



# Principles of Cartography and Databases in GIS

## 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.IIi1.07192.24	
<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>	Artur Krawczyk, Stanisław Szombara	
<b>Lecturer</b>	Artur Krawczyk, Stanisław Szombara	
<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	Impart knowledge of spatial data storage and processing and basic cartographic technologies.
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### 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	principles of GIS: spatial and attribute data and scope of their processing and analysis.	GEI2A_W01, GEI2A_W02, GEI2A_W03, GEI2A_W04	Activity during classes, Execution of a project, Test, Project
W2	database logic models and its importance in creating database systems; the functions of database management systems and database languages; database architecture, database services, database functionalities (reporting).	GEI2A_W01, GEI2A_W02, GEI2A_W03, GEI2A_W04	Activity during classes, Execution of exercises, Execution of a project, Test, Project
W3	the characteristics of personal databases; client/server databases are acquainted with the ways and principles of verifying the correctness of geometry of objects; the SQL definitions of spatial queries.	GEI2A_W01, GEI2A_W02, GEI2A_W03, GEI2A_W04, GEI2A_W06, GEI2A_W09	Activity during classes, Execution of exercises, Execution of a project, Test, Project
W4	the theory of cartographic projections and coordinate reference systems: real shape and models of the Earth.	GEI2A_W01, GEI2A_W02, GEI2A_W03, GEI2A_W04	Activity during classes, Participation in a discussion, Execution of exercises, Execution of a project, Test, Scientific paper
<b>Skills - Student can:</b>			
U1	use GIS for mapping; use thematic mapping for spatial data.	GEI2A_U01, GEI2A_U02, GEI2A_U03, GEI2A_U04, GEI2A_U05, GEI2A_U06, GEI2A_U08, GEI2A_U09	Activity during classes, Participation in a discussion, Execution of a project, Test, Project, Involvement in teamwork
U2	recognize, define and convert basic formats of the spatial data also is able to find and use resources in the public domain (WMS, WFS etc.).	GEI2A_U01, GEI2A_U02, GEI2A_U04, GEI2A_U05	Participation in a discussion, Execution of exercises, Execution of a project, Project, Report
U3	find, purchase commercial resources of the spatial data.	GEI2A_U01, GEI2A_U02, GEI2A_U04, GEI2A_U05, GEI2A_U06	Execution of exercises, Execution of a project, Project, Report, Scientific paper
<b>Social competences - Student is ready to:</b>			
K1	work in a team and appreciate it; discuss about methods applied for resolving and visualisation of the problems.	GEI2A_K01, GEI2A_K02, GEI2A_K03, GEI2A_K04	Activity during classes, Participation in a discussion, Involvement in teamwork

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

This module is to provide a student with terminology from various fields of broadly understood cartography and GIS. This course introduces current developments in mapping and cartographic skills applied to map design.

### Student workload

Activity form	Average amount of hours* needed to complete each activity form

Lectures	15
Project classes	30
Preparation for classes	10
Realization of independently performed tasks	10
Examination or final test/colloquium	2
Contact hours	5
Preparation of project, presentation, essay, report	15
Other	3
<b>Student workload</b>	<b>Hours</b> 90
<b>Workload involving teacher</b>	<b>Hours</b> 45

\* hour means 45 minutes

### Program content

No.	Program content	Course's learning outcomes	Activities
1.	The theory of cartographic projections and coordinate reference systems: real shape and models of the Earth; ellipsoid and concept of the datum; geographic coordinate systems; projected coordinate system; local and universal coordinate systems; national systems; transformations of the coordinate systems; GIS - introduction, basic terms, origin, history, recent developments; practical application; Types of the data: spatial and attribute; attribute data and role of the Data Base; formats of the spatial data; Acquisition of the spatial data: public domain (servers: WMS, WFS, local country sources, INSPIRE); GIS software - review (ArcGIS, Quantum GIS, GRASS, SAGA GIS and others); Geovisualization	W1, W2, W3, W4	Lectures
2.	GIS software exploration (Quantum GIS); exploration of the spatial data (vector and raster), import - export and conversion tools; data formats; Acquisition of the spatial data: public domain (servers: WMS, WCS, ArcIMS, ArcGIS, USGS, local country sources); digitising (on screen and tablet) and processing of the output data; attribute data (creating, editing, export - import; working with data bases); Cartographic projections and reference coordinate systems: defining, processing and transformations;	W1, W2, W3, W4, U1, U2, U3, K1	Project classes

No.	Program content	Course's learning outcomes	Activities
3.	<p>The fundamentals of the relationship theory. The concept of a data set, the structure of an array in a database (relation, attributes, short circuits (ounces), definitions of an identification array and a key (foreign and main). The concept and application of an index in a database. Database consistency aspects and types, replication. The concept of transaction in a database. Database systems Database architecture, database services, database functionality. Characteristics of personal databases, client/server databases, characteristics of available databases on the market, data exchange between the database and client applications. File formats of databases.</p> <p>Spatial data types Spatial data types in TCH text form, TCH binary form. Examples of definitions of 2D spatial elements defined by EWKT (Extended JCC) or EWKB (Extended JCC) The language of data definition and spatial queries. Entry of data into the database using SQL commands and file loading. Verify that the geometry of objects is correct.</p> <p>Spatial queries. Definitions of spatial queries in SQL language. Basics of raster format in databases. Use of spatial databases in GIS systems The importance of spatial databases in GIS. Connecting to databases in GIS systems.</p>	W1, W2, W3, W4	Lectures
4.	<p>Working with existing database - SQL project from DQL subset - data selection queries Simple SQL queries - Select manual syntax ... where</p> <p>Working with existing database - project from SQL subset of DML - data modification queries. Use of Insert, DELETE, UPDATE instructions</p> <p>Create a new own database - project from SQL language subset DDL - data definition queries. Use of DROP, CREATE, REFERENCES instructions</p> <p>Project Implementation of dependencies between relation ounces, multiplication of optionality. Database design using View Definition (VIEW). Different types of joints (JOIN). Key concept and other conditions (CONSTRAINTS), keys (PRIMARY KEY, FOREIGN KEY), CONSTRAINTS (UNIQUE, NOT NULL, DEFAULT, CHECK).</p> <p>Data import data export from cvs text files, data export (data objection) and data formatting for printing.</p> <p>Building an exemplary monitoring database. The database should contain tables of measurement points for dates of measurements and measured values. Selective inquiries, data entry forms and reports should be carried out.</p> <p>Spatial databases Spatial data types in JTS text form, JTS binary form. Examples of definitions of 2D spatial elements defined by EWKT (Extended JCC) or EWKB (Extended JCC). Entry of data into the database using SQL commands and file loading. Verify that the geometry of objects is correct. Geometric functions of PostGIS. Definitions of spatial queries in SQL language. Basics of raster format in databases. Raster tiling and storage methods. Creation and modification of clusters. SQL statements for spatial analysis.</p> <p>Importance of spatial databases in GIS. Connecting to databases in GIS systems. Access to databases.</p>	W1, W2, W3, W4, U1, U2, U3, K1	Project classes

## Extended information/Additional elements

### Teaching methods and techniques :

Discussion

Activities	Methods of verification	Credit conditions
Lectures	Activity during classes, Participation in a discussion, Execution of exercises, Execution of a project, Test, Project, Scientific paper	
Project classes	Activity during classes, Participation in a discussion, Execution of exercises, Execution of a project, Test, Project, Report, Scientific paper, Involvement in teamwork	

### 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

The evaluation of project exercises is an arithmetic average of cards and projects, provided that each of the projects has been passed as a positive grade. Submission of the project after the set deadline results in a 20% reduction of the grade, with projects being submitted no later than two weeks before the last classes. The basic deadline for passing the credit is the last day of classes. The student has the right to take the exam on re-start dates on terms specified in the regulations of the AGH studies.

### Method of determining the final grade

The final evaluation from the exercises is a weighted average from the average score obtained from all projects and an average from all colloquia, tests and cards. The average score obtained from the projects is 0.4, whereas the average score from the control works (i.e. colloquia, tests and cards) is 0.6.

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

Presence on design exercises is obligatory. Absence in class can be justified within two weeks of leaving. Leaving 20% of classes without justification results in failure to pass the project exercises. Students absent from the classes, after consulting the teacher, are required to complete the indicated material on their own.

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

Lectures: Studenci uczestniczą w zajęciach poznając kolejne treści nauczania zgodnie z sylabusem przedmiotu. Studenci winni na bieżąco zadawać pytania i wyjaśniać wątpliwości. Rejestracja audiowizualna wykładu wymaga zgody prowadzącego. Project classes: Studenci wykonują prace praktyczne mające na celu uzyskanie kompetencji zakładanych przez sylabus. Ocenie podlega sposób wykonania projektu oraz efekt końcowy.

## Literature

### Obligatory

1. Elwood, S., Goodchild, M. F., & Sui, D. Z. (2012). Researching volunteered geographic information: Spatial data, geographic research, and new social practice. *Annals of the Association of American Geographers*, 102(3), 571-590.
2. Kosara, R., & Mackinlay, J. (2013). Storytelling: The next step for visualization. *Computer* (5), 44-50.
3. Sui, Daniel, and Bo Zhao. "GIS as Media Through the Geoweb." *Mediated Geographies and Geographies of Media*. Springer Netherlands, 2015. 191-208.
4. Shekhar, S., & Xiong, H. (2008). Spatial Semantic Web. *Encyclopedia of GIS*, 1106-1106.

## Scientific research and publications

### Publications

1. Interaktywna mapa obozu koncentracyjnego KL Płaszów w aplikacji ArcGIS Story Map — Interactive map of KL-Płaszów concentration camp in ArcGIS Story Map application / Anna Kuryłowicz, Marzena Koziak, Krystian KOZIOŁ // Roczniki Geomatyki = Annals of Geomatics / Polskie Towarzystwo Informatyki Przemysłowej ; ISSN 1731-5522. — 2017 t. 15 z. 3, s. 319-333. — Bibliogr. s. 331-332, Streszcz., Abstr.. — Publikacja dostępna online od: 2017-09-30. — tekst: <https://goo.gl/ZuMDeG>
2. A method for assessing generalized data accuracy with linear object resolution verification / Tadeusz CHROBAK, Stanisław SZOMBARA, Krystian KOZIOŁ, Michał LUPA // Geocarto International ; ISSN 1010-6049. — 2017 vol. 32 no. 3, s. 238-256. — Bibliogr. s. 255-256, Abstr.. — Publikacja dostępna online od: 2016-02-05. — tekst: <https://goo.gl/cAO0td>
3. The importance of contextual topology in the process of harmonization of the spatial databases on example BDOT500 / Adam Ingłot, Krystian KOZIOŁ // W: BGC Geomatics 2016 [Dokument elektroniczny] : 2016 Baltic Geodetic Congress (Geomatics) : Gdansk, Poland 2-4 June 2016 : proceedings. — Wersja do Windows. — Dane tekstowe. — Los Alamitos ; Washington ; Tokyo : IEEE, cop. 2016. — e-ISBN: 978-1-5090-2421-6. — S. 251-256. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. 256, Abstr.. — tekst: <https://goo.gl/BtV3IG>
4. An attempt to automate the simplification of building objects in multiresolution databases / Michał LUPA, Krystian KOZIOŁ, Andrzej LEŚNIAK // W: Beyond Databases, Architectures and Structures : 11th international conference, BDAS 2015 : Ustroń, Poland, May 26-29, 2015 : proceedings / eds. Stanisław Kozielski, [et al.]. — Switzerland : Springer International Publishing, cop. 2015. — (Communications in Computer and Information Science ; ISSN 1865-0929 ; 521). — ISBN: 978-3-319-18421-0 ; e-ISBN: 978-3-319-18422-7. — S. 448-459. — Bibliogr. s. 459, Abstr.
5. The extended structure of multi-resolution database / Krystian KOZIOŁ, Michał LUPA, Artur KRAWCZYK // W: Beyond databases, architectures and structures : 10th international conference, BDAS 2014 : Ustroń, Poland, May 27-30, 2014 : proceedings / eds. Stanisław Kozielski, [et al.]. — Switzerland : Springer International Publishing, cop. 2014. — (Communications in Computer and Information Science ; ISSN 1865-0929 ; 424). — ISBN: 978-3-319-06931-9 ; e-ISBN: 978-3-319-06932-6. — S. 435-443. — Bibliogr. s. 442-443, Abstr.

## 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 rozstrzygnięcia problemów związanych z wykonywaniem zawodu.
GEI2A_K03	aktywnego i kreatywnego włączenia się w dynamiczny rozwój geoinformacji, wzmacniania jej roli w społeczeństwie oraz popularyzowania powszechnego korzystania z danych przestrzennych.
GEI2A_K04	aktywnego i kreatywnego współdziałania w zespole oraz efektywnego kierowania nim.
GEI2A_U01	stosować zaawansowane metody pozyskiwania, integracji i przetwarzania informacji pochodzących z różnych źródeł danych.
GEI2A_U02	programować, modyfikować i rozbudowywać istniejące aplikacje oraz łączyć różne technologie informatyczne w zakresie geoinformacji.
GEI2A_U03	stosować specjalistyczne metody przetwarzania obrazu i wykorzystania danych fotogrametrycznych i teledetekcyjnych.
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_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_W02	złożone zasady programowania oraz konstruowania algorytmów, niezbędne do czytania ze zrozumieniem, pisania, uruchamiania i weryfikacji programów.
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_W06	zasady modelowania obiektów i procesów na terenach miejskich i przemysłowych oraz procesów środowiskowych.
GEI2A_W09	podstawowe pojęcia i zasady z zakresu ochrony własności intelektualnej, prawa autorskiego oraz zasobów informacji patentowej.