AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Advanced Geoinformation Modelling

Academic year: 2019/2020 Code: ZSDA-3-0086-s ECTS credits: 2

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: Polski i Angielski Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: dr hab. inż, prof. AGH Cichociński Piotr (piotr.cichocinski@agh.edu.pl)

Module summary

The student learns specialized spatial and descriptive (attribute) databases. She processes and verifies data from various sources for feeding official and other databases, connects, enriches, changes formats, controls the quality of raw data. She automates the processes of spatial data analysis and processing, including the creation and application of geoinformation models. She visualizes (also in 3D) data and results of spatial analyses, including those changing over time.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	correctly identify and solve problems related to the acquisition, integration, processing and analysis of spatial data	SDA3A_K01	Execution of exercises, Execution of a project, Report, Oral answer, Test, Activity during classes
M_K002	maintain an ethical attitude while performing and presenting the results of assigned tasks	SDA3A_K03	Execution of exercises, Execution of a project, Report, Test, Activity during classes
Skills: he can			
M_U001	acquire, integrate, process and analyse data from specialised spatial and descriptive (attribute) databases and assess their quality	SDA3A_U07, SDA3A_U06, SDA3A_U01	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
M_U002	automate processes of spatial data analysis and processing, including the creation and application of geoinformation models	SDA3A_U07, SDA3A_U06, SDA3A_U01	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises

M_U003	visualize (also in 3D) data and results of spatial analyses, including those changing over time	SDA3A_U02, SDA3A_U03	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
Knowledge: he knows and understands			
M_W001	specialised spatial and descriptive (attribute) databases and their usability	SDA3A_W07, SDA3A_W04, SDA3A_W01	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
M_W002	methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time	SDA3A_W07, SDA3A_W04	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
M_W003	standards defining the formal basis for modelling and the description of the quality of geoinformation	SDA3A_W02, SDA3A_W07, SDA3A_W06, SDA3A_W01	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
M_W004	methods and techniques of integration and harmonization of spatial data	SDA3A_W07, SDA3A_W04	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises
M_W005	advanced methods and techniques of spatial data processing and analysis, including ways of their automation	SDA3A_W03, SDA3A_W02	Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
30	8	0	0	22	0	0	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes									
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												

M_K001	correctly identify and solve problems related to the acquisition, integration, processing and analysis of spatial data	-	-	-	+	-	-	-	-	-	-	-
M_K002	maintain an ethical attitude while performing and presenting the results of assigned tasks	-	-	-	+	-	-	-	-	-	-	-
Skills: he can												
M_U001	acquire, integrate, process and analyse data from specialised spatial and descriptive (attribute) databases and assess their quality	-	-	-	+	-	-	-	-	-	-	-
M_U002	automate processes of spatial data analysis and processing, including the creation and application of geoinformation models	-	-	-	+	-	-	-	-	-	-	-
M_U003	visualize (also in 3D) data and results of spatial analyses, including those changing over time	-	-	-	+	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	specialised spatial and descriptive (attribute) databases and their usability	+	-	-	+	-	-	-	-	-	-	-
M_W002	methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time	+	-	-	+	-	-	-	-	-	-	-
M_W003	standards defining the formal basis for modelling and the description of the quality of geoinformation	+	-	-	+	-	-	-	-	-	-	-
M_W004	methods and techniques of integration and harmonization of spatial data	+	-	-	+	-	-	-	-	-	-	-
M_W005	advanced methods and techniques of spatial data processing and analysis, including ways of their automation	+	-	-	+	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	6 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	6 h
Realization of independently performed tasks	6 h
Contact hours	2 h
Summary student workload	50 h
Module ECTS credits	2 ECTS

Additional information

Module content

Lectures

Standardization in the area of geographic information

Object of standardization. Advantages of standardization. Significant standardization organizations: ISO TC211, CEN TC287, PKN KT297. Demand for European standards: INSPIRE, ESDI. Review of adopted Polish Standards and important drafts of international standards: Reference model (ISO 19101), Spatial schema (ISO 19107), Spatial referencing by coordinates (ISO 19111).

Harmonization and exchange of spatial data

Basic concepts. Harmonization in the INSPIRE directive and in the act on spatial data infrastructure. Components of spatial data harmonization. Additional aspects of harmonization. Planning for harmonization. Searching for the optimal level of harmonization. Stages of harmonization. Spatial data exchange rules and standards (including GML, KML, GeoJSON). New business models: processing and verification of data from various sources in order to integrate them into official and other databases, combining, enrichment, changing formats, quality control of raw data.

Integration of spatial and non-spatial data

Censuses and other statistical data, spatial statistics. Table Joining Service (TJS) standard. Geocoding: definition, construction of an address locator, alias table, geocoding process, characteristics of possible errors and possibilities of their correction. Methods of visualizing three-dimensional data: extrusion of objects by a height value, 3D symbols. Animations of spatial data, including time-varying. The specificity of large, variable and diverse data sets (big data).

Metadata and quality of spatial data

Definition of metadata. The structure and content of metadata. Tools for creating and managing metadata. Rules for collecting and sharing metadata. Basics of spatial data quality description. Quality evaluation procedures.

Spatially enabled society (SES)

Information society. The needs of societies in the field of spatial information. The role and tasks of real estate management: cadastre and land registry, real estate appraisal, spatial planning. Essential elements enabling the implementation of the SES

vision: legal basis, integration of data from various sources, infrastructure allowing for precise location, spatial data infrastructure, information about land ownership, the possibility of free re-use of data.

Project classes

Visualization of three-dimensional and time-varying data

Extrusion of objects by a height value, 3D symbols. Ways of creating animations for previously prepared visualization. Creating animation of the time layer, playing the animation, creating animations of data presented in the chart.

Automation in geographic information systems

Creating one's own tools: adding a toolbox, adding, editing, setting parameters and running the script. Building the analysis model, determining the model parameters, launching the model from the dialog.

Exchange and harmonization of spatial data

Automation of the process of changing data structures, their harmonization and integration in spatial data warehouses. Understanding mechanisms that enable combining data from different sources, stored in different formats and coordinate systems into one coherent data set. The use of ETL tools. Processing of large, variable and diverse data sets (big data).

Individual project

Individual formulation of the problem and implementation of a complex GIS project including the acquisition, evaluation and harmonization of data, carrying out selected spatial analyses using data processing automation methods and the presentation of results.

Teaching methods and techniques:

Lectures: The content presented at the lecture is communicated in the form of a multimedia presentation in combination with a classic blackboard lecture enriched with demonstrations related to the presented topics.
Project classes: Students prepare the project on their own, without much intervention of the teacher. This is to develop a sense of responsibility for teamwork and responsibility for decisions made.

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

1. Active participation and positive results of current checking whether the assumed learning outcomes have been achieved by the student are the basis for passing the course.
2. Participation in classes is obligatory. A maximum of two unexcused absences per semester is allowed. A justification for absence may be health reasons (confirmed by medical exemption) or other important reasons recognized by the person conducting the exercise. The student is obliged to justify absence at the first class after the cause of absence has ceased. Exceeding the threshold of 20% of unexcused absences results in the lack of the possibility to pass the course.
3. In exceptional cases, a student who has exceeded the above-mentioned limits for important random reasons or because of a documented long-term illness may obtain the teacher's consent to pass the course.
4. The program of the course includes 5-6 exercises (or 2-3 projects) and 1-2 tests every semester. All topics / projects and tests must be passed.
5. The ongoing control of learning outcomes is based on: checking exercises / projects systematically submitted by students (on a computer screen or in the form of a write-up), verifying the knowledge of issues covered by a given exercises (a student may be asked to explain / present how to implement the task), conducting practical test at the computer and written tests of theoretical knowledge.
6. Student can become acquainted with detailed results of the evaluation of written work (exercises,

projects, tests) only in person at the teacher.
7. The student should keep files created as a result of the implementation of exercises / projects until passing the course.
8. Detected lack of independence of the student's work or use of unauthorized materials results in failing grade (2.0) in the nearest term of passing. In addition, detected cases of plagiarism will be reported to the dean's authorities.
9. The possibility of using auxiliary materials is determined by the teacher for each test. During tests it is forbidden to use devices that allow the registration, storage and playback of texts or images, in particular mobile phones.
10. An unexcused absence from the test results in obtaining "nb".
11. The student is obliged to correct the test, from which she obtained a failing grade (2.0). It is not possible to correct positively passed test.
12. Passing the course is made on the basis of control of learning outcomes during the semester and should be made no later than on the last day of the semester in which the classes are conducted (Deadline 1). The grade is a weighted average of the grades from tests (weight 0.6) and grades for completed exercises / projects (weight 0.4). Failure to pass the course within the prescribed period results in obtaining the failing grade (2.0). Two additional deadlines are set: Deadline 2 – until the end of the basic session, Deadline 3 – until the end of the re-sit session.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: No
– Participation rules in classes: Students participate in classes learning new content according to the syllabus of the course. Students should ask questions and clarify doubts on an ongoing basis. Audiovisual registration of a lecture requires the consent of the lecturer.
Project classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Students carry out practical work in order to acquire the competences assumed by the syllabus. The way the project is carried out and the final result are evaluated.

Method of calculating the final grade

FG = P
where:
P – grade from project classes (arithmetic mean of all deadlines; if the grade of at least one deadline is positive, then P>=3.0)

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Compensation of backlogs resulting from the student's absence from the classes consists in participation in classes with another group (as far as free computers are available) or through the individual implementation of the tasks to be performed on these classes.

Prerequisites and additional requirements

Basic knowledge of geographic information systems (GIS). Basic knowledge of English.

Recommended literature and teaching resources

1. Bielecka E. Systemy informacji geograficznej. Teoria i zastosowania. Wydawnictwo PJWSTK, Warszawa 2006.
2. Eckes K. Modele i analizy w systemach informacji przestrzennej. AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2006.
3. Future Trends in geospatial information management: the five to ten year vision, Second Edition December 2015. http://ggim.un.org/knowledgebase/Attachment1311.aspx?AttachmentType=1
4. Handbook on Geospatial Infrastructure in Support of Census Activities, United Nations Publications, Sales No. E.09.XVIII.8, 2009. http://ggim.un.org/knowledgebase/Attachment218.aspx?AttachmentType=1
5. Kraak M.-J., Ormeling F. Kartografia – wizualizacja danych przestrzennych. PWN, Warszawa 1998.
6. Litwin L., Myrda G. Systemy informacji geograficznej : zarządzanie danymi przestrzennymi w GIS,

SIP, SIT, LIS. Wydawnictwo Helion, Gliwice 2005.
7. Litwin L., Rossa M. Metadane geoinformacyjne w INSPIRE i SDI : Zrozumieć. Edytować. Publikować. Wydawnictwo ApropoGEO, Gliwice 2010.
8. Longley P.A., Goodchild M.F., Maguire D.J., Rhin D.W. GIS. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa 2006.
9. Medyńska-Gulij B. Kartografia i geowizualizacja, Wydawnictwa Naukowe PWN, Warszawa 2012.
10. Ratajski L. Metodyka kartografii społeczno-gospodarczej. PPWK, Warszawa 1989.
11. de Smith M.J., Goodchild M.F., Longley P.A. Geospatial Analysis – A Comprehensive Guide to Principles, Techniques and Software Tools 3rd edition, Web version. http://www.spatialanalysisonline.com/output/
12. Specyfikacje Open Geospatial Consortium (OGC). http://www.opengeospatial.org/standards
13. Steudler D., Rajabifard A. Spatially Enabled Society. FIG Report 2012. http://fig.net/pub/figpub/pub58/figpub58.pdf
14. Tomlinson R. Rozważania o GIS. Planowanie Systemów Informacji Geograficznej dla menadżerów. ESRI Polska, Warszawa 2008.
15. Zeiler M. Modeling Our World. The ESRI Guide to Geodatabase Design. ESRI Press, Redlands 1999.

Scientific publications of module course instructors related to the topic of the module

1. Cichociński P.: Problem opisu jakości danych w Systemach Informacji o Terenie (na przykładzie katastralnej bazy danych)(Problem of the data quality description in Land Information Systems (on the example of cadastral database)). Polskie Towarzystwo Informacji Przestrzennej. VI Konferencja Naukowo – Techniczna Systemy Informacji Przestrzennej. Warszawa, 18-19 czerwca 1996 r.
2. Cichociński P.: Metadane – sposób na dokumentowanie cyfrowych danych przestrzennych (Metadata – the means of digital spatial data documentation). Polskie Towarzystwo Informacji Przestrzennej. VII Konferencja Naukowo – Techniczna Systemy Informacji Przestrzennej. Warszawa, 4-5 czerwca 1997 r.
3. Cichociński P., Janik J.: Warstwa tematyczna sieci dróg jako układ odniesienia dla rejestracji obiektów i zdarzeń w systemach informacji przestrzennej (Thematic layer of the road network as a reference system for the registration of objects and events in spatial information systems). Polskie Towarzystwo Informacji Przestrzennej. VIII Konferencja Naukowo – Techniczna Systemy Informacji Przestrzennej. Warszawa, 19-21 maja 1998 r.
4. Cichociński P.: Język XML i jego implementacje dla danych przestrzennych (XML language and its implementations for spatial data). XI Konferencja Naukowo – Techniczna Systemy Informacji Przestrzennej. Warszawa, 28-30 maja 2001 r.
5. Cichociński P.: Modelowanie dostępności komunikacyjnej nieruchomości jako atrybutu niezbędnego w procesie wyceny (Modelling of real estates communication accessibility as an attribute essential in the valuation process). Roczniki Geomatyki 2006, tom IV, zeszyt 3, s. 71-80. Warszawa 2006.
6. Cichociński P., Dębińska E.: Conceptual modelling of real estates for the purposes of mass appraisal. Proceedings of FIG Working Week 2007, 13-17 May 2007, Hong Kong SAR, China.
7. Cichociński P.: Zastosowanie metod kartograficznych i geostatystycznych do wstępnej analizy rynku nieruchomości (Application of cartographical and geostatistical methods for preliminary analysis of real estate market). Studia i materiały Towarzystwa Naukowego Nieruchomości, volume 15, number 3-4, s. 155-166. Olsztyn 2007.
8. Śliż I., Cichociński P.: GML – A Real Standard? Proceedings of FIG Working Week 2009 in Eilat, Israel, 3-8 May 2009.
9. Cichociński P.: Ocena możliwości automatyzacji procesu wyznaczania atrybutów nieruchomości dla potrzeb wyceny (Analysis of the automatisation possibility of real estate attributes determination for the purposes of valuation). Studia i materiały Towarzystwa Naukowego Nieruchomości, volume 17, number 2, s. 65-76. Olsztyn 2009.
10. Bydłosz J., Cichociński P., Dębińska E.: Modelowanie baz danych o nieruchomościach (The modelling of real estate databases). Archiwum Fotogrametrii, Kartografii i Teledetekcji 2009, vol. 19, s. 35–46.
11. Cichociński P.: Próba zastosowania metod geostatystycznych do taksacji nieruchomości (An attempt to apply geostatistical methods to real estate valuation). Roczniki Geomatyki 2009, tom VII, zeszyt 4, s. 17-24. Warszawa 2009.
12. Cichociński P.: Metadane i jakość danych w systemach informacji geograficznej (Metadata and data quality in geographic information systems). III Krajowa Konferencja Naukowa „Technologie Przetwarzania Danych”. Materiały konferencyjne. Poznań, 21-23 czerwca 2010 r. WNT, Warszawa 2010.
13. Basista I., Bydłosz J., Cichociński P.: Przykłady wykorzystania języka GML przy udostępnianiu polskich zasobów geoinformacyjnych. (Some examples of using GML for the exchange of polish geoinformation resources). Roczniki Geomatyki 2010, tom VIII, zeszyt 5, s. 31-41. Warszawa 2010.
14. Cichociński P.: Porównanie metod interpolacji przestrzennej w odniesieniu do wartości nieruchomości (Comparison of spatial interpolation methods for real estate values). Studia i Materiały

Towarzystwa Naukowego Nieruchomości 2011, vol. 19, nr 3, s. 120–132.
15. Cichociński P.: Zastosowanie techniki GPS oraz funkcji analiz sieciowych oprogramowania GIS do optymalizacji ruchu drogowego w miastach (Application of GPS technology and network analysis functions of GIS software for optimization of city traffic). Geomatyka i Inżynieria : kwartalnik naukowy Państwowej Wyższej Szkoły Techniczno-Ekonomicznej w Jarosławiu 2011 nr 1 s. 13–25.
16. Cichociński P.: How to Calculate Real Estate Accessibility. Proceedings of FIG Working Week 2012 in Rome, Italy, 6-10 May 2012.
17. Cichociński P.: Analizy sieciowe w środowisku baz danych przestrzennych (Network analysis in spatial databases). Studia Informatica, vol. 33, no. 2B, s. 131–143. Gliwice 2012.
18. Cichociński P., Dębińska E.: Badanie dostępności komunikacyjnej wybranej lokalizacji z wykorzystaniem funkcji analiz sieciowych (Accessibility study of a selected location using network analysis functions). Roczniki Geomatyki 2012, tom X, zeszyt 4, s. 41-48. Warszawa 2012.
19. Cichociński P.: Ocena przydatności OpenStreetMap jako źródła danych dla analiz sieciowych (Assessment of OpenStreetMap suitability as a data source for network analysis). Roczniki Geomatyki 2012, tom X, zeszyt 7, s. 15-24. Warszawa 2012.
20. Dębińska E., Cichociński P.: The application of multimodal network for the modeling of movement in public transport. 13th International Multidisciplinary Scientific GeoConference. GeoConference on Informatics, Geoinformatics and Remote Sensing. Conference Proceedings Volume I, pp. 559-563. 16-22, June, 2013. Albena, Bulgaria.
21. Cichociński P., Basista E.: The comparison of spatial interpolation methods in application to the construction of digital terrain models. 13th International Multidisciplinary Scientific GeoConference. GeoConference on Informatics, Geoinformatics and Remote Sensing. Conference Proceedings Volume I, pp. 959-966. 16-22, June, 2013. Albena, Bulgaria.
22. Cichociński P.: A proposal of an algorithm for linking address points and numbering ranges with lines representing streets. W: Źróbek R, Kereković D. (red.) GIS and its implementations, pp. 65-74. Zagrzeb, Chorwacja 2013.
23. Cichociński P.: Propozycja geoportalu dla przestrzenno-czasowych danych statystycznych (A proposal of a geo-portal for spatio-temporal statistical data). Roczniki Geomatyki 2013, Tom XI, Zeszyt 1(58), s. 35-44. Warszawa 2013.
24. Cichociński P., Jurczyszyn D., Kochan M.: Proposal of data source and method for creating 3D models of buildings. Proceedings of the 9th International Conference Environmental Engineering. May 22–23, 2014, Vilnius, Lithuania.
25. Cichociński P.: Problematyka geokodowania zdarzeń drogowych (Problems of road accidents geocoding). Roczniki Geomatyki 2014, Tom XII, Zeszyt 2(64), s. 205-216. Warszawa 2014.
26. Cichociński P., Dębińska E.: Application of 3D network analysis for development of evacuation plans and procedures for multi-storey building. GIS ODYSSEY 2016 : Geographic Information Systems Conference and Exhibition : 5th–9th September 2016, Perugia, Italy : conference proceedings, pp. 63-69.
27. Cichociński P., Dębińska E., Krystek K.: Problemy prowadzenia analiz sieciowych w przestrzeni trójwymiarowej z wykorzystaniem oprogramowania Network Analyst (ArcGIS) i pgRouting (PostGIS) (Problems of 3D network analysis performed in Network Analyst (ArcGIS) and pgRouting (PostGIS) software). Roczniki Geomatyki 2017, Tom XV, Zeszyt 3(78), s. 271-282. Warszawa 2017.
28. Cichociński P.: Data sources and acquisition methods for 3D indoor network analyses. GIS ODYSSEY 2017 : Geographic Information Systems Conference and Exhibition : 4th–8th September 2017, Trento – Vattaro, Italy : conference proceedings, pp. 60-66.

Additional information

1. Information, announcements, results of tests, as well as auxiliary materials for classes are posted on the course website placed on the University e-Learning Platform (https://upel.agh.edu.pl/wggiis). The password for access to the course is provided by the lecturer at the first class. Publication of information on this site is considered to be made available to students.
2. Individual consultations, held on dates announced at the beginning of each semester are supplementary to all forms of classes.
3. Classes are held at the Computer Laboratory of the Department of Mining Surveying and Environmental Engineering. The student is required to know and comply with the rules and regulations in force on the website http://pk.geod.agh.edu.pl.