



# Geospatial Analysis

## Course description sheet

### Basic information

<b>Field of study</b> Geospatial Computer Science		<b>Didactic cycle</b> 2024/2025	
<b>Major</b> Remote Sensing and GIS		<b>Course code</b> DGEITGS.IIi1.07191.24	
<b>Organisational unit</b> Faculty of Geo-Data Science, Geodesy, and Environmental Engineering		<b>Lecture languages</b> English	
<b>Study level</b> Second-cycle (engineer) programme		<b>Mandatoriness</b> Obligatory	
<b>Form of study</b> Full-time studies		<b>Block</b> Core Modules	
<b>Profile</b> General academic		<b>Course related to scientific research</b> Yes	
<b>Course coordinator</b>	Piotr Cichociński		
<b>Lecturer</b>	Piotr Cichociński, Ewa Dębińska		
<b>Period</b> Semester 1	<b>Method of verification of the learning outcomes</b> Completing the classes	<b>Number of ECTS credits</b> 3	
	<b>Activities and hours</b> Lectures: 15 Project classes: 30		

## Goals

C1	To acquaint students with standards defining the formal basis for geoinformation modelling and description of its quality.
C2	To provide students with the knowledge of advanced methods and techniques of spatial data processing and analysis, including ways of their automation and methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time.
C3	To make students aware of the problems related to integration and harmonisation of spatial data from different sources and geodata quality description and evaluation.

## Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
<b>Knowledge - Student knows and understands:</b>			
W1	specialised spatial and descriptive (attribute) databases and their usability	GEI2A_W01, GEI2A_W04	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
W2	methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time	GEI2A_W04, GEI2A_W06	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
W3	advanced methods and techniques of spatial data processing and analysis, including ways of their automation	GEI2A_W03, GEI2A_W05	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
W4	methods and techniques of integration and harmonization of spatial data	GEI2A_W01, GEI2A_W03	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
W5	standards defining the formal basis for modelling and the description of the quality of geoinformation	GEI2A_W06, GEI2A_W08	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
<b>Skills - Student can:</b>			
U1	visualize (also in 3D) data and results of spatial analyses, including those changing over time	GEI2A_U09	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
U2	acquire, integrate, process and analyse data from specialised spatial and descriptive (attribute) databases and assess their quality	GEI2A_U01, GEI2A_U05, GEI2A_U06, GEI2A_U08	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
U3	automate processes of spatial data analysis and processing, including the creation and application of geoinformation models	GEI2A_U04, GEI2A_U07	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer
<b>Social competences - Student is ready to:</b>			

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
K1	maintain an ethical attitude while performing and presenting the results of assigned tasks	GEI2A_K01	Activity during classes, Execution of exercises, Execution of a project, Test, Report
K2	correctly identify and solve problems related to the acquisition, integration, processing and analysis of spatial data	GEI2A_K02	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer

### Program content ensuring the achievement of the learning outcomes prescribed to the module

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.

### Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	15
Project classes	30
Preparation for classes	15
Realization of independently performed tasks	7
Contact hours	1
Preparation of project, presentation, essay, report	7
<b>Student workload</b>	<b>Hours</b> 75
<b>Workload involving teacher</b>	<b>Hours</b> 45

\* hour means 45 minutes

### Program content

No.	Program content	Course's learning outcomes	Activities
1.	Standardization as a formal basis for geoinformation modelling, spatial databases design and geodata quality description and evaluation.	W5, U2, U3, K1, K2	Lectures, Project classes

No.	Program content	Course's learning outcomes	Activities
2.	Harmonisation of spatial data from different sources for the supply of official and other databases. Rules and standards for data exchange.	W1, W3, W4, U2, U3, K1, K2	Lectures, Project classes
3.	Integration of spatial and non-spatial data. Geocoding. Censuses and other statistical data. Specificity of big data.	W1, W2, W3, W4, U1, U2, U3, K1, K2	Lectures, Project classes
4.	Automation of operations in geographic information systems: multiple repetition of actions, creation of own tools (models, scripts).	W3, U2, U3, K1, K2	Lectures, Project classes
5.	Visualization of three-dimensional and time-varying data: geovisualization methods, applications of animations.	W1, W2, U1, K1, K2	Lectures, Project classes
6.	Geospatial metadata: definition, structure and content, creation and management tools. Spatial data quality principles. Quality evaluation procedures.	W1, W3, W5, U2, U3, K1, K2	Lectures, Project classes
7.	Volunteered geographic information (VGI): characteristics, demand and creation opportunities, pros and cons, examples, applications.	W1, W2, W3, W4, W5, U1, U2, U3, K1, K2	Lectures, Project classes

### Extended information/Additional elements

#### Teaching methods and techniques :

Lectures

Activities	Methods of verification	Credit conditions
Lectures	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer	Obtaining a pass in the project classes.
Project classes	Activity during classes, Execution of exercises, Execution of a project, Test, Report, Oral answer	Class attendance and completion of all assignments.

#### Additional info

1. Information, announcements, grades for assignments and tests, as well as learning materials are posted on the course website placed on the University e-Learning Platform (<https://upel.agh.edu.pl>). The password for access to the course is provided by the teacher 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 Faculty of Geo-Data Science, Geodesy, 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>

#### Conditions and the manner of completing each form of classes, including the rules of making retakes, as well as the conditions for admission to the exam

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 project 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 course programme includes assignments in the number that ensures the required workload of the student as determined by the credits assigned to the course and 1-2 tests. All assignments and tests must be passed.
5. The ongoing control of learning outcomes is based on: checking assignments 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 only in person at the teacher.
7. The student should keep files created as a result of the implementation of assignments 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. A student who does not justify their absence from the test is given a fail (2.0).
11. The student is obliged to correct a failed test. During the semester, one resit test is organized, any subsequent tests may be held during the session. Re-taking a passed test is only possible in exceptional, justified cases.
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 assignments (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 resit session.

### **Method of determining 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  $P \geq 3.0$ )

### **Manner and mode of making up for the backlog caused by a student justified absence from classes**

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 during these classes.

## **Prerequisites and additional requirements**

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

### **Rules of participation in given classes, indicating whether student presence at the lecture is obligatory**

Lectures: 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. Attendance is not compulsory.

Project classes: Attendance is compulsory. Students carry out tasks aimed at achieving the competences assumed by the syllabus. They work independently, using materials provided by the teacher, without much interference from him/her - this is to develop a sense of responsibility for their decisions.

## Literature

### Obligatory

1. de Smith M.J., Goodchild M.F., Longley P.A. Geospatial Analysis – 6th Edition, 2018.  
<http://www.spatialanalysisonline.com/HTML/index.html>
2. Zeiler M. Modeling Our World: The ESRI Guide to Geodatabase Design. Redlands : ESRI, 1999.  
[http://downloads2.esri.com/support/documentation/ao\\_Modeling\\_our\\_World.pdf](http://downloads2.esri.com/support/documentation/ao_Modeling_our_World.pdf)

### Optional

1. Capineri, C, Haklay, M, Huang, H, Antoniou, V, Kettunen, J, Ostermann, F and Purves, R. (eds.) European Handbook of Crowdsourced Geographic Information. London : Ubiquity Press 2016.
2. Haklay, M., Antoniou, V., Basiouka, S., Soden, R., and Mooney, P., Crowdsourced geographic information use in government, Report to GFDRR (World Bank). London 2014.
3. Handbook on Geospatial Infrastructure in Support of Census Activities. United Nations, New York 2009.  
<http://ggim.un.org/knowledgebase/Attachment218.aspx?AttachmentType=1>
4. Longley P., Cheshire J., Singleton J. Consumer Data Research. UCL Press, London 2018.  
<http://discovery.ucl.ac.uk/10046615/1/Consumer-Data-Research.pdf>
5. Norris J. Future trends in geospatial information management: the five to ten year vision. UN-GGIM 2015.  
<http://ggim.un.org/knowledgebase/Attachment1311.aspx?AttachmentType=1>
6. Open Geospatial Consortium (OGC) standards. <https://www.ogc.org/docs/is>
7. Steudler D., Rajabifard A. Spatially Enabled Society. FIG Report 2012. <http://fig.net/pub/figpub/pub58/figpub58.pdf>

## Scientific research and publications

### Publications

1. Analysis of the possibility of using archival maps as a source of elevation data / Piotr CICHOCIŃSKI // GIS Odyssey Journal [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 2720-2682. — 2021 — vol. 1 no. 1, s. 177-188. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. 187-188, Abstr.
2. A study on the usability of open spatial data for road network-based analysis – using OpenStreetMap as an example — Badania użyteczności otwartych danych przestrzennych do analiz opartych na sieciach drogowych - na przykładzie OpenStreetMap / Piotr CICHOCIŃSKI // Geoinformatica Polonica ; ISSN 1642-2511. — 2021 — vol. 20, s. 89-96. — Bibliogr. s. 96, Abstr., Streszcz. — Publikacja dostępna online od: 2021-12-30
3. Zastosowanie wolnego oprogramowania i otwartych danych w analizie przestrzennej systemu awaryjnego zaopatrzenia w wodę pitną na przykładzie miasta Cottbus/Chósebusz (Niemcy) / Magdalena Klich, Piotr CICHOCIŃSKI, Konrad Thürmer // ROCZNIKI GEOMATYKI 2022 Tom XX Zeszyt 2(97): 31-42
4. Influence of the central city on the location of commercial buildings in the agglomeration : the example of Krakow, Poland / Ewa DĘBIŃSKA, Joanna A. PAŁUBSKA // Journal of Applied Engineering Sciences ; ISSN 2247-3769. — 2021 — vol. 11 iss. 1 art. no. 303, s. 17-22. — Bibliogr. s. 22, Abstr. — Publikacja dostępna online od: 2021-05-31

## Learning outcomes prescribed to a field of study

Code	Content
GEI2A_K01	samosdoskonalenia, a także postępowania profesjonalnego, odpowiedzialnego i zgodnego z zasadami etyki zawodowej.
GEI2A_K02	prawidłowej identyfikacji i rozstrzygania problemów związanych z wykonywaniem zawodu.
GEI2A_U01	stosować zaawansowane metody pozyskiwania, integracji i przetwarzania informacji pochodzących z różnych źródeł danych.
GEI2A_U04	stosować i rozwijać modele w zakresie geoinformacji o środowisku, terenach i obiektach miejskich oraz przemysłowych.
GEI2A_U05	formułować i rozwiązywać zadania przestrzenne, posługując się zaawansowanymi funkcjami analitycznymi, w tym implementować adekwatne algorytmy obliczeniowe.
GEI2A_U06	tworzyć, modyfikować, aktualizować oraz wykorzystywać specjalistyczne bazy danych przestrzennych, , a także dokonać oceny ich jakości.
GEI2A_U07	wykorzystywać i automatyzować specjalistyczne metody analiz oraz symulacji dla celów modelowania i rozwiązywania problemów z zastosowaniem geoinformacji.
GEI2A_U08	pozyskiwać informacje ze specjalistycznej dokumentacji technicznej, literatury przedmiotu, baz wiedzy i innych źródeł, a także wyciągać wnioski oraz formułować i uzasadniać opinie; posługiwać się językiem obcym w stopniu wystarczającym (na poziomie B2+).
GEI2A_U09	pracować indywidualnie i kierować zespołem; szacować czas potrzebny na realizację zleconego zadania; potrafi opracować i zrealizować harmonogram prac zapewniający dotrzymanie terminów; przygotować i przedstawiać wyniki przeprowadzonych analiz oraz opracować specjalistyczne raporty z realizacji powierzonego zadania.
GEI2A_W01	złożone zasady pozyskiwania z różnych źródeł danych przestrzennych oraz środowiskowych.
GEI2A_W03	zaawansowane metody i techniki, w tym teledetekcyjne, stosowane do pozyskiwania i przetwarzania danych przestrzennych i środowiskowych na potrzeby geoinformacji.
GEI2A_W04	zasady modelowania i wizualizacji obiektów i zjawisk przestrzennych, tworzenia i wykorzystywania tematycznych baz danych, w tym baz danych przestrzennych oraz korzystania z systemów zarządzania nimi.
GEI2A_W05	zasady i metody automatyzacji przetwarzania danych, pozwalające na rozwiązywanie zagadnień geoinformatycznych i inżynierskich.
GEI2A_W06	zasady modelowania obiektów i procesów na terenach miejskich i przemysłowych oraz procesów środowiskowych.
GEI2A_W08	wybrane aspekty społeczne, ekonomiczne i prawne w zakresie funkcjonowania społeczeństwa geoinformacyjnego.