code: TTGME7008_EN**	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to provide knowledge of the architecture and applicability of database management systems in the geoinformatics and spatial data environment. They will gain insights into the background and possible solutions for data management problems. Students will learn the representation and tools of the basic data model types and the procedures to compose different data models to be used according to the specific requirements. They will learn basic database design principles that will help them to build, operate and maintain a consistent database system. The following topics will be covered: data models and databases, database management system, database administrators, user groups; the essence of the database approach, general data modeling concepts, abstraction, entity, property, relationship. Classification of attributes and relationships, the relational model: relational schema, relationals; constraints of the relational model - examples, functional dependency and its properties, closure of a set of attributes - examples, database design basics: Guidelines, Normal Forms (1NF, 2NF, 3NF, BCNF), Relational algebra, ER model structure, mapping ER model to relational model, EER model structure, mapping EER model to relational model, Object Oriented Database basic concepts, ODMG model structure, ODL language, mapping ODL schema to relational schema, Transaction and Privilege Management, Oracle Spatial concepts overview, Oracle Spatial types.

Literature

- Ulmann, J. D. - Widom, J. 2009. Database systems: a primer. Panem, Budapest
- Coronel, C., Morris, S. 2019: Database Systems: Design, Implementation, and Management. Cengage.
- Beaulieu, A. 2020: Learning SQL: Generate, Manipulate, and Retrieve Data. O'Reilly Media

Requirements:

Participation at classes is strongly suggested.
In the end of the semester there is one test.
The minimum requirement for the test and the examination respectively is 50%. Based on the score of the test, the grade for the test and the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-72	satisfactory (3)
73-84	good (4)
85-100	excellent (5)

Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor

Lecturer: Dr. László Bertalan, PhD, Assistant Professor

Title of course: Database management, practice **Code: TTGML7009_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: -
- practice: -
- laboratory: 2 hours/week

Evaluation: mid-semester grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: -
- laboratory: 28 hours
- home assignment: 32 hours
- preparation for the exam: -

Total: 60 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to provide students the understanding of the architecture and applicability of database management systems in the Earth science work environment. They will gain an insight

into the operation of the SQL structured query language used in the management of widely used relational data models and database systems. Students will review their previous database management skills and build on them to perform complex data query operations. The course will provide students with the basic practical skills to perform effective data queries independently. The following topics will be covered: overview of the main theoretical basics of database management, setting up and testing the SQL Developer software environment, DDL statements: creating data tables, adding constraints, modifying, deleting, renaming columns in data tables; DML statements: inserting columns and values, batch data loading; DQL statements: simple and single-table queries; DQL statements: using functions; DQL statements: displaying grouped data using row set functions; DQL statements: concatenating data tables, DQL statements: nested queries; DQL sta-tements: logical tests; DCL statements: privilege management.

Literature

- Ulmann, J. D. - Widom, J. 2009. Database systems: a primer. Panem, Budapest
- Coronel, C., Morris, S. 2019: Database Systems: Design, Implementation, and Management. Cengage.
- Beaulieu, A. 2020: Learning SQL: Generate, Manipulate, and Retrieve Data. O'Reilly Media

Requirements:
Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
During the semester there is one practical test. It can be completed in the 13th or 14th week.
The minimum score is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-72	satisfactory (3)
73-84	good (4)
85-100	excellent (5)

-an offered grade:
it may be offered for students if the test written in the 13th week is at least satisfactory (3).
- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to repeat in the last week

Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor

Lecturer: Dr. László Bertalan, PhD, Assistant Professor

Remote sensing

Title of course: Hyperspectral remote sensing **Code: TTGME7045_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Hyperspectral Remote Sensing deals with the collection, information retrieval and processing of airborne and near-ground hyperspectral data. Students will be introduced to hyperspectral data types from a variety of sources, from ground-based technology to satellite remote sensing. Practical courses will provide the opportunity to learn about different methods for pre-processing hyperspectral imagery, mainly in the fields of geometric and atmospheric correction. They will learn about the application of different information retrieval techniques for processing large-scale data.
Students will be introduced to different algorithms of image classification techniques, both teaching and non-teaching methods, and the methodology of evaluating the results in the practical classes.

Literature

- Borengasser, M., Hungate, W., Watkins, R. (2008). Hyperspectral Remote Sensing. Boca Raton: CRC Press.
- Thenkabail, PS, Lyon, JG, Huete, A. 2018. Hyperspectral Remote Sensing of Vegetation, Second Edition, Four Volume Set, CRC Press, ISBN 9781138066250

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Loránd Szabó, PhD, assisstant professor
Lecturer:

Title of course: Multispectral remote sensing **Code: TTGMG7046_EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 1 hours/week - practice: 2 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: 28 hours - laboratory: - - home assignment: - - preparation for the exam: 16 hours Total: 30 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to learn the theoretical and practical aspects of multispectral remote sensing, widely used in geography, using databases with different sensors in different types of land cover.

The theoretical part of the course will cover the following topics: main characteristics of the electromagnetic spectrum; electromagnetic spectral intervals used in remote sensing; types of remote sensing sensors; properties of typical sensor systems; main characteristics of raster databases; steps of processing remote sensing databases; preprocessing of space images; main types of classifications in remote sensing; automatic and unsupervised classifications; main characteristics of supervised classifications; object-based classifications; additional processing techniques with space images (filters, palettes, etc.).

The practical part of the course will cover the following topics: study of the main features of the electromagnetic spectrum on surface objects, calculation of their effects; study of spectral ranges used in remote sensing, atmospheric windows; operations with raster-based databases; pre-processing of space images, main methods and steps; methods and parameterisation issues of unsupervised classification (K-mean, ISODATA, ISOCLUSTER); semi-automatic classification procedure; methods and parameterisation issues of supervised classification (Maximum Likelihood, Support Vector Machine, Random Forest, k-Neareaset Neioghbour); object-based classification (GEOBIA). Cloud-based image processing using Geoogle Earth Engine.

Literature

- Campbell, J. (1996). Introduction to remote sensing (2nd ed.). New York: Guilford Press

- Congedo, L. (2021) Semi-Automatic Classification Plugin Documentation Release 7.8.0.1 https://readthedocs.org/projects/semiautomaticclassificationmanual/downloads/pdf/latest/
- Hadjimitsis, D. ed. (2013) Remote Sensing of Environment. IntechOpen https://www.intechopen.com/books/remote-sensing-of-environment-integrated-approaches
- Schowengerdt, R. A. (2007). Remote sensing: Models and methods for image processing. S.l.: Academic Pr.
- Lillesand, T., Kiefer, R. (1994). Remote sensing and image interpretation (3rd ed.). New York: Wiley and Sons

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Loránd Szabó, PhD, Assistant Professor

Lecturer:

Title of course: Remote sensing with uncrewed aerial vehicles **Code: TTGMG7047_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to give students an insight into the theoretical and practical basics of unmanned aircraft-based aerial photography. During the course, students will learn the theory of unmanned aerial photography, and in the exercises they will gain insight into the specific features of aerial photography, as well as the processing of aerial photographs.
In the theoretical part of the course, the following topics will be covered: development of unmanned aerial vehicles (UAVs); the main types of UAV systems; the technical background of UAV applications; the main fields of UAV applications; a comparison of professional and consumer sensors from a photogrammetric point of view; photogrammetry with UAV images; digital photogrammetric processing procedures; additional systems in UAV photogrammetry (GPS, flight tracking, etc.); content and quality issues of UAV-based products; legal background for the use of UAVs.
The practical part of the course will cover the following topics: main characteristics of unmanned aerial vehicles (UAV); technical conditions for the use of unmanned aerial vehicles; different types of UAV imaging systems (visible range); different UAV imaging systems (multispectral and thermal sensors); flight and project planning; orthophoto generation from UAV images; surface modelling from UAV images; modelling of surface objects from unmanned aerial vehicle images; distortion handling in UAV photogrammetry; orientation in UAV photogrammetry; data classification, database cleaning.

Literature

- Casagrande, G. - Sik, A. - Szabó, G. (2018) Small flying drones. Springer, 161 p.
- Krauss, K. - Waldhausl, P. (1998) Photogrammetry. Tertia Publishing, 379 p.
- Toro, F. G.- Tsourdos, A. (2020) UAV or Drones for Remote Sensing Applications

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Gergely Szabó, PhD, Associate Professor,
Dr. László Bertalan, PhD, Assistant Professor

Lecturer:

Title of course: Photogrammetry **Code: TTGME7019_EN TTGML7020 _EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 1 hours/week - practice: 2 hours/week - laboratory: -	
Evaluation: exam and practical grade	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: 28 hours - laboratory: - - home assignment: - - preparation for the exam: 16 hours Total: 30 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to give students an insight into classical photogrammetry, to learn about the main characteristics of analogue and digital aerial photographs and to master the steps of processing.
The theoretical part of the course will cover the following topics: the origin, development and photographic basics of classical aerial photography; the practice of classical aerial photography; analytical evaluation of aerial photographs; data extraction from aerial photographs - quantitative data collection; data extraction from aerial photographs - qualitative data collection; single-image photogrammetry - distortions; single-image photogrammetry - orthorectification; two-image photogrammetry - visual and digital evaluation from camera images; multi-image photogrammetry - processing of small format digital images, types of orthophotos; object photogrammetry; generation of surface models by photogrammetry.
In the practical part of the course, the following topics will be covered: review of the main features of aerial photography; examination of the development of aerial photography; characteristics of modern analogue and digital aerial photography; examination of historical aerial photography; practice in the analysis of stereo aerial photography; examination of distortions in aerial photography; practice in single-image photogrammetry; practice in stereo photogrammetry; event reconstruction with aerial photography; practical application of aerial photography.

Literature

- Eltner, A., Hoffmeister, D., Kaiser, A., Karrach, P., Klingbeil, L., Stöcker, C., Rovere, A. (eds) 2022: UAVs for the Environmental Sciences. ISBN 978-3-534-40588-6.
- Casagrande, G., Sik, A., Szabó, G. (2018). Small Flying Drones Applications for Geographic Observation. ISBN 978-3-319-66576-4
- Krauss, Karl - Waldhausl, Peter (1998) Photogrammetry. Tertia Publishing, 379 p.

Requirements:
- for a signature

Attendance at **lectures** is higly recommended.
- *for a grade*
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Gergely Szabó, PhD, Associate Professor

Lecturer:

Computer science and programming

Title of course: GIS-specific programming **Code: TTGME7010_EN TTGML7011 _EN**	**ECTS Credit points: 6**

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 78 hours

Total: 120 hours

Year, semester: 1st year, 2st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to provide students with the most important programming skills related to spatial computing and to enable them to apply the acquired knowledge in practice. The course covers the following topics: programming basics, basic steps of programming, the concept of algorithm, entry modes, structured programming, control structures, basics of Python language,

operator types (relational, logical), rules of expression evaluation, syntax and operation of different types of selection and the front-end test loop, the concept of modules, their use, steps of script writing. numeric data types and the string; basic principles of object-oriented programming (object, property, method, object type variables, syntax), types of for loop and their operation, lists; the concept, need, syntax of exception handling, user input; introduction to the ArcPy package (elements of the Mapping module); Concept, properties, structure, storage options of attribute classes (shape file, geodatabase), Types of cursor objects and their use; adding a new descriptive field to an attribute class (with control), options for defining attribute values, calculations; working with text files (steps, operation types, checks), writing run results to a file; ways of storing geometric data of a feature class, object types and their methods for access; defining a new geometry and assigning it to a feature, principle of building a multigeometry, defining a new feature class for a new shape file or geoadatabase; counting with geometric data; accessing the contents and properties of raster files from code, the Spatial Analyst module.

Literature

- Gérard Swinnen (2005) Learn to program in Python, (mek.oszk.hu/08400/08435/08435.pdf)
- Wentworth, P., Elkner, J., Downey, A.B., Meyers, C. (2019) How to think like a computer scientist: learning with Python 3. University of Debrecen, Faculty of Computer Science, https://mtmi.unideb.hu/pluginfile.php/554/mod_resource/content/3/thinkcspy3.pdf
- Eric Pimpler (2013) Programming ArcGIS 10.1 with Python Cookbook, Packt Publishing
- Rance D. , Necaise (2011) Data Structures and Algorithms Using Python, Wiley
- Kent D. Lee, Steve Hubbard (2015) Data Structures and Algorithms with Python, Springer
- Paul A. Zandbergen (2013) Python Scripting for ArcGIS, ESRI Press

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

Grade is given based on the scores gained at the exam according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:
it may be offered for students if his/her performance at the lab tests exceeds the satisfactory level and he/she takes part at the classes actively.
- in case an offered grade cannot be given, or student declines it, there is a possibility to have an exam in the exam session.

Person responsible for course: Dr. Dávid Abriha, PhD, Assisstant Professor

Lecturer:

Title of course: Technical informatics, lecture **Code: TTGME7012_EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 2 hours/week - practice: - - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: 28 hours - practice: - - laboratory: - - home assignment: 22 hours - preparation for the exam: 40 hours Total: 90 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to familiarise students with the most important elements and technologies of systems based on modern communication technologies, with an emphasis on the broad basics, the physical/technical foundations of the technologies and their interrelationships, rather than on detailed descriptions. The knowledge acquired during the course provides a sufficient theoretical basis for further advanced knowledge and for the formal management and practical implementation of basic hardware and software tasks. The following topics will be covered during the semester: basic network concepts, terminology, overview of network services; basic communication concepts (transmission, types, communication modes), data communication tasks, evolution of data communication networks, architecture. basic concepts of data communication; transmission, interconnection and connection modes, network addressing and services; layered implementation of systems; reference models (OSI, TCP/IP), messages, packets, messaging through layers; application layer of the OSI model, DNS namespace structure and name resolution. recursive and iterative name resolution; transport layer of the OSI model, UDP and TCP protocols, connection management, reliable data transmission; network layer of the OSI model, IP addressing mechanisms, classes and subnets, routing, details of the routing process; the data link layer of the OSI model, network channel allocation, channel management protocols, ARP address resolution protocol, data fragmentation; the physical layer of the OSI model, technical implementation of data transmission, cable types, physical basis of technical implementation, metallic and optical wired, wireless transmission. Networking tools, networking, signal coding methods; precision location based analysis and automation in field data collection; Big Data technology and its applications in geospatial analysis; Machine Learning or the role of Machine Learning in geoinformatics; Internet of Things - sensor systems: new data collection opportunities in geoinformatics.

Literature

- Japkowicz, N. - Stefanowski, J. 2016. Big Data Analysis: New Algorithms for a New Society, Springer
- Baesens, B. 2014. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
In the end of the semester there is one final test.
- for a grade
The course ends in an **examination**. The exam grade is the result of the examination.
The minimum requirement for the examination is 50%. Based on the score of the test the grade for the examination is given according to the following table:

Score	Grade
0-49%	fail (1)
50-59%	pass (2)
60-72%	satisfactory (3)
73-84%	good (4)
85-100%	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. László Bertalan, PhD, Assistant Professor

Lecturer:

Title of course: Technical informatics, practice **Code: TTGML7013_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: -
- practice: 2 hours/week
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 28 hours
- laboratory: 0 hours
- home assignment: 16 hours
- preparation for the exam: 16 hours

Total: 60 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

In addition to the theoretical part of the course, the following topics will be covered in student lectures based on the processing of specific scientific publications: big data and GIS; Web2.0 and GIS; Smart City and GIS; IoT - Internet of Things; Distributed and Parallel Computing Systems (Supercomputers and GIS); Machine Learning; Mini and Micro Computing; Automation and GIS in Precision Agriculture; VR Technology; "Digital Earth"; Google and GIS. In the second half of

the semester, network configuration options for operating systems with different distributions installed on virtual computers will be reviewed. The course will cover the following topics: configuration of microcomputer controlled sensors; programming of microcomputer controlled sensors; use of virtual machines, installation of Operating Systems (Windows Server); use of virtual machines, installation of Operating Systems (Linux distributions).

Literature

- Blokdyk, G. 2020. Technical Informatics A Complete Guide, Emereo Publishing, 9781867453758
- Raphael, B., Smith IFC. 2013.Engineering Informatics: Fundamentals of Computer-Aided Engineering, Wiley, 978-1119953418

Requirements:

Attendance at **classes** is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
During the semester the students have to complete a project and present it, and in the end of the semester there is one final test.
The exam grade is calculated from the result of the test (70%) and the grade of presentation (30%). The minimum requirement for the examination is 50%. Based on the score of the test the grade is given according to the following table:

Score	Grade
0-49%	fail (1)
50-59%	pass (2)
60-72%	satisfactory (3)
73-84%	good (4)
85-100%	excellent (5)

If the result of any task is below 50%, students have to compose a short document about the topics of presentation and retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:
it may be offered for students if the test written in the 13th week is at least satisfactory (3).
- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to repeat in the last week.

Person responsible for course: Dr. László Bertalan, PhD, Assistant Professor

Lecturer:

Specific application

Title of course: Applied agricultural informatics **Code: TTGMG7048_EN**	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: - - practice: 2 hours/week - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: - - preparation for the exam: 16 hours Total: 30 hours	
Year, semester: 2nd year, 3rd semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

Students will learn about spatial modelling methods used in the context of agricultural production systems and processes, data collection, data integration and decision support methods of the models. They will learn the operational tasks of agroecological potential assessment and monitoring. They will learn about the main precision agriculture sensors and decision support tools used in this field. They will be able to assess agri-environmental risks in space and time and learn about the main options for their prevention.
The course will cover the following topics: IT systems in production technologies; hierarchical IT systems; computer networks and protocols; fuzzy logic, fuzzy logic management systems; artificial intelligence methods in process control; characteristics of industrial agricultural production; IT characteristics of production tools, product as information carrier; the product and the environment as information carriers; data transmission systems in agricultural technological systems; information technology in arable farming; information technology in horticulture; information technology in animal husbandry; primary product processing systems; information technology in food processing systems

Literature

- Qin Zhang 2015 Precision Agriculture Technology for Crop Farming CRC Press ISBN 1482251086 Gerard Sylvester 2018 Drones for agriculte. FAO, https://www.taylorfrancis.com/books/precision-agriculture-technology-crop-farming-qin-zhang/e/10.1201/b19336

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Zoltán Krisztián Túri, PhD, assistant professor

Lecturer:

Title of course: Applied GIS in regional development **Code: TTGML6517_EN**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 2nd year, 3rd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to enable students to learn and apply the geospatial methods they may encounter in professional activities related to spatial planning at different spatial scales, and to use ArcGIS and Quantum GIS software in a problem-oriented and targeted way.
The course will cover the following topics: review of the ArcGIS software, practice of basic operations, use of vector-based, raster-based or hybrid data models, vectorisation, rasterisation, data and accuracy loss; review of the Quantum GIS software, practice of basic operations - spatial relationships of geometric objects (adjacency), point, line, polygon topology; geospatial solutions to micro-scale local problems - data browsing methods, scale dependency, generalisation; geospatial solutions to micro-scale local problems - review, characterisation and acquisition of basic maps at plot and household level (town and country planning, regulatory plans, Google Earth, Bing, Google Street View, Openstreetmap); geospatial solutions to micro-level local problems - steps of processing map and geospatial sources, georeferencing, projection transformations; geospatial solutions to micro-level local problems - vectorisation (overview of the problem domain), corrections in the vector file, related operations in the attribute table; geospatial solutions to micro-scale local problems - geospatial calculations and analysis (zone generation, hot spot

analysis, nearest neighbour index calculation, quadrat analysis); geospatial solutions to micro-scale local problems - thematic mapping and publication of results, use of Google Earth for publication; geospatial solutions to meso-scale (municipal and small spatial scale) problems - GADM, Corine Land Cover, Urban Atlas, review of WMS sources and other free geoinformatics databases; geospatial solutions to a problem at the field level (municipal or small spatial scale) - corrections in the vector file, related operations in the attribute table; geospatial solutions to problems at field level (municipal or small spatial level) - steps for processing map and geospatial data sources, geospatial analysis (area calculation, grid network application), thematic map production, publication; geospatial problem solving at macro level (network of settlements, county level) - obtaining census and other statistical data sources and their attribute tabulation, transformation; geospatial problem solving at macro level (network of settlements, county level) - using Network Analyst, combined use of line and polygonal functions, geoprocessing, publication of thematic maps.

Literature

- https://desktop.arcgis.com/en/arcmap/latest/tools/spatial-statistics-toolbox/cluster-and-outlier-analysis-anselin-local-moran-s.htm
- Kitchin, R. - Thrift, N. (eds.) (2009): International Encyclopedia of Human Geography. Oxford: Elsevier Science. Volume 2 (ISBN: 978-0-08-044911-1)

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)
75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. János Pénzes, PhD, Associate Professor

Lecturer: Dr. Zoltán Krisztián Túri, PhD, Assistant Professor

Title of course: Open source GIS **Code: TTGMG7050_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: -
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

Year, semester: 2nd year, 4th semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to familiarise students with the open source and free geoinformatic softwares that have emerged in recent years and are becoming more and more widespread. Based on the basic knowledge of software management, the course is mainly built around the QGIS software and the introduction and use of other free modules offered by the software (SAGA, Orfeo Toolbox, LAStools, other useful plugins).
The course will cover the following topics: introduction and characterisation of open source and free geoinformatic softwares; QGIS basics overview - vector data visualisation, management and conversion; QGIS basics overview - raster data visualisation, management and conversion; Introduction to QGIS plug-ins - using WMS client, displaying free maps, analysing vector files; Introduction to QGIS plug-ins - using WMS client, displaying free maps, analysing raster data; selection criteria for remotely sensed data, their display and analysis. free satellite imagery, elevation models; introduction to QGIS Orfeo Toolbox; practical use of QGIS Orfeo Toolbox, analysis of Landsat imagery, image classification; introduction to QGIS LAStools; practical use of QGIS LAStools, DEM, SRTM models; introduction to SAGA GIS, its connection to QGIS built-in modules; SAGA GIS, image processing and modelling; SAGA GIS. Spatial interpolation methods, geostatistics.

Literature

- QGIS User Guide: QGIS User Guide Release 3.4. https://docs.qgis.org/3.4/pdf/en/QGIS-3.4-UserGuide-en.pdf
- SAGA User Guide: Satellite Image Analysis and Terrain Modelling. A practical manual for natural resource management, disaster risk and development planning using free geospatial data and software https://sagatutorials.files.wordpress.com/2016/02/saga_manual_english_cdu_june-2017.pdf
- Shammunul Islam, Simon Miles, Kurt Menke (2019) Mastering Geospatial Development with QGIS 3.x - Third Edition.

Requirements:
- for a signature
Attendance at **lectures** is recommended, but not compulsory.
- for a grade
The course ends in a writing examination.
The minimum requirement for the test respectively is 50%. Based on the score of the test, the grade for the test is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-74	satisfactory (3)

75-86	good (4)
87-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Prof. Dr. Szilárd Szabó, PhD, DSc, Full Professor

Lecturer:

Title of course: **CAD-systems** **Code**: **TTGML7021_EN**	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 14 hours
- laboratory: -
- home assignment: 20 hours
- preparation for the exam: 12 hours

Total: 60 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course is to give students an insight into the world of CAD-based systems and to familiarize them with the specific features and unique solutions of these systems. During the course, students will learn the basics of vector-based CAD editing, layer management, object modification, and gain insight into vector 3D editing.
The theoretical part of the course covers the following topics: theoretical background of vector-based systems; philosophy of CAD systems; short history of CAD systems; geometric features in CAD; objects in CAD; modification of objects, characteristics of graphic data in CAD; operations with objects; layer management in CAD; topological object construction, fills; projections in CAD environment; map representation in CAD.
In the practical part of the course, the following topics will be covered: introduction to the main features of CAD; the main parts of CAD software, their parameterization; the practical environment of CAD philosophy; creation of objects, modification of their characteristics; object relations, topology in CAD environment; operations with objects (merging, splitting, modification, etc.); characteristics of fills and their parameterization in CAD; setting and modification of projections; management of raster files, georeferencing; creation of map content from hybrid base data in CAD; parameterization of print views, export

Literature

- AutoCad Map 3D https://knowledge.autodesk.com/support/autocad-map-3d/learn-explore/caas/CloudHelp/cloudhelp/2019/ENU/MAP3D-Learn/files/GUID-095B8CCB-CC00-4CAC-9072-1BCF56A8A5B8-htm.html
- Luckett, Gordon - AutoCAD MAP 3D Essential Training: https://www.lynda.com/course-tutorials/AutoCAD-Map-3D-Essential-Training-REVISION/761940-2.html

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
During the semester there are middle-term and end-term examinations. The end-tem referring involves the knowledge of the software skills.

The minimum requirement for the middle-term and end-term examinations is 60%. Based on the score of the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Gergely Szabó, PhD, Associate Professor

Lecturer:

Title of course: **Environmental informatics** **Code**: **TTGMG7003 TTGME7002_1**	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: 20 hours
- preparation for the exam: 12 hours

Total: 60 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

In the context of environmental informatics, students will learn about the conceptual background of environmental informatics, the possibilities of data mining of natural, social and economic environment databases, data mining techniques, the structure of environmental information systems and the necessary geoinformatics applications. The following topics will be covered in the lecture part of the course: basic concepts of environmental informatics, natural environment databases (geology, morphology), natural environment databases (hydrology, hydrology), natural environment databases (soil, vegetation), natural environment databases (climatic elements), natural hazards and environmental protection data, social environment databases (settlements, population), databases of the economic environment (mining, energy), databases of the economic environment (agriculture, industry), databases of the economic environment (trade, services), databases of the social environment (tourism, sports), the structure of environmental information systems, an introduction to the geoinformatics systems used, the application of environmental informatics in spatial planning and landscape assessment.
The practical part of the course covers the following topics: ArcGIS basics - repetition, geodatabase and geodatabase topology, the use of remotely sensed data in spatial data analysis for environmental purposes, geological and morphological studies, tessellation data models, visibility studies and profile editing, animation in ArScene, ArcGlobe virtual globe, hydrological hydrology and soil databases - modelling and analysis of surface and subsurface contamination spreading, climate and vegetation databases - time series analysis of land cover and land use change I. , Climate and vegetation databases - time series analysis of land cover and land use change II. , vegetation databases - time series analysis of forest fragmentation, natural hazards and environmental databases - role of forests in climate change, natural hazards and environmental databases - environmental reconstruction of wetlands, built environment databases - 3D city modelling using remotely sensed data, analysis of the relationship between built-up area and temperature in urban environments, Model Builder basics, referencing software skills.

Literature

- Kerényi A., McIntosh R. (2020) Sustainable Development in Changing Complex Earth Systems, Springer International Publishing, Springer Nature Switzerland AG, ISBN 978-3-030-21644-3
- Paul, P, K, Choudhury, A, Biswas, A, Kumar Singh, A (2022): Environmental Informatics: Challenges and Solutions, Springer International Publishing, Springer Nature Switzerland AG, ISBN 9811920826

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.
During the semester there are middle-term and end-term examinations. The end-tem referring involves the knowledge of the software skills.

The minimum requirement for the middle-term and end-term examinations is 60%. Based on the score of the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Zoltán Krisztián Túri, PhD, Assistant Professor
Lecturer:

Geovisualisation and modelling

Title of course: **Maps on the WEB** **Code: TTGME7014_EN**	**ECTS Credit points: 4**
Type of teaching, contact hours - lecture: 2 hours/week - practice: 1 hours/week - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: 28 hours - practice: 14 hours - laboratory: - - home assignment: 28 hours - preparation for the exam: 50 hours Total: 120 hours	
Year, semester: 2nd year, 3rd semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course
The aim of the course is to introduce students to some of the ways in which map information can be communicated on the web. After completing the course, they will be able to display individual map information on a web map. The course will introduce students to the elements of the KML language and their effective use, enabling their widespread application. They will learn the basics of JavaScript and HTML in order to create maps embedded in a web page using the Google Maps API. The course will cover the following topics: online maps, exploring, testing and critiquing geospatial applications on the web; creating and sharing simple maps using Google Maps; location markers with different geometry types (point, line polygon, non-simple polygon), height management, extrusion; HTML formatting in the location marker bubbles (character formatting, links, images, tables), chaining location markers; applying custom styles (icon style, title style, line style, polygon style, bubble style, list style); definition and use of split formatting, style sheets, multigeometric placemarkers; definition and use of overlay images (ground overlay, screen overlay, photo overlay), use of image files as overlay images, types and characteristics of overlay images, alternatives for use; network links and their applications, animation using timestamps and time intervals; efficient management of large amounts of placemarks, data storage options, use of regions; map display using Google Maps API; displaying custom content on online maps using KML, event management.
Literature

- Peterson, M.P. Web and mobile sub-mapping. Google Maps JavaScript API V3 Basics (2011)
- Pinde Fu, Jiulin Sun, Web GIS, Principles and applications, ESRI Press, 2011.
- Josie Wernecke, The KML Handbook, Addison-Wesley, 2009
- Alper Dincer, Balkan Uraz, Google Maps JavaScript API Cookbook, Packt Publishing, 2013.
- Alan M. MacEachren, Menno-Jan Kraak (2001) Research Challenges in Geovisualization, Cartography and Geographic Information Science, 28:1, 3-12, DOI: 10.1559/152304001782173970

Requirements:

Attendance at **lectures** is recommended, but not compulsory.
Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented.
The final grade will be the average of the practical grade and the examination grade.
The minimum requirement for the end-term test and the examination respectively is 51%. Based on the score of the tests separately, the grade for the end-term tests and the examination is given according to the following table:

Score	Grade
0-50%	fail (1)
51-60%	pass (2)
61-70%	satisfactory (3)
71-85%	good (4)
86-100%	excellent (5)

If the score of any test is below 51%, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Dávid Abriha, PhD, assistant professor

Lecturer:

Title of course: Models in GIS, lecture **Code: TTGME7017_EN**	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: 24 hours
- preparation for the exam: 38 hours

Total: 90 hours
Year, semester: 2nd year, 4th semester
Its prerequisite(s): -
Further courses built on it: -

Topics of course

The aim of the course is to familiarize students with the types of models used in geoinformatics, the way of model creation, the main steps (implementation, calibration, validation) through concrete examples. They will learn and apply with confidence modeling tools that facilitate the automation of operations, such as Model Builder (ArcGIS). Be able to independently build and run simple and complex models. System and model. The following topics will be covered: types of models; calibration and validation; statistical foundations of modelling; statistical foundations of modelling; spatial interpolations, geostatistical modelling; modelling landscape change; modelling surface water; modelling groundwater; modelling soil erosion; diffusion models; reachability models, network modelling; time series.

Literature

- Mujumdar, P. P., Nagesh Kumar, D. (2013) Floods in a Changing Climate: Hydrologic Modeling. Cambridge University Press
- Pourghasemi, H.R., Gokceoglu, C. (2019) Spatial Modeling in GIS and R for Earth and Environ-mental Sciences.
- Sanders, L. (2007) Models in Spatial Analysis (Geographical Information Systems Series (ISTE-GIS). Wiley.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests

- for a grade

The course ends in an **examination**.

The minimum requirement for the the examination is 50%. The grade for the examination is given according to the following table:

Score	Grade
0-49%	fail (1)
50-59%	pass (2)
60-72%	satisfactory (3)
73-84%	good (4)
85-100%	excellent (5)

Students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:

it may be offered for students if the test written in the 14th week is at least satisfactory (3).

Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor

Lecturer: Dr. László Bertalan, PhD, Assistant Professor

Title of course: Models in geoinformatics, practice **Code: TTGML7018_EN**	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: - - practice: 2 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: - - laboratory: 28 hours - home assignment: 6 hours - preparation for the exam: 10 hours Total: 30 hours	
Year, semester: 2nd year, 4th semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to familiarize students with the types of models used in geoinformatics, the way of model creation, the main steps (implementation, calibration, validation) through concrete examples. They will learn and apply with confidence modelling tools that facilitate the automation of operations, such as Model Builder (ArcGIS). The course covers the following topics: types, characteristics and errors of models 1 (general introduction); types, characteristics and errors of models 2 (statistical models); regression models and their practical application through examples; Model Builder 1.Model Builder 2: practical examples, building complex models, iterations; Model Builder 3: practical examples, building complex models, iterations; modelling of areas at risk of soil erosion; watershed modelling in Model Builder, hydrodynamic transport modelling in MODFLOW.

Literature

- Mujumdar, P. P., Nagesh Kumar, D. (2013) Floods in a Changing Climate: Hydrologic Modeling. Cambridge University Press
- Pourghasemi, H.R., Gokceoglu, C. (2019) Spatial Modeling in GIS and R for Earth and Environ-mental Sciences.
- Sanders, L. (2007) Models in Spatial Analysis (Geographical Information Systems Series (ISTE-GIS). Wiley.

Requirements:
- for a signature
Attendance at classes is compulsory.
- for a grade
The final grade is calculated as the weighted average of practical examination grade (75%) and the presentation quality (25%).
The minimum requirement for the the examination is 50%
Students can take a retake theexamination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:

it may be offered for students if the results in the 13th week is at least satisfactory (3).
Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor
Lecturer: Dr. László Bertalan, PhD, Assistant Professor

Title of course: Geovisualisation **Code: TTGMG7051_EN**	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: - - practice: 2 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: 6 hours - preparation for the exam: 10 hours Total: 30 hours	
Year, semester: 2nd year, 3rd semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to familiarize students with the different possibilities of interactive mapping, the web-based visualization of 3D data, and related visualization solutions and technologies.
The course covers the following topics: the toolbox of map visualisation: from paper maps to interactive digital web maps; basic elements of traditional maps in the light of today's needs; web-based map, story map, WMS, WFS, TMS; creating web maps in a QGIS environment based on a defined theme; basics of 3D data visualization, concept and levels of LOD; visualisation of three dimensional topographic and built environment data; role of graphic data in digital map editing and interpretation (map colours, patterns, classification procedures); 3D object generation and process modelling (Blender); 3D object generation and process modelling (Blender).

Literature

- Jason Dykes, Alan M. MacEachren, M. J. Kraak 2005 Exploring Geovisualization. p. 730. ISBN: 9780080445311
- Terry A. Slocum , Robert B. McMaster, Fritz C. Kessler, Hugh H. Howard 2020. Thematic Cartog-raphy and Geovisualization. p.500. ISBN-13: 978-0132298346, ISBN-10: 0132298341
- Smith M.J., Hillier J.K., Otto J.-C., and Geilhausen M. (2013) Geovisualization. In John F. Shroder (ed.) Treatise on Geomorphology, Volume 3, pp. 299-325. San Diego: Academic Press.
- (PDF) Geovisualization. https://www.researchgate.net/publication/235875086_Geovisualization

- Recommended literature
- M. Dodge, Mary Mcderby. Martin J. Turner 2008 Geographic Visualization: Concepts, Tools and Applications. p. 348. ISBN: 978-0-470-51511-2

Requirements:
- for a signature
Attendance at classes is compulsory.
- for a grade
The final grade is calculated as the weighted average of practical examination grade (75%) and the presentation quality (25%).
The minimum requirement for the the examination is 50%
Students can take a retake theexamination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:
it may be offered for students if the results in the 13th week is at least satisfactory (3).

Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor

Lecturer:

Applied analysis

Title of course: GIS-software **Code: TTGML7022_EN**	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 1 hours/week - practice: 2 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: 28 hours - laboratory: - - home assignment: 6 hours - preparation for the exam: 10 hours Total: 30 hours	
Year, semester: 2nd year, 4th semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

In the course, students will learn about the feature set and the different modules of ArcGIS Pro geoinformatics software and gain insight into its potential applications by solving practical problems. They will learn about the theoretical background of object-based image processing, its application areas, the feature set of the eCognition software, segmentation techniques, classification procedures, the main toolkits, their use in the analysis of remotely sensed data and the production of thematic maps. The theoretical part of the course will cover the following topics: theoretical and conceptual background of object-based image processing; object-based approach vs. object-based image processing software, modules; applications of object-based image processing in earth and environmental sciences; image coordinate system, image features; layers, relations, segment, image object; image object hierarchy; decision tree; segmentation algorithms I.; segmentation algorithms II; class mapping algorithms I; class mapping algorithms II; accuracy checking, spatial data integration;
The practical part of the course will cover the following topics: project-based geoinformatics work environment, ArcGIS Pro software environment, product support, graphical user interface; menu systems, work windows, toolbars, panels, data formats in ArcGIS Pro; adding and displaying vector and raster data, map navigation, resizing, setting layer properties, symbol attributes, layer hierarchy; vector editing, attributes, geometric relationships, filters; map layout in ArcGIS Pro; introduction to eCognition software, system requirements, installation, product support; drop-down menus, work windows, toolbars, panels, data formats in eCognition; project creation and modification, file operations; segmentation procedures; image classification, creating class maps; error matrix, integrating class maps into geoinformation systems

Literature

- Introduction to ArcGIS Pro: https://giscourses.cfans.umn.edu/sites/giscourses.cfans.umn.edu/files/l1_intro2arcpro.pdf
- Manual for Satellite Data Analysis eCognition Developer (2013) https://openjicareport.jica.go.jp/pdf/12150314_03.pdf
- Kabir Uddin: Image classification - Hands-on exercise using eCognition
- USER GUIDE Trimble eCognition Developer for Windows operating system (2018) https://usermanual.wiki/Document/UserGuide.995437221.pdf
- Recommended literature:
- https://geospatial.trimble.com/products-and-solutions/ecognition
- Ormsby, T. (2010). Getting to know ArcGIS desktop (2nd ed., updated for ArcGis 10]. ed.). Redlands, Calif.: ESRI Press

Requirements:
- for a signature
Attendance at classes is compulsory.
- for a grade
The final grade is calculated as the weighted average of practical examination grade (75%) and the presentation quality (25%).
The minimum requirement for the the examination is 50%
Students can take a retake theexamination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:
it may be offered for students if the results in the 13th week is at least satisfactory (3).

Person responsible for course: Dr. Zoltán Krisztián Túri, PhD, Assistant Professor

Lecturer:

Title of course: Raster analysis **Code: TTGMG7052_EN**	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: - - practice: 2 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: 6 hours - preparation for the exam: 10 hours Total: 30 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The aim of the course is to familiarise students with the pre-processing of raster map files. The following topics will be covered: practical use of raster data models; preprocessing of raster datasets in GIMP; data integration: consistency, scale, thematics; data extraction: point sampling, zonal statistics, task solving in multiple software; operations with nominal raster datasets (Boolean operations); operations with scale data on a raster basis.(map algebra); multicriteria evaluation; analytical hierarchy process; texture determination, Haralick indices

Literature

- J. Ronald, Eastman (2010): Geospatial Informatics; IDRISI Tajga: Guide to GIS and Image Processing - IDRISI -TAJGA, Clark Labs Clark University, Worcester, MA, USA - UNIGIS Educational Center - Hungary. Knowledge Publishing House ZRt.,
- Schowengerdt, R. A. (2007). Remote sensing: Models and methods for image processing. S.l.: Academic Pr.

Requirements:
- for a signature
Attendance at classes is compulsory.
- for a grade
The final grade is calculated as the weighted average of practical examination grade (75%) and the presentation quality (25%).
The minimum requirement for the the examination is 50%
Students can take a retake theexamination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:
it may be offered for students if the results in the 13th week is at least satisfactory (3).

Person responsible for course: Prof. Dr. Szilárd Szabó, PhD, DSc, Full Professor

Lecturer:

Title of course: Point cloud processing **Code: TTGMG7053_EN**	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: 1 hours/week - practice: 1 hours/week - laboratory: -	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: 14 hours - laboratory: - - home assignment: 6 hours - preparation for the exam: 10 hours Total: 30 hours	
Year, semester: 2nd year, 3rd semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

In this course, students will learn about the types of point clouds, their production and processing methods, and the main steps involved. Through practical examples, students will gain insight into the main applications and potential of point clouds. In addition to the MicroStation and TopoDOT software, students will learn how to view, classify and evaluate point clouds using alternative Open Source softwares.

The theoretical part of the course will cover the following topics: Theoretical and conceptual background of point clouds; Methods of point cloud production; Types of point clouds; Background of terrestrial laser scanning; Background of airborne laser scanning; Photogrammetry-based point clouds; Methods of point cloud processing; Types of softwares used for point cloud evaluation; Potentials of point cloud application; Point clouds in urban environments; Point clouds in agricultural environments; Point clouds in natural environments,

The practical part of the course will cover the following topics: introduction to software for point cloud processing; MicroStation software architecture; 2D editing in MicroStation; 3D editing in MicroStation; planning a point cloud survey; point cloud field survey; point cloud visualization; point cloud classification; point cloud evaluation in TopoDOT, information extracted from point clouds; Open Source software and solutions for point cloud processing; photogrammetric point cloud evaluation.

Literature

- Riveiro, B., González-Jorge, H., Conde, B., & Puente, I. (2016). Laser scanning technology: fundamentals, principles and applications in infrastructure. Non-Destructive Techniques for the Evaluation of Structures and Infrastructure, 11(7).
- - Mukupa, W., Roberts, G. W., Hancock, C. M., & Al-Manasir, K. (2017). A review of the use of terrestrial laser scanning application for change detection and deformation monitoring of structures. Survey review, 49(353), 99-116.
- - Disney, M., Burt, A., Calders, K. et al. Innovations in Ground and Airborne Technologies as Refe-rence and for Training and Validation: Terrestrial Laser Scanning (TLS). Surv Geophys 40, 937–958 (2019). https://doi.org/10.1007/s10712-019-09527-x

Requirements:
- for a signature
Attendance at classes is compulsory.
- for a grade
The final grade is calculated as the weighted average of practical examination grade (75%) and the presentation quality (25%).
The minimum requirement for the the examination is 50%
Students can take a retake theexamination in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.
-an offered grade:
it may be offered for students if the results in the 13th week is at least satisfactory (3).

Person responsible for course: Dr. László Bertalan, PhD, Assisstant Professor, Dr. Gergely Szabó, PhD, habil., associate professor

Lecturer:

Title of course: GIS-fieldwork **Code: TTGMG7507_EN**	**ECTS Credit points: 4**

Type of teaching, contact hours
- lecture: -
- practice: 1 week/semester
- laboratory: -

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: -
- laboratory: -
- home assignment: 6 hours
- preparation for the exam: 10 hours

Total: 30 hours

Year, semester: 2nd year, 3rd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

During the field placement, students will visit organisations and companies in the public, professional and corporate spheres. During these visits, the companies and organisations will provide information on their organisational structure, their activities related to spatial information technology, and the requirements for their work.

Literature

- Surfer User Guide: Powerful Contouring, Gridding, and Surface Mapping, http://downloads.goldensoftware.com/guides/Surfer12_Users_Guide_Preview.pdf
- Gopi, S., Sathikumar, R., Madhu, N. 2016. Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India;, ISBN 978-8131700679

- Zimmer, RJ 2013. GIS For Surveyors: A Land Surveyor's Introduction to Geographic Information Systems, Montana Technical Writing, 978-0988873735

Requirements:
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- for a grade
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-an offered grade:
it may be offered for students if the results in the 13th week is at least satisfactory (3).

Person responsible for course: Dr. Boglárka Bertalanné Balázs, PhD, Assistant Professor

Lecturer: