Óbuda University

Alba Regia Technical Faculty

CURRICULUM OF

Geoinformatics MSc

Budapest

2022

CURRICULUM OF GEOINFORMATUICS MSc

1. Aim of the course

The goal of the master's program in geoinformatics is to train geoinformatics researchers and analysts who, based on their basic and practical knowledge of natural sciences, mathematics, IT and English, are able to creatively cultivate the science of geoinformatics. Based on their preparation, experts in geoinformatics are able to interpret spatial phenomena, processes and information related to geographic location, as well as to perform problem solving, planning, development, operation, management and consulting tasks in the operation of geoinformatics systems, decision support systems and expert systems. They are prepared to continue their studies in doctoral training.

2. Field of the course: natural science

3. Duration and training language

- full time (regular), English, 4 semesters, 1190 contact classes

- correspondence, English, 4 semesters, 425 contact classes

4. Number of credits to obtain: 120 credits

5. Educational level and qualification indicated in the degree

- degree level: master's (master, abbreviated: MSc) degree

- designation of qualification in English: Expert in Geoinformatics

6. Main areas of the course

	Credits
Basics of natural sciences (8-12 credits)	10
Economic, legal and human knowledge (6-10 credits)	7
Professional knowledge in geoinformatics (75-80 credits)	69
Optional subjects (6 credits)[1]	6
Professional practice (8 credits)	8
Thesis (20 credits)	20
Altogether:	120

7. Professional practice

The professional practice is a continuous practice corresponding to 240 hours and lasting six weeks, which is the solution of a field geoinformatics task at a professional practice place outside the institution (field data collection, evaluation and processing after a survey). The professional practice can also be completed abroad, which can also be considered a mobility window. The credit value of the professional practice is a total of 8 credits.

8. Physical education

Completion of two semesters of physical education is a requirement.

[1]Optional subjects are also professional subjects, so they can be included in the subject area of professional knowledg in geoinfromaticse, where the minimum credit value assigned to optional subjects is 6 credits.

9. Language requirements

In addition to the completion of the criteria subject, the language criterion for obtaining the final certificate is the passing of the internal professional language exam. The internal professional language exam is based on language skills corresponding to level B2 of the Common European Framework of Reference (CER) and knowledge of the professional language of the training.

10. Type of training

a) Full time (regular)

b) Correspondence

11. Means of evaluation

a) signature

b) practical mark

c) examination

d) final examination

11. Conditions to take the final examination

a) Obtaining a final certificate (absolutory).

b) Thesis accepted by the reviewer

The condition for admission to the final exam is obtaining the final certificate. A final certificate is issued by the higher education institution to the student who has completed the study and examination requirements prescribed in the curriculum and the prescribed professional practice and has obtained the prescribed number of credits.

12. Components of the final examination

The final exam consists of the defense of the thesis and a complex oral exam on the 2 final exam subjects prescribed in the curriculum. Candidates will receive the questions for the oral exam 30 days before the final exam. The preparation time for the final exam is at least 15 minutes per question.

13. Result of the final examination (F):

The overall result of the final examination is the weighted mean of grades obtained for the thesis (Th) and the subjects of the oral part of the final examination (S1, S2,…, Sm):

$$F = (Th + S_1 + S_2 + \ldots + S_m)/(1+m)$$

14. Conditions to issue the degree

a) Successful final exam

b) Fulfilling the language requirement

15. Date of effect: 01 September 2023

Confirmed by Senate of Óbuda University on ……. 2022

Budapest, 21 October, 2022

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Dr. habil. György Györök

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Content

Subjects

Basics of natural sciences

Name: **Geomathematics and Geostatistics**		*NEPTUN-code:* AGXGEGEMNF AGXGEGEMLF	*Number of periods/week:* full-time: 2 lec + 2 lab correspondence: 10 lec + 10 lab
Credit: 4 ***Requirement:*** exam		***Prerequisite:*** -	
Responsible: Prof József Kázmér TAR, DSc.	***Position:*** university professor	***Faculty and Institute name:*** John von Neumann Faculty of Infromatics Institute of Applied Mathematics	
Way of assessment: - mid-term tests			

Competences

a) knowledge: The student knows and uses geomathematical methods with open source and commercial mathematical and statistical softwares and has comprehensive knowledge and understanding of the most important contexts and concepts in the field of geomathematics.
b) abilities: The Student is able to perform geomathematics calculations to support decision makers.
c) attitude: The Student monitors professional development in geomathematics. He/she is open to professional cooperation with professionals working in related fields.
d) autonomy and responsibility: The Student is independent regarding the reflection and elaboration of professional issues and processes in the field of geomathematics. Using the methods of geomathematics, he/she collaborates responsibly with experts in other fields

Course description:

The students become thoroughly acquainted with the following areas of geomathematics:
Fundamental theoretical issues: Plane and spatial coordinate systems. Geographical applications of trigonometric functions. Notable lines, distances and surfaces. Spherical triangular theorems and their application. Possibilities of converting the coordinates of ground points. Projection transformations. Matrices. Matrix operations and their properties. Sets, set operations and their properties. Probability theory. Distributions of continuous probability variables.
The students will learn also about Geospatial Data Science and Analysis with practicals applying descriptive statistics. They acquire knowledge about point pattern analyses, spatial analyses with exploring the Modifiable Area Unit Problem. The students will obtain skills in the domain of Cluster Analysis & Spatial Autocorrelation. They will study advanced interpolation methods and will apply this knowledge in surface analyses. Students also will acquire knowledge related to the problem of weighting, aggregation. They get acquainted with the calculation of spatial regression, and spatial autocorrelation (Moran's I, Geary c), using two-dimensional methods based on the distance matrix.
They learn how to optimally implement spatial sampling and field data collection when examining different objects. In the practical lessons students interpret the theoretical material through practical examples with the help of built-in modules of specific commercial (eg ArcGIS) and open source (GeoDA, R,) software.

Literature

Willi Freeden, Clemens Heine, M. Zuhair Nashed: An Invitation to Geomathematics, Springer, 2019, ISBN 978-3-030-13053-4, 2019
Christakos, G., Modern spatiotemporal geostatistics, Oxford University Press, New York, 2000, ISBN 0-19-513895-3
Cressie, N., Statistics for spatial data. John Wiley & Sons, New York, 2015, 928 pp., ISBN13 (EAN): 9781119114611
Ajánlott irodalom:
Ripley, B.D., Spatial statistics. John Wiley & Sons, New York, 2004, 272 pp., ISBN: 978-0-471-69116-7

Name: **Modeling of environmental processes**		*NEPTUN-code:* AGXKFMEMNF AGXKFMEMLF	*Number of periods/week:* full-time: 2 lec + 2 lab correspondence: 10 lec + 10 lab
Credit: 4 ***Requirement:*** midterm mark		***Prerequisite:***	
Responsible: Malgorzata VERŐNÉ WOJTASZEK, CSC.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: Case studies, preparation of two essays on two complex project tasks during the semester, test			

Competences

a) knowledge:
Is familiar with the concepts of environmental modelling, knows the various types of models, data requirements, criteria.
b) abilities:
Is suitable for describing the processes taking place in environmental systems by means of mathematical and statistical tools, Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them.
c) attitude:
Open to the use of information technology tools. Seeks to know and routinely use the tools needed to solve the environmental problems. Considers it important to mediate environmentally conscious behaviour, to support sustainable development by using GIS tools.
d) autonomy and responsibility:
Independently identifies and analyses the environmental processes, problems and describes these by using models. Openly accepts substantiated critical remarks.

Course description:

The aim of the subject is to provide students with knowledge of the natural and anthropogenic processes in the environment, as well as the possibilities of modelling environmental systems.
Students will learn about the formation, evolution. The course will provide a general introduction to systems theory, an overview of global Earth systems, systems classification, systems functioning, properties, equilibrium and sensitivity. It introduces the various types of model and the role of modelling in the environmental sciences, shows basic steps of model building, model calibration, validation and uncertainty investigation (simulation of methods e.g. MC). It reviews the methods of integrated modelling, the combination of complex material transportation models, and the application of conservative and soft (Fuzzy) calculation methods in the modelling of environmental problems processes.
The course will give introduction to modelling of environmental systems. The subject combines theoretical and practical sessions. The scope of the practical (computer-based exercises) is to consolidate the theory, to learn & train practical skills and to apply problem-solving methodologies to real-life examples. The practical lessons show the models related to soil-water-air processes and pollution (noise pollution, point and diffuse pollution e.g. eutrophication P-model, RUSLE, SEDIMENTATION model). It provides the student with the software background of the environmental impact assessment and the development of the database required for the investigation.

Literature

Turner G. M.- Gardner H. R.- O'neill V. R.: Landscape Ecology in theory and practice. Sprnger-Verlag. ISBN 0-387-95123-7
Takács A. A.-Végső F.: Térinformatikai alkalmazások II, Jegyzet. Székesfehérvár, GEO, 2010. A jegyzet elektronikus változata a Tankönyvtár portálon.
Hunsaker C.T.-Goodchild M. F. Friedl M. A. – Case T.J.:Spatial Uncertainty in Ecology. Impications for Remote Sensing and GIS Applications.Springer-Verlag (2001) ISBN 0-387-95129-6

Economic, legal and human knowledge

Name: **Business economics**		*NEPTUN-code:* AGXUZGEMNF AGXUZGEMLF	*Number of periods/week:* full-time: 1 lec + 2 sem + lab correspondence: 5 lec + 10 sem + lab
Credit: 4 *Requirement:* exam		*Prerequisite:* -	
Responsible: Katalin TAKÁCSNÉ GYÖRGY, PhD.	*Position:* professor	*Faculty and Institute name:* Keleti Károly Faculty of Business and Management, Institute of Business Development and Infocommunications	
Way of assessment: Business plan (Business plan_1) and a final written exam at the end of the semester.			

Competences

a) knowledge

- Has basic management and leadership skills to perform tasks related to your field.
- Knows the possibilities, principles and problems of the application of geoinformatics for state (e-government) and market purposes.

b) abilities

- Ability to recognize and apply new problem-solving methods and procedures in their field and apply what they have learned in a diverse, multidisciplinary environment.
- Ability to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems. Able to work with decision makers.

c) attitude

- He/she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with the tools of geoinformatics.
- Committed to adhering to and adhering to quality requirements.

d) autonomy and responsibility

- Independent regarding the reflection and elaboration of professional issues and processes.
- Feels responsible for meeting and meeting deadlines. He / she is responsible for the work of himself / herself and his / her staff, as well as his / her staff (working on a project).

Course description:

To acquaint the students with the system of macroeconomic conditions for the establishment and operation of enterprises. To interpret the basic concepts of business organization management in the framework of a regulated market economy. To present the main types of corporate strategies, the process and the need for planning. Analyze business processes: marketing, production / service, innovation and asset management, human resource management, logistics, finance and crisis management. Due to the nature of the subject, Students should analyze business processes using a project approach (based on economic and management theory), during which they prepare a situation assessment (case study) of an existing company as a teamwork (Company Introduction_1) and present a business plan of an existing or planned company as an individual task (Business plan_1). With this, they acquire the analysis methods necessary for strategic planning (STEEP, competitive environment analysis; resource diagnostics). During presentation they have to defend their plan, before schoolmates.

Literature

Andrew Gillespie: Business Economics, Oxford, 2010
Campbell, D.J. - Craig, T. (2005) Organisations and the Business Environment, Routledge.
Elsevier Butterworth-Heinemann, p. 696
Sloman John: Economics for business, Pearson education limited, 2019, ISBN13
(EAN): 9781292239279
Turèková,N. – Svetlanská, T. – Takács I. (2016): Business Economics – International V4 Studies. Nitra. International Visegrad Fund´s, Visegrad University Studies Grant No. 61200004. 109. p
Savov R, Takács-György K: Selected chapters from strategic management
Nyitra: Slovak Agricultural University, 2016. 85 p.

Name: **Data protection, data policy**		*NEPTUN-code:* AGXADAEMNF AGXADAEMLF	*Number of periods/week:* full-time: 1 lec + 2 sem correspondence: 5 lec + 10 sem
Credit: 3 ***Requirement:*** midterm mark		***Prerequisite:***	
Responsible: Prof. Dr. Zoltán Rajnai	***Position:*** professor	***Faculty and Institute name:*** Donát Bánki Faculty of Mechanical and Safety Engineering, Institute of Mechanical Engineering and Security Sciences	

Way of assessment:

- preparation of two essays on two complex project tasks during the semester.
- mid-term tests

Competences

a) knowledge: Has knowledge of the specific tools of the geoinformatics field, is able to apply field survey procedures, data management and analysis, and representation solutions. Knows and uses spatial data collection technologies, available databases and geospatial software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions.
-Knows the possibilities, principles and problems of applying geoinformatics for state (e-public administration) and market purposes.
-In his native language, he confidently uses the conceptual system and terminology describing natural processes and can match it to the conceptual system of geoinformatics.
b) skills: Able to interpret complex professional problems arising in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve the problems.
- Capable of creating geoinformatics systems that support and assist decision makers.
c) attitude: he shares his knowledge, considers it important to convey professional geoinformatics results. Open to professional cooperation with professionals working in related fields.
d) autonomy and responsibility: With his geoinformatics knowledge and skills, he cooperates responsibly with specialists in other fields.

Course description:

Data, information, public sector information, open data, large data sets, national data wealth, national data policy, data protection. Importance of data value chain. Connections between international and Hungarian data policy. National data policy, White Paper. Development of basic information rights, basic principles. Description of the General Data Protection Regulation. Domestic law enforcement practice, administrative requirements related to data management. Information security.
Presentation of territorial levels of territorial development. Decision support for changing the spatial structure of society and the economy. Construction of a geoinformatics database using data from the National Spatial Development and Spatial Planning Information System; Creation of thematic maps of the spatial distribution of territorial differences. Presentation of case studies to support spatial decisions with geoinformatics methods.

Literature

Yomralioglu, Tahsin, McLaughlin, John (Eds.): Cadastre: Geo-Information Innovations in Land Administration, Springer International Publishing AG., 2017. ISBN 978-3-319-51215-0, 978-3-319-51216-7.
Cadastral Data Content Standard for the National Spatial Data Infrastructure, v1.3, NSDI, 2003.
Martin van Maarseveen (Editor), Javier Martinez (Editor), Johannes Flacke (Editor): GIS in Sustainable Urban Planning and Management: A Global Perspective 1st Edition, ISBN-13: 978-1138505551

Professional knowledge in geoinformatics

Name: **Digital photogrammetry**		***NEPTUN-code:*** AGXDFOEMNF AGXDFOEMLF	***Number of periods/week:*** full-time: 2 lec + 3 lab correspondence: 10 lec + 15 lab
Credit: 5 ***Requirement:*** exam		***Prerequisite:*** -	
Responsible: Tamás JANCSÓ, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	

Way of assessment:

- performing complex project tasks and preparing technical descriptions based on them.

Competences

a) knowledge:
Complex knowledge in the following areas: collection, editing and analysis of spatial data, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems. Primary and secondary data collection, 3-dimensional modeling, development of spatial services.
b) abilities:
Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of photogrammetric technology in their native language and in English. Able to work with decision makers.
c) attitude:
He / she monitors professional, technological developments and labor market trends related to photogrammetric technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools.
d) autonomy and responsibility:
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Course description:

The aim of the course is to acquaint students with the data collection methods and requirements of digital photogrammetry. It deals with the planar and spatial aspects of photogrammetric automated data collection and data integration into GIS. It covers state-of-the-art sensors and digital photogrammetric workstations that support evaluation. It discusses in detail image processing, adjustment, error filtering methods and algorithms that support automated data acquisition. Due to the nature of the course, in the form of practice-oriented 4 complex mid-year tasks and technical descriptions prepared from them, students get to know the final products and evaluation methods (1. orthophoto, 2. cartographic evaluation, 3. digital surface and terrain models, 4. aerial triangulation procedures) through application examples according to the nature of the training (60% practice) and their state-of-the-art technologies by presenting them in a project-oriented manner.

Literature

Wilfried Linder: Digital Photogrammetry: A Practical Course, Springer (2009), 220 p., ISBN-13: 978-3540927242
Karl Kraus: Photogrammetry - Geometry from Images and Laser Scans, De Gruyter (2007), 459 p., ISBN: 978-3-11-089287-1
Thomas Luhmann, Stuart Robson, Stephen Kyle, and Jan Boehm: Close-Range Photogrammetry and 3D Imaging, De Gruyter (2020,), 822 p., ISBN: 978-3-11-060724-6

<table>
<tr><td colspan="2">Name:

Application of UAV technology</td><td>NEPTUN-code:
AGXUAVEMNF
AGXUAVEMLF</td><td>Number of periods/week:
full-time: 2 lec + 3 lab
correspondence: 10 lec + 15 lab</td></tr>
<tr><td colspan="2">Credit: 5
Requirement: midterm mark</td><td colspan="2">Prerequisite: Digital Photogrametry
AGXDFOEMNF, AGXDFOEMLF</td></tr>
<tr><td>Responsible:
Tamás JANCSÓ, PhD.</td><td>Position:
associate professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Geoinformatics</td></tr>
<tr><td colspan="4">Way of assessment:
- technical descriptions, preparation of two essays on two complex project tasks during the semester.
- mid-term tests</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) knowledge:
Complex knowledge in the following areas: collection, editing and analysis of spatial data, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems. Primary and secondary data collection, 3-dimensional modeling, development of spatial services.
b) abilities:
Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of UAV technology in their native language and in English. Able to work with decision makers.
c) attitude:
He / she monitors professional, technological developments and labor market trends related to UAV technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools.
d) autonomy and responsibility:
With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">The aim of the course is to acquaint students with the data collection methods and requirements of UAV technology. It deals with the possibilities of automated data collection of UAV technology, data integration into geoinformatics systems. It covers state-of-the-art sensors, software that supports flight mission plans and evaluation. It discusses in detail image processing, adjustment, error filtering methods and algorithms that support automated data acquisition. It introduces cloud-based services related to UAV technology and the end products that can be produced.
We present the entire technological process through complex, project-based practical examples. Through application examples, state-of-the-art technologies for products and evaluation methods that can be produced with UAV technology are presented in a project-oriented way, primarily from a practical point of view.</td></tr>
<tr><td colspan="4">Literature</td></tr>
<tr><td colspan="4">James S. Aber, Irene Marzolff, Johannes Ries, Susan Elizabeth Ward Aber: Small-Format Aerial Photography and UAS Imagery: Principles, Techniques and Geoscience Applications 2nd Edition, Elsevier (2019), 394 p., ISBN-13: 978-0128129425
David R. Green, Billy J. Gregory, Alexander Karachok: Unmanned Aerial Remote Sensing: UAS for Environmental Applications, Taylor & Francis (2020), 363 p., ISBN-13: 978-1482246070
Amy E. Frazier, Kunwar K. Singh (eds.): Fundamentals of Capturing and Processing Drone Imagery and Data,Taylor & Francis (2021), 361 p., ISBN13 (EAN): 9780367245726</td></tr>
</table>

Name: **Remote sensing and its applications**		*NEPTUN-code:* AGXTAVEMNF AGXTAVEMLF	*Number of periods/week:* full-time: 2 lec + sem + 2 lab correspondence: 10 lec + sem + 10 lab
Credit: 4 ***Requirement:*** midterm mark		***Prerequisite:***	
Responsible: Malgorzata VERŐNÉ WOJTASZEK, CSC.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: Case studies, preparation of two essays on two complex project tasks during the semester, test			

Competences

a) knowledge:
Is familiar with the physical principles of RS, technics of data gathering. Has comprehensive knowledge of digital image analysis: preprocessing and classification methods, algorithms. Has practical experience in multi sensor data analysis and challenges of scale, and the global, regional and local applications of remote sensing.
b) abilities:
Able to search for open-source remote sensing data taking into account the purposes of the application and organize spatial data into a database. Able to creatively and methodically process, evaluate, interpret, analyse measurements and draw conclusions from them,
c) attitude:
Seeks to know and routinely use the tools of image processing, understand and practice the potential of remote sensing. Tries to support sustainable development by using GIS/RS tools.
d) autonomy and responsibility:
Independently identifies and analyses tasks and problems based on remote sensing. Co-operates responsibly with team members and professionals of other fields. Applies a systematic approach in his / her thinking, independent of the thinking and elaboration of professional issues and processes. Feels responsible for meeting deadlines.

Course description:

The aim of the subject is to provide the student with concepts of remote sensing, principle of RS techniques, up-to-date sensors and applications. It aims at introducing basic and advanced techniques of digital image processing. It covers the fundamental concepts required to understand and apply commonly used and more advanced algorithms for image classification. It focusses on the theory, methods and practical application of most recent semi-automated image data analysis and image information extraction processes used by professional Earth and Environmental system science researchers in order to provide reliable and reproducible information about human and physical earth environments. It focuses on an image classification knowledge, techniques and skills for getting information from imagery and ability to solve complex tasks based on remote sensing. Emphasis is placed on gaining a practical understanding of the principles behind each technique and a consideration of their appropriateness in different applications. The exercises and case studies allow students to explore a range of practical techniques.

Literature

Lillesand T. M. et al. (2007): Remote sensing and image interpretation, John Wiley & Sons, Inc. ISBN 978-0-470-05245-7
Verőné Wojtaszek M. et all (2020): IRSEL (Innovation on Remote Sensing Education and Learning) some modules of electronic Learning Materials: available from 2020 on the website of ÓE AMK.
Blaschke T., Lang S., Hay G. J.: Object-Based Image Analysis, Springer, 2008, ISBN: 978-3-540-77057-2
Verőné Wojtaszek M. – Tóth Z. (2015): Digitális képelemzés. Elektronikus jegyzet. Székesfehérvár, Óbudai Egyetem, 60 p.

Name: **Earth observation and advanced analysis of spatial data**		***NEPTUN-code:*** AGXFOLEMNF AGXFOLEMLF	***Number of periods/week:*** full-time: 2 lec + sem + 3 lab correspondence: 10 lec + sem + 15 lab
Credit: 5 ***Requirement:*** midterm mark		***Prerequisite:*** Remote sensing and its applications AGXTAVEMNF, AGXTAVEMLF	
Responsible: Malgorzata VERŐNÉ WOJTASZEK, CSC.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: Case studies, preparation of two essays on two complex project tasks during the semester, exam			

Competences

a) knowledge:
Has complex knowledge of RS data sources and digital image analysis, evaluates the data quality of remote sensing products. Is familiar with the classical and advanced image processing algorithms and application possibilities (advantages, limitations).
b) abilities:
Has advanced skills in analysing, integrating and managing spatial data. Identify specific applications where remote sensing may be used as a tool for monitoring and research. Has ability to critically evaluate existing theories and technologies and identify the needs for improvement.
c) attitude:
Seeks to know and routinely use the tools of image processing, understand and practice the potential of remote sensing. Tries to support sustainable development by using GIS/RS tools.
d) autonomy and responsibility:
Independently identifies and analyses tasks and problems based on remote sensing. Co-operates responsibly with team members and professionals of other fields. Applies a systematic approach in his / her thinking, independent of the thinking and elaboration of professional issues and processes.

Course description:

The aim of the subject is to provide students with the high-level knowledge necessary for the practical application of remote sensing. The subject is divided into theoretical part and some practical real-world application components in order to train students to process standardized, accurate, reproducible, reliable and relevant environmental information of the land cover. Within the framework of the subject, students will gain a comprehensive knowledge of the latest, high-quality methods and practical application of image processing. It focuses on object-based image analysis (OBIA). Hard and soft classification procedures (Fuzzy logic, advanced classifiers e. g. SWM, FT, CART), artificial intelligence in image processing. Main topics: the advanced algorithms of image processing, application possibilities and software-specific solutions: e.g., radiometrically corrected products, PCA, indexes, image segmentation, thematic mapping using advanced classifiers: Fuzzy logic, member functions, advanced classifiers e.g. SWM, FT, CART), the role of artificial intelligence in data analysis. Accuracy issues.

Literature

Lillesand T. M. et al. (2007): Remote sensing and image interpretation, John Wiley & Sons, Inc. ISBN 978-0-470-05245-7
Verőné Wojtaszek M. et all (2020): IRSEL (Innovation on Remote Sensing Education and Learning) some modules of electronic Learning Materials: available from 2020 on the website of ÓE AMK.
Blaschke T., Lang S., Hay G. J.: Object-Based Image Analysis, Springer, 2008, ISBN: 978-3-540-77057-2
Verőné Wojtaszek M. – Tóth Z. (2015): Digitális képelemzés. Elektronikus jegyzet. Székesfehérvár, Óbudai Egyetem, 60 p.

Name: **Data science**		***NEPTUN-code:*** AGXADIEMNF AGXADIEMLF	***Number of periods/week:*** full-time: 2 lec + sem + 2 lab correspondence: 10 lec + sem + 10 lab
Credit: 5 ***Requirement:*** exam		***Prerequisite:***	
Responsible: Rozália LAKNER, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Science and Software Engineering	
Way of assessment: - mid-term tests			
Competences			
a) knowledge: Comprehensive knowledge in the following areas: database management, Big Data - data mining, primary and secondary data collection, spatial and temporal data analysis. Big data tools, Machine learning and optimalisation. b) abilities: Able to initiate initiative, project work and group work with experts in co-sciences and other related fields (geology, geography, geodesy, cartography, meteorology, environmental science, earth science, informatics, mathematics, statistics, archeology). Planning databases, Made queries. Solving simple problems using machine learning. c) attitude: Open and committed to critical feedback and evaluation based on self-examination. Create well-structured data. d) autonomy and responsibility: He / she feels responsibility to meet deadlines. He / she is responsible for the work of his / her own staff and those working with him / her or with him / her (working on a project). Cooperation with database experts.			
Course description:			
The aim of the course is to introduce the basic concepts, tools, and methods of data science through real-life examples of their application. Main topics: General characterization and basic statistical properties of data. Data models, structured, semi-structured and unstructured data. Data pre-processing steps, data cleaning, data integration, data reduction, data transformation. Data exploration, tools for data visualization Machine learning methods and tools: supervised and unsupervised learning; classification, regression, and clustering. Learning, validation and testing sets, cross-validation. Evaluation of classifiers: accuracy, recall, F1-measure, ROC curve. Exercises: implementation of data processing, machine learning, visualization tasks with real data (e.g. Kaggle datasets), using data analysis software (e.g. RapidMiner, Knime).			
Literature			
Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, 3rd ed. The Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann Publishers, July 2011. ISBN 978-0123814791 Abonyi János (szerk): Adatbányászat - A hatékonyság eszköze, Computerbooks, 2006. ISBN: 9789636183424 Fogarassyné Wathy Ágnes, Starkné Werner Ágnes: Intelligens adatelemzés, Typotex, 2011.			

Name: **Data Mining**		***NEPTUN-code:*** AGXADBEMNF AGXADBEMLF	***Number of periods/week:*** full-time: 1 lec + 0 sem + 3 lab partial:5 lec+0sem+15lab
Credit: 4 ***Requirement:*** exam		***Prerequisite:*** Data Science AGXADIEMNF, AGXADIEMLF	
Responsible: Éva NAGYNÉ HAJNAL, PhD	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Science and Software Engineering	
Way of assessment: - colloquium			

Competences

a) knowledge
- Comprehensive knowledge of the geoinformatics field, especially in the following areas: database management, Big Data - data mining.

b) abilities
- He / she is able to collect data independently and organize spatial data into a database, as well as to organize the data with the tools of geoinformatics. Able to perform operations and create models with independently organized databases.
- Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.

c) attitude
- He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
- Committed to adhering to and adhering to quality requirements.

d) autonomy and responsibility
- Independent in thinking and elaborating professional issues and processes.

With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Course description:

The concept of data mining, its components; datasets, structures, goodness functions, optimization; measures and data; measuring scales, distance measures. Principles and techniques of data visualization; basic statistics, one- and bivariate case, multivariate case; multidimensional scaling (MDS) ;. Regression: linear models; generalized linear models; sample search; dynamic programming; Clustering: basic concepts, measures ; hierarchical algorithms; dendrogram. Probability algorithms: G-PAS, fuzzy C-mean, k-mean. Machine learning methods in data analysis. Data mining methods on data streams.

Exercises:

Due to the nature of the course, it is practice-oriented. Theoretical knowledge should be tested in computer laboratory exercises with specific data sets. Within this course, a complex data mining case study based on specific data must be carried out, as well as the accompanying documentation

Literature

Zhao Janchang: R and Data Mining: RDataMining.com http://www.rdatamining.com/
Charu C. Aggarwal: Data Mining: The Textbook, Springer (2015), 763 pp., ISBN-13 : 978-3319141411
Pang-Ning Tan: Introduction to Data Mining, Pearson (2005), 792 pp. ISBN-13 : 978-0321321367

Name: **Spatial data collection**		***NEPTUN-code:*** AGXTEREMNF AGXTEREMLF	***Number of periods/week:*** full-time: 2 lec + sem + 3 lab correspondence: 10 lec + sem + 15 lab
Credit: 5 ***Requirement:*** exam		***Prerequisite:*** -	
Responsible: László SZŰCS, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Ybl Miklós Faculty of Architecture and Civil Engineering, Institute of Civil Engineering	
Way of assessment: technical descriptions of the measurements and the processing of the obtained data			

Competences

a) knowledge
- Has complex knowledge in the field of planning, preparation, implementation of spatial data collection and transformation of the obtained data for GIS.
- Has knowledge to select the most appropriate data collection method for the implementation of geographical and spatial data collection at different scales.

b) abilities
- He / she is able to collect data independently and organize spatial data into a database with the tools of geoinformatics. Able to interpret geographic / spatial phenomena.
- Able to creatively and methodically process, evaluate, interpret, analyze measurements and draw conclusions from them.
- Able to initiate project work and group work with experts in co-sciences and other related fields.

c) attitude
- He / she accepts and adheres to the ethical principles of work and organizational culture with his / her colleagues, especially with regard to the copyright environment related to GIS.
- He / she shares his / her knowledge and considers it important to communicate professional results in geoinformatics. He / she is open to professional cooperation with professionals working in related fields.

d) autonomy and responsibility
- Independent in thinking and elaborating professional issues and processes.
- With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.

Course description:

The goal of the subject is to introduce students with the theory of spatial data collection techniques and to execute the practical application of the learned geodetic measurement techniques in real conditions. Within this, execute complex engineering tasks with data collection methods and technologies in the production of 1D (elevation), 2D (horizontal) and 3D (spatial) data.
They will also learn how to convert the collected data for GIS systems. They learn how accurate data collection is need for the task, what instrumentation is appropriate to use, and how detailed the data collection have to do. The subject introduces the specific needs and problems of databases (environmental studies, archeology, etc.).
Finally, it deals with the economic issues in data collection including the performance factors as well.

Literature

James B. Campbell – Randolph H. Wynne: Introduction to Remote Sensing, The Guilford Press Kiadó, New York, p. 667, 2011. ISBN: 978-1-60918-176-5
Karl Krauss: Photogrammetry, Walter de Gruyter Berlin, p. 459, 2000. ISBN:978-3-11-019007-6
Kurt Menke – Richard Smith Jr. – Luigi Pirelli – John Van Hoesen: Mastering QGIS, Packt Publishing, Birmingham, pp. 388., 2015. ISBN: 978-1-78439-868-2
C. Vincent Tao, Jonathan Li: Advances in Mobile Mapping Technology ISPRS Book Series, 2007.
Charles K. Chui, Guanrong Chen: Kalman Filtering with Real-Time Applications, Springer, 2009.

Name: **Geomatics**		***NEPTUN-code:*** AGXGEOEMNF AGXGEOEMLF	***Number of periods/week:*** full-time: 2 lec + sem + 2 lab correspondence: 10 lec + sem + 10 lab
Credit: 5 ***Requirement:*** exam		***Prerequisite:*** -	
Responsible: Gábor MOLNÁR, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: - mid-term tests			
Competences			
a) knowledge: Complex knowledge in the following areas: Mathematical background of geodetic measurements, map projections, geodetic datums and least squares adjustment. b) abilities: Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of geomatics in their native language and in English. Able to work with decision makers. c) attitude: He / she monitors professional, technological developments and labor market trends related to geomatics. Throughout his field activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior and to support sustainable development. d) autonomy and responsibility: With his geomatics knowledge and skills, he / she collaborates responsibly with experts in other fields.			
Course description:			
Azimuthal, cylindrical, and conic projections of the sphere. Distortion metrics based on the projection equations. Pseudocylindrical and pseudoconic projections. Azimuthal and conic projections of the ellipsoid. Cylindrical projections of the ellipsoid. Map transformations. Adjustment of two-dimensional and three-dimensional transformations. Bursa-Wolf transformation, Molodensky transformation, Transformation of ellipsoid coordinates using correction grid. Adjustment of three-dimensional networks (GPS, photogrammetry) Robust estimates, filtering of error. In practice, the parametrization of map projections and geodetic datums in GIS software and calculation of locally applicable map projection transformations, and their application in GIS software.			
Literature			
Grafarend, E.W., Krumm, F.W.: Map projections, Springer-Verlag Berlin Heidelberg, 2006. Charles K. Chui, Guanrong Chen: Kalman Filtering with Real-Time Applications, Springer, 2009. ISBN: 978-3-642-36494-5 Mikhail E.M. Observations and least squares, 1976. ISBN: 0700224815			

Name:		***NEPTUN-code:***	***Number of periods/week:***
Informatics in cadastre		AGXKINEMNF AGXKINEMLF	full-time: 2 lec + 2 lab correspondence: 10 lec + 10 lab
Credit: 4 ***Requirement:*** exam		***Prerequisite:*** -	
Responsible: Zoltán TÓTH, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: - mid-term tests, exam			
Competences			
a) knowledge: Complex knowledge in the following areas: collection, editing and analysis of spatial data, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems. b) abilities: Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of UAV technology in their native language and in English. c) attitude: He / she monitors professional, technological developments and labor market trends related to UAV technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools. d) autonomy and responsibility: With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.			
Course description:			
Digital base map model: geometric and topological elements. Topics, concepts: Cadastre, data, basic data, public basic data, Databases, digital base map, Data security, data collection, data consistency, data model, data protection, Subdivision, land division, other separate property, land division delimitation, building, location, Cadastral survey, parcel number, connection, public domain, metadata, technical cadastral map, Object, Object class, Object group, Object change management. 3D based data infrastructure			
Literature			
Digital Maps. Part 1: Digital Base Map. Conceptual Model. Yomralioglu, Tahsin, McLaughlin, John (Eds.): Cadastre: Geo-Information Innovations in Land Administration, Springer International Publishing AG., 2017. ISBN 978-3-319-51215-0, 978-3-319-51216-7. Cadastral Data Content Standard for the National Spatial Data Infrastructure, v1.3, NSDI, 2003. Dr. Szabolcs Mihály HUNGARIAN STANDARD PROPOSAL Digital Base Map (DAT). Conceptual Modelhttp://lazarus.elte.hu/gb/standard/standind.htmAmy E. Frazier, Kunwar K. Singh (eds.): Fundamentals of Capturing and Processing Drone Imagery and Data,Taylor & Francis (2021), 361 p., ISBN13 (EAN): 9780367245726			

Name: **Data Integration**		*NEPTUN-code:* AGXAINEMNF AGXAINEMLF	*Number of periods/week:* full-time: 1 lec + 3 lab correspondence: 5 lec + 15 lab
Credit: 5 ***Requirement:*** midterm mark		***Prerequisite:*** Spatial Data Collection AGXTEREMNF, AGXTEREMLF	
Responsible: Rozália PIGLERNÉ LAKNER, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Science and Software Engineering	

Way of assessment:

- 2 reports
- 2 complex practical tasks

Competences

a) knowledge:
Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: geographical, spatial data collection, use of cartographic procedures, knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modeling, visualization, geoinformatics system construction.
b) abilities:
Able to interpret geographic / spatial phenomena, processes and information, and to plan, organize, manage and control processes in the geoinformatics field
c) attitude:
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
d) autonomy and responsibility:
Independent in thinking and elaborating professional issues and processes.

Course description:

The aim of the course is for the student to analyze the properties and relationships of geographical data, to get acquainted with the practical implementation of the integration of geographical and descriptive data. To do this, we review the basics of system design and the theoretical and practical implementation of databases. After mastering the subject, the student should be able to integrate different types of geographic data into a GIS database, link descriptive and other data to them.
Topics: I.) Basics of system design; II.) Database management; III.) GIS data integration;
Theory: I.) Model types, methodologies, tools, UML; II.) DBMS system, Data modeling, SQL; III.) Basic concepts of GIS, Summary of spatial data types, data formats, data models, Database construction issues, GIS basic operations, GIS software;
Exercise: I.) Modeling with UML; II.) Design and implementation of a data model in a DBMS system, use of SQL commands, Complex task I-II (Creating and implementing a data model in a DBMS system, data upload, query); III.) GIS software basics, data management, database construction, Complex task III (creating a GIS database);

Literature

Maguire, D., Goodchild, M.F. and Rhind, D.W. (Eds.): Geographical Information Systems, New York (US), Longman, 1991.; ISBN 0-582-05661-6
Zeiler, M.: Modeling Our World, Redlands (US), ESRI Press, 1999.; ISBN 1-879102-62-5
Bernhardsen, T.: Geographic Information Systems, Arendal (NO), Viak IT and Norwegian Mapping Authority, 1992.; ISBN 82-991928-3-8
Detrekői, Á. – Szabó, Gy.: Térinformatika, Nemzeti tankönyvkiadó, Budapest, 2002.; ISBN 978-963-2796-81-9

Name: **GIS project management**		*NEPTUN-code:* AGXGISEMNF AGXGISEMLF	*Number of periods/week:* full-time:1 lec + 3 lab correspondence: 5 lec + 15 lab
Credit: 4 ***Requirement:*** mid-term mark		***Prerequisite:*** Spatial databases AGXTADEMNF, AGXTADEMLF	
Responsible: Andrea PŐDÖR, PHD	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	

Way of assessment:

- During the semester, students solve group and individual project tasks, which are evaluated in the exercises. In addition, the theoretical material is given 2 times during the semester in closed form, which must be completed at a level of at least 50%. The exam consists of the presentation of the individual task and the assessment of the related theoretical knowledge.

Educational purpose:

During the semester, students solve group and individual project tasks, which are evaluated in the exercises. In addition, the theoretical material is given 2 times during the semester in closed form, which must be completed at a level of at least 50%. The exam consists of the presentation of the individual task and the assessment of the related theoretical knowledge.

Competences

a)Knowledge:- He/she knows the knowledge acquisition and problem-solving methods of surveying.
- He/she has a comprehensive knowledge of the available GIS and professional data processing software applications.
- He/she has adequate foreign language skills to practice the profession.
b)Abilities: - He/she is capable of planning and implementing geographic information systems (spatial information systems), as well as collecting, storing, analyzing, managing, displaying and distributing related data.
- He/she is able to manage and use spatial data related to changes in natural resources and the social environment in the planning of urban development, rural development and regional development.
c)Attitude:- He/she strives for decision-making that takes into account legislation and professional ethical standards even in unexpected decision-making situations that require a complex approach.
d)Autonomy and responsibility:- He/she uses the data received from the associated professions in the design and construction work process.
- He/she possesses the communication skills and sense of responsibility necessary for professional and interprofessional cooperation.

Course description:

Basic concepts of GIS management.
The importance of the environment: internal, company-specific and external environment.
Geospatial project management – project planning, project marketing and monitoring.
The GIS implementation process: from project idea to commissioning: assessment of user needs, planning based on information needs, and its work parts.
Logical frame matrix. Creating a Gantt chart. Data and IT management.
Cost and benefit analysis. Quality assurance.
Change management.
The place, role and effects of GIS in the organization.
Development trends

References

Márkus B.: GIS Management, lecture notes, University of West Hungary, Faculty of Geoinformatics, Székesfehérvár, 2010
Holdstock D. A.: Strategic GIS Planning and Management in Local Government, CRC Press, 2016
Croswell P. L.: The GIS Management Handbook, Kessey Dewitt Publications, 2009

<table>
<tr><td colspan="2">Name:

GIS programming</td><td>NEPTUN-code:
AGXGISEMNF
AGXGISEMLF</td><td>Number of periods/week:
full-time: 2 lec + 2 lab
correspondent: 10 lec + 10 lab</td></tr>
<tr><td colspan="2">Credit: 5
Requirement: midterm mark</td><td colspan="2">Prerequisite:</td></tr>
<tr><td>Responsible:
Gábor NAGY, PhD</td><td>Position:
assistant professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Geoinformatics</td></tr>
<tr><td colspan="4">Way of assessment:
tests and exercises</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) knowledge:
Comprehensive knowledge of the problem-solving principles, methodology and procedures of the planning, development and operation processes of the geoinformatics field, especially in the following areas: database management.
b) abilities:
Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
c) attitude:
Open and committed to critical feedback and evaluation based on self-examination.
d) autonomy and responsibility:
Independent in thinking and elaborating professional issues and processes.</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">Programming in Python.
Creating an object-oriented program.
General-purpose (e.g. search, sorting, operations on graphs) and geospatial (e.g. route optimization, cutting polygons, area calculation) algorithms.
Knowledge of basic tools used to design programs (e.g. UML class diagram, other UML diagrams) and represent algorithms (e.g. flowchart, structure diagram, various types of textual descriptions).
Developing your own application to solve simpler GIS programming tasks using open source modules.
Presentation of the WKT and GeoJSON formats and their use in self-developed programs.
During the exercises:
Creating programs for general purposes and geoinformatics tasks.</td></tr>
<tr><td colspan="4">References</td></tr>
<tr><td colspan="4">Iványi A. (ed.): Algorithms of Informatics. Vol. 1. Foundations. 2007. mondAT Kiadó., ISBN: 963 463 664 0
Iványi A. (ed.): Algorithms of Informatics. Vol. 2. Applications. 2007. mondAT Kiado., ISBN: 963 463 775 2
Iványi A. (ed.): Algorithms of Informatics. Vol. 3. Selected topics 2013. Mondat Kft.,
Peter Wentworth, Jeffrey Elkner,Allen B. Downey and Chris Meyers: How to Think Like a Computer Scientist, Learning with Python 3 (RLE)</td></tr>
</table>

Name: **Programming of GIS systems**		***NEPTUN-code:*** AGXGRPEMNF AGXGRPEMLF	***Number of periods/week:*** full-time: 2 lec + 2 lab correspondence: 10 lec + 10 lab
Credit: 5 ***Requirement:*** midterm mark		***Prerequisite:*** GIS programming AGXGISEMNF, AGXGISEMLF	
Responsible: Zoltán TÓTH, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	

Way of assessment:

- technical descriptions, preparation of two essays on two complex project tasks during the semester.
- mid-term tests

Competences

a) knowledge
- Knows and uses spatial data collection technologies, available databases and GIS software, as well as open source and commercial geoinformatics software, cloud-based geoinformatics solutions

b) abilities
Able to create geoinformatics systems to support and assist decision makers.
Able to perform problem solving, planning, development, operation, management and consulting tasks in the operation of GIS systems, decision support systems and expert systems.
Able to initiate initiative with design and development professionals and end users of geoinformatics results
Is able to recognize and apply new problem-solving methods and procedures in his / her field and apply what he / she has learned in a diverse, multidisciplinary environment.
c) attitude
He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
d) autonomy and responsibility
In the operation of geoinformatics systems, he / she can be assigned development-operational responsibility in accordance with professional competencies.

Course description:

The subject is based on the development of specific commercial (e.g. AutoCad MAP-Api) and open source (e.g. QGIS) environments - from the view of GIS, through the data collection, processing, visualization and analysis. We put special emphasis on the possibilities of automating data collection and mapping. We also look at the algorithmizing capabilities of GIS operations in these environments.
Practical knowledge:
Due to the nature of the course, students get to know the modern technologies of GIS application development through practice-oriented, 7 complex mid-year tasks (application development), presenting them in a project-oriented way.

Literature

Gary Sherman(2014):The PyQGIS Programmer's Guide - Extending QGIS with Python
Gary Sherman(2014):The PyQGIS Programmer's Guide - Extending QGIS with Python 0989421724
Kurt Menke (2019): Discover QGIS 3.x A workbook for Classroom or Independent Study 099854776X
Reinaldo N Togores (2019): AutoCAD Expert's Visual LISP 1722376570

<table>
<tr><td colspan="2">Name:

Spatial Databases</td><td>NEPTUN-code:
AGXTADEMNF
AGXTADEMLF</td><td>Number of periods/week:
full-time: 2 lec + 2 lab
correspondent: 10 lec + 10 lab</td></tr>
<tr><td colspan="2">Credit: 5
Requirement: midterm mark</td><td colspan="2">Prerequisite: Data integration (AGXAINEMNF, AGXAINEMLF), Data science (AGXADIEMNF, AGXADIEMLF)</td></tr>
<tr><td>Responsible:
Prof. András MOLNÁR</td><td>Position:
professor</td><td colspan="2">Faculty and Institute name:
John von Nuemann Faculty of Informatics
Institute of Cyberphysical Systems</td></tr>
<tr><td colspan="4">Way of assessment:
exercises and tests</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) knowledge: Has complex knowledge of general geographic, cartographic, planning, mathematical and IT principles, rules, contexts required for cultivating the field of geoinformatics, especially in the following topics: geographical, spatial data collection, use of cartographic procedures, knowledge of geographical and spatial processes, collection, editing and analysis of spatial data, remote sensing, photogrammetry, geostatistics, modeling, visualization, geoinformatics system construction.
b) abilities: Able to interpret complex professional problems in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve problems.
c) attitude: He / she monitors professional, technological developments and labor market trends related to his / her professional qualifications, the field of geoinformatics.
Open and committed to critical feedback and evaluation based on self-examination.
d) autonomy and responsibility: He / she feels responsibility to meet deadlines. He / she is responsible for the work of his / her own staff and those working with him / her or with him / her (working on a project).</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">Databases suitable for storing spatial (spatial) data. Relational databases storing geospatial data according to the OGC 06-104 standard and their management based on SQL (PostGIS, SpatiaLite). Solving complex spatial analysis tasks with SQL queries using the spatial functions provided by the standard. Definition of topological relationship using DE-9IM. Management of spatial data reference system. Spatial data storage by mapping a topological model to a relational database.
Data storage in KML, GML and GeoPackage formats. The role, operation and practical application of spatial indexes. OGC's protocols enabling spatial data and services to be accessed via the network (WMS, WFS, etc.).
On exercises: Design and creation of spatial databases. Uploading spatial data to spatial databases. Spatial queries.</td></tr>
<tr><td colspan="4">References</td></tr>
<tr><td colspan="4">OGC 06-104 („OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option”), ISBN: 978-613-2-04665-9
OGC 07-36 („OpenGIS Geography Markup Language (GML) Encoding Standard”), ISBN: 978-613-2-04665-9
Nagy Gábor: Spatial Databases by Open Standards and Software, NymE-GEO, Székesfehérvár, 2010
PostGIS manual (http://postgis.net/documentation/)</td></tr>
</table>

Name: **Digital terrain modeling**		***NEPTUN-code:*** AGXDIGEMNF AGXDIGEMLF	***Number of periods/week:*** full-time: 1 lec + sem + 2 lab correspondence: 5 lec + sem + 10 lab
Credit: 4 ***Requirement:*** midterm mark		***Prerequisite:*** Geomatemathics and geostatistics AGXGEGEMNF, AGXGEGEMLF	
Responsible: Andrea PŐDÖR, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	

Way of assessment:

- presenting theoretical knowledge with practical examples and repeating the examples as independent work

Competences

a) knowledge

- Knows a comprehensive theoretical knowledge of digital spatial modelling.
- Knowledge of data collection technologies, model types and their advantages and disadvantages.
- Knows the information and products that can be derived from the models.
- Knows the different visualisation options.

b) abilities

- Ability to apply theoretical knowledge in practice, such as: choosing the right data collection technology and model type, visualising the model, extracting information, collaborating with other domain experts and decision makers.

c) attitude

- The training takes into account state-of-the-art technological tools and methods in the field, open to feedback and evaluation.
- Ability to cooperate and a strong emphasis on environmental awareness.
- The quality of the training provided is an indicator of the quality required in the professional field.

d) autonomy and responsibility

- The geoinformatics specialist is able to perform complex, engineering tasks and strives for innovation.
- Demanding, responsible, capable of performing managerial tasks.

Course description:

During the lectures, students will get acquainted with the theoretical background and technologies of digital topography and surface modelling, based on their topographic knowledge, and with the modern data acquisition possibilities that can be used for modelling.
The achievable accuracy of different data acquisition methods will be analyzed to evaluate that a certain accuracy in which specific field such as industrial engineering, field survey. agricultural use, inland water and flood risk management can be applied.
During the practice students will gain knowledge about the usage of open source and commercial software (QGIS, SURFER) in processing low- and high-resolution data files. The students will learn about the advantages, disadvantages of different model types and about the derived product such as slope, aspect, hill shade, watershed delimitation.

Literature

Naser El-Sheimy, Caterina Valeo, Ayman Habib: Digital Terrain Modeling - Acquisition, Manipulation and Applications, 2005 ISBN 1-58053-921-1
Zhilin Li, Qing Zhu, Christopher Gold: Digital terrain modeling – Principles and Methodology, CRC Press, 2005, ISBN: 0-415-32462-9
Michael J de Smith - Michale F Goodchild – Paul A Lanley: Geospatial Analysis - 6th edition, 2018 - Immediate download. 602 pages, 26Mbytes https://www.spatialanalysisonline.com/HTML/index.html

Optional subjects

Name: **GIS application development**		*NEPTUN-code:* AGVGALEMNF AGVGALEMLF	*Number of periods/week:* full-time: 1 lec + sem + 2 lab correspondence: 5 lec + sem + 10 lab
Credit: 3 ***Requirement:*** midterm mark		***Prerequisite:*** -	
Responsible: Gábor MOLNÁR, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: - mid-term tests			
Competences			
a) knowledge: Complex knowledge in the following areas: Mathematical background of geodetic measurements, map projections, geodetic datums and least squares adjustment. b) abilities: Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of geomatics in their native language and in English. Able to work with decision makers. c) attitude: He / she monitors professional, technological developments and labor market trends related to geomatics. Throughout his field activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior and to support sustainable development. d) autonomy and responsibility: With his geomatics knowledge and skills, he / she collaborates responsibly with experts in other fields.			
Course description:			
Providing theoretical and practical knowledge to develop thinking in system. To introduce system development as a special form of problem solving. Introduce students to the need for methodically. Introduce and apply different methods and methodologies of system design. Introduce the design of systems with the help of the available CASE tool. During the exercise, after learning about some processing software, student will be given the task of creating his/her own software or software module as a project. Both the formulation of the task and its implementation require, - in addition to general application development skills, - the use of specific GIS methods, modules and function libraries. The project task also includes the documentation of the application.			
Literature			
Grafarend, E.W., Krumm, F.W.: Map projections, Springer-Verlag Berlin Heidelberg, 2006. Charles K. Chui, Guanrong Chen: Kalman Filtering with Real-Time Applications, Springer, 2009. ISBN: 978-3-642-36494-5 Mikhail E.M. Observations and least squares, 1976. ISBN: 0700224815			

<table>
<tr><td colspan="2">Name:

Geovisualisation</td><td>NEPTUN-code:
AGVGVIEMNF
AGVGVIEMLF</td><td>Number of periods/week:
full-time: 1 lec + sem + 2 lab
correspondence: 5 lec + sem + 10 lab</td></tr>
<tr><td colspan="2">Credit: 3
Requirement: midterm mark</td><td colspan="2">Prerequisite:</td></tr>
<tr><td>Responsible:
Andrea PŐDŐR, PhD.</td><td>Position:
associate professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Geoinformatics</td></tr>
<tr><td colspan="4">Way of assessment:
- fulfillment of midterm project</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) knowledge: Knowledge and ability to use geovisualization methods and technologies, Comprehensive knowledge and understanding of the contexts and concepts of geovisualization. Know the possible applications of different visualization tools, the possibility of misinterpretation due to improper representation
b) abilities Ability to create a geovisualisation to support decision-makers. Ability to perform problem-solving, planning, development, operation, management and consulting tasks with the appropriate application of geovisualization. Ability to initiate collaboration, project work and group work with experts in co-sciences and other related fields
c) attitude: Continuous monitoring of the field of geovisualisation to be able to apply new technologies, as well to evaluate the possible application field of its
d) autonomy and responsibility: Independence in elaboration and processes in the field of geovisualisation. Applying the proper geovisualisation methods the students will be able to adequately collaborate with other experts</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">The aim of the course is that student understand the definition of geovisualization, to be able to distinguish between different ways of geovisualization. The students will acquire knowledge in the following domains: use and user issues in geovisualization; Geovisualization, exploration, and insight; Dynamic interface design; Multimedia visualization; Visual perception and cognition. Principles of interaction, Web-based geovisualization platforms.
They will be able to create visualizations using and combining spatial and non-spatial data; analyze and categorize available techniques in terms of quality, efficiency, and suitability for a particular data type,analyze and process geodata within a geovisualization context;
In the context of this course, students will interpret the theoretical material through practical examples using specific commercial (e.g. ArcGIS, Tableau) and open source (R,) software modules built in.</td></tr>
<tr><td colspan="4">Literature</td></tr>
<tr><td colspan="4">Dykes, J., MacEachren, A. M., & Kraak, M. J., (Eds.), (2004). Exploring geovisualization. Amsterdam: Elsevier. ISBN: 9780080531472
Slocum, T. A., McMaster, R. B., Kessler, F. C., & Howard, H. H. (2009). Thematic cartography and geovisualization ISBN 9781003150527
Smith, M. J., Hillier, J. K., Otto, J. C., & Geilhausen, M. (2013). Geovisualization. In Treatise on Geomorphology (Vol. 3, pp. 299-325). Elsevier Inc.. https://doi.org/10.1016/B978-0-12-374739-6.00054-3</td></tr>
</table>

<table>
<tr><td colspan="2">Name:

Modern GIS instruments</td><td>NEPTUN-code:
AGVKGMEMNF
AGVKGMEMLF</td><td>Number of periods/week:
full-time: 1 lec + 2 lab
correspondence: 5 lec + 10 lab</td></tr>
<tr><td colspan="2">Credit: 3
Requirement: mid-year grade</td><td colspan="2">Prerequisite:
-</td></tr>
<tr><td>Responsible:
Prof. Dr. György GYÖRÖK</td><td>Position:
Professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Engineering</td></tr>
<tr><td colspan="4">Way of assessment:
Each student is given a project task. Document it, present the working tool.</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) Knowledge: theoretical overview of the most common solutions of sensors, actuators, microcontrollers used in geoinformatics, their practical application, applicability in the context of laboratory exercises.
b) Skills: Ability to understand the technical terminology used in the context of geodetic instrumentation, used as parameters, configuration, measurement.
c) Attitude: be sensitive to technical solutions, their evolution, new technologies used in embedded informatics, in their field of expertise.
d) Autonomy and responsibility: through his/her specialised engineering knowledge, he/she will be an excellent applicator and an empathetic and understanding professional.</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">The instruments, stations and equipment used in geodesy employ electronic, optical, mechanical and informatics solutions, the understanding of which is important for the users of the equipment in relation to the measurement and calibration tasks, possibilities and limitations. All of this equipment has strong embedded IT and info conformance support.
In the context of optical sensors, we will learn about CCD, CMOS, PIN, and LED, LLED light sources, the possibilities and application criteria of their electronics, the coincidence principle, moire phenomenon. We will learn about MEMS based position, velocity and acceleration sensors, various temperature measurement techniques.
For actuator side processes, we will learn about the different processes used for position control, such as motors, electrostatic and electrodynamic (MEMS) devices, their possibilities, control criteria, system integration solutions. We will learn about position and displacement control principles, their electronic solutions at block diagram level.
We will cover analog and digital circuit principles, a concrete microcontroller (MC), its elementary programming steps, the most commonly used algorithmic, digital solutions.
In the framework of the course, the students will be introduced to measurement, control, regulation, principles, concepts and solutions with an interdisciplinary approach (where necessary, supplemented by physical and optical knowledge), supported by a practical laboratory environment.</td></tr>
<tr><td colspan="4">Literature</td></tr>
<tr><td colspan="4">Selected chapters;
Dr. Györök György, Számítógép perifériák I. Budapest, Magyarország : Óbudai Egyetem (2013), ISBN: 9786155018572 Dr. Györök György, Számítógép perifériák II. Budapest, Magyarország : Óbudai Egyetem (2015), ISBN: 9786155460517
Jörg Haus, Optical Sensors: Basics and Applications, John Wiley & Sons, 2010.
Han-Way Huang: PIC Microcontroller: An Introduction to Software and Hardware Interfacing, Microchip, 2005</td></tr>
</table>

Name: **Web mapping workshop**		*NEPTUN-code:* AGVWTMEMNF AGVWTMEMLF	*Number of periods/week:* full-time:1 lec + 2 lab correspondence: 5 lec + 10 lab
Credit: 3 ***Requirement:*** mid-term mark		***Prerequisite:***	
Responsible: Andrea PŐDÖR, PHD	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	

Way of assessment:

- Participation in the exercises is mandatory, the mid-year assignments must be processed and submitted in a suitable quality by the specified deadline, and literature processing must be completed.

Competences

a)Knowledge:- He/she knows the knowledge acquisition and problem-solving methods of surveying.
- He/she has a comprehensive knowledge of the available GIS and professional data processing software applications
- He/she has adequate foreign language skills to practice the profession.
b)Abilities: - He/she is capable of planning and implementing geographic information systems (spatial information systems), as well as collecting, storing, analyzing, managing, displaying and distributing related data.
- He/she is able to manage and use spatial data related to changes in natural resources and the social environment in the planning of urban development, rural development and regional development.
c)Attitude:- He/she strives for decision-making that takes into account legislation and professional ethical standards even in unexpected decision-making situations that require a complex approach.
d)Autonomy and responsibility:- He/she uses the data received from the associated professions in the design and construction work process.
- He/she possesses the communication skills and sense of responsibility necessary for professional and interprofessional cooperation.

Course description:

Overview of different web applications. And based on these, creating your own application in exercises. Familiarity with ArcGIS Online and QGIS cloud platform. Creation of thematic web maps:
• Geography
• geology
• climate change
• population
• financial
• in environmental topics
Making your own Story Maps based on samples.
Creating a QGIS Online map.

References

Obligatory:
Notes and additional course materials published in the Moodle system
1. Introducing ArcGIS Online, 2012, Esri
2. QGIS Cloud documentation, 2016, Sourcepole AG
3. Story Maps, 2016, ESRI

Name: **Digital image processing in photogrammetry**		***NEPTUN-code:*** AGVDKFEMNF AGVDKFEMLF	***Number of periods/week:*** full-time: 1 lec + sem + 2 lab correspondence: 5 lec + sem + 10 lab
Credit: 3 ***Requirement:*** midterm mark		***Prerequisite:*** -	
Responsible: Tamás JANCSÓ, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: - preparing two essays on two complex project assignments during the semester.			
Competences			
a) knowledge: Complex knowledge in the following areas: collection, editing and analysis of spatial data, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems. Primary and secondary data collection, 3-dimensional modeling, development of spatial services. b) abilities: Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of technology in their native language and in English. Able to work with decision makers. c) attitude: He / she monitors professional, technological developments and labor market trends related to technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools. d) autonomy and responsibility: With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.			
Course description:			
The aim of the course is to acquaint students with the basics and methods of digital image processing. During the course, students will get an overview of the following topics: digital (commercial and open source) image processing programs and software packages, using OpenCV, digital image properties, compression methods, histogram generation, histogram transformations, calculation of image properties and its parameters, image filtering procedures, geometric transformations , interpolation methods, shape detection, segmentation, automated recognition of characteristic points, edges, shapes, image correlation. Through application examples, state-of-the-art technologies for image processing products and evaluation methods are presented in a project-oriented way, primarily from a practical point of view. The topic of the two complex exercises is: 1. basic operations of digital image processing, 2. automated recognition of shapes.			
Literature			
R.C. Gonzales, R.E. Woods: Digital Image Processing, Pearson; 4th Edition (2017), ISBN-13 : 978-0133356724 Chris Solomon: Fundamentals of Digital Image Processing, John Wiley & Sons (2010), ISBN: 0470844736			

<table>
<tr><td colspan="2">Name:

Rural development in EU</td><td>NEPTUN-code:
AGVVFEEMNF
AGVVFEEMLF</td><td>Number of periods/week:
full-time: 1 lec + 2 lab
correspondence: 5 lec + 10 lab</td></tr>
<tr><td colspan="2">Credit: 3
Requirement: midterm mark</td><td colspan="2">Prerequisite:</td></tr>
<tr><td>Responsible:
Dr Péter Udvardy</td><td>Position:
associate professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Geoinformatics</td></tr>
<tr><td colspan="4">Way of assessment:
- technical descriptions, preparation of two essays on two complex project tasks during the semester.
- mid-term tests</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) his knowledge: He has complex knowledge of the general geographical, cartographic, planning, mathematical and IT principles, rules and correlations necessary for cultivating the field of rural development science, he knows the current theories, models and literature of geoinformatics science based on scientific results.
b) abilities: Able to interpret complex professional problems arising in the field of geoinformatics, to explore the necessary theoretical and practical background and to solve the problems. Capable of designing value-added services, especially land observation.
c) his attitude: He monitors the professional and technological development related to his professional qualification, the field of rural development, and labor market trends. Open and committed to critical feedback and evaluation based on introspection. He shares his knowledge and considers it important to convey professional results.
d) autonomy and responsibility: Independent in thinking and developing professional issues and processes in the field of rural development. With his knowledge and skills, he cooperates responsibly with professionals from other fields.</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">The purpose of the subject is to introduce students to the concepts related to rural and regional development, to shed light on regional differences, and to explain their causes, the needs and possibilities of development. Another goal is to present the different rural development policies, plans and programs and to describe the rural development aspects of the Common Agricultural Policy.
EU knowledge, common agricultural policy, agricultural production, forestry, wildlife management, rural development target areas, rural development programs.
Rural development - regional development: common points, differences.
In addition to the theoretical foundations, the subject also presents concrete practical rural development models and success stories.</td></tr>
<tr><td colspan="4">Literature</td></tr>
<tr><td colspan="4">Udvardy Péter: Rural development. Óbudai Egyetem, Budapest, Magyarország, ISBN 978-963-449-125-5
Dorgai László: Vidék- és területfejlesztés TÁMOP jegyzet, 2011. https://dtk.tankonyvtar.hu/xmlui/handle/123456789/7588
http://www.erdn.euMartin van Maarseveen (Editor), Javier Martinez (Editor), Johannes Flacke (Editor): GIS in Sustainable Urban Planning and Management: A Global Perspective 1st Edition, ISBN-13: 978-1138505551</td></tr>
</table>

<table>
<tr><td colspan="2">Name:

Urban Analytics</td><td>NEPTUN-code:
AGVVTEEMNF
AGVVTEEMLF</td><td>Number of periods/week:
full-time: 1 lec + sem + 2 lab
correspondence: 5 lec + sem + 10 lab</td></tr>
<tr><td colspan="2">Credit: 3
Requirement: midterm mark</td><td colspan="2">Prerequisite:</td></tr>
<tr><td>Responsible:
Andrea PŐDŐR, PhD.</td><td>Position:
associate professor</td><td colspan="2">Faculty and Institute name:
Alba Regia Technical Faculty
Institute of Geoinformatics</td></tr>
<tr><td colspan="4">Way of assessment:
- fulfillment of midterm project</td></tr>
<tr><td colspan="4">Competences</td></tr>
<tr><td colspan="4">a) knowledge: Students will know and use urban analytics methods and technologies, available databases and GIS software, and open source and commercial geoinformatics software. They will have comprehensive knowledge and understanding of the most important contexts and concepts in the field of urban analytics. They will be able to properly interpret and evaluate the results obtained during GIS analyzes. They understand the requirements for planning field data collection and sampling.
b) abilities They will be able to create analyzes to support and assist decision-makers. They will be able to perform problem-solving, planning, development, operation, management, and consulting tasks with the proper interpretation of the results of urban analytics. They will be able to initiate collaboration, project work and group work with experts in other related fields.
c) attitude: -hey will pay attention to professional, technological developments and labor market trends related to urban analytics. Throughout their field and laboratory activities, they are committed to environmentally friendly behavior. They will share their knowledge and consider it’s important to transmit professional results. They will be open to professional cooperation with professionals working in related fields.
d) autonomy and responsibility: Using the methods of urban analytics, the students collaborate responsibly with professionals in other fields. They will be able autonomously to evaluate questions and processes in the field of urban analytics.</td></tr>
<tr><td colspan="4">Course description:</td></tr>
<tr><td colspan="4">The aim of the course is to introduce Urban Analytics to students. The student will gain a comprehensive knowledge of the special areas of urban GIS:
They get acquainted with sensor networks, processing and analyzing the data obtained from them. One of the main tasks is to properly understand and acquire data the integration of like weather, population statistics etc. Students will design and implement crowdsourcing procedures. They will examine the quality and reliability of the data obtained with crowdsourcing, compare them with official data, Analyze the possibilities of data integration. The main task of the students will be to integrate the official data of a sample area and the data obtained through community data acquisition and to analyze them with the most accepted methods of spatial statistics.
Within the course, built-in modules of specific commercial (e.g. ArcGIS) and open source (GeoDA, R,) software are used</td></tr>
<tr><td colspan="4">Literature</td></tr>
<tr><td colspan="4">Singleton, Alex, Spielman, Seth E., Folch, David C. 2018. Urban Analytics. Thousand Oaks, CA: SAGE Publications Ltd. ISBN-13: 978-1473958630
Ripley, B.D., 1981. Spatial statistics. John Wiley & Sons, New York. ISBN:9780471083672</td></tr>
</table>

Name: **Land valuation on the basis of GIS**		***NEPTUN-code:*** AGVFTAEMNF AGVFTAEMLF	***Number of periods/week:*** full-time: 1 lec + 2 lab correspondence: 5 lec + 10 lab
Credit: 3 ***Requirement:*** midterm mark		***Prerequisite:***	
Responsible: János KATONA, PhD.	***Position:*** associate professor	***Faculty and Institute name:*** Alba Regia Technical Faculty Institute of Geoinformatics	
Way of assessment: - preparation and presentation of a valuation report			
Competences			
a) knowledge: Complex knowledge in the following areas: collection, editing and analysis of spatial data, 2- and 3-dimensional GIS modeling, digital image processing, applied GIS systems. Primary and secondary data collection, 3-dimensional modeling, development of spatial services. b) abilities: Able to creatively and methodically process, evaluate, interpret, analyze measurement conclusions and draw conclusions from them. Able to use the professional vocabulary of UAV technology in their native language and in English. Able to work with decision makers. c) attitude: He / she monitors professional, technological developments and labor market trends related to UAV technology. Throughout his field and laboratory activities, he / she is committed to environmentally conscious behavior. He / she considers it important to mediate environmentally conscious behavior, to support sustainable development and to help it with aerial photogrammetry tools. d) autonomy and responsibility: With his geoinformatics knowledge and skills, he / she collaborates responsibly with experts in other fields.			
Course description:			
Presentation of the peculiarities of the agricultural land market. Possible objectives of land valuation. Methods of land valuation. Description of the requirements of international standards. Content and form requirements of the expert opinion. Evaluation of arable land by market comparison. Land valuation with yield calculation. Analysis of value-modifying factors on the basis of GIS: shape, form, area size, location, location, accessibility, road conditions, topography and slope conditions, order of waterways, objects inhibiting cultivation, probability of frost, ice, game damage, irrigation, irrigation, irrigation subsistence income conditions, demographic conditions, natural protection of land. Generate a value map. Acquisition of practical knowledge: In parallel with the theoretical knowledge, the real estate appraisal of a given arable land must be carried out in the practices of the course. At the end of the course, the completed expert opinion must be presented in the form of a presentation.			
Literature			
54/1997. (VIII. 1.) FM rendelet a termőföld hitelbiztosítéki értéke meghatározásának módszertani elveiről European Valuation Standards (EVS) - Európai Értékelési Szabványok, ISBN: 9789081906050 RICS Értékbecslési Szabványok (Royal Institution of Chartered Surveyors 2010) Recommended literature: E. Stylianidis, T. Roustanis, N. Karanikolas, A Geographical Information System for Real Estate (GEOVAL), Computer Science, 2009, ISBN: 978-3-540-87393-8			