# Geo-information Tools

Course description sheet

## Basic information

| | |
|---|---|
| **Field of study**<br>Remote Sensing and Geo Informatics<br>**Major**<br>All<br>**Organisational unit**<br>Faculty of Geo-Data Science, Geodesy, and Environmental Engineering<br>**Study level**<br>Second-cycle studies<br>**Form of study**<br>Full-time studies<br>**Profile**<br>General academic | **Didactic cycle**<br>2025/2026<br>**Course code**<br>DRSGIS.II2.15497.25<br>**Lecture languages**<br>English<br>**Mandatoriness**<br>Obligatory<br>**Block**<br>Core Modules<br>**Course related to scientific research**<br>Yes |

| | |
|---|---|
| **Course coordinator** | Wojciech Drzewiecki |
| **Lecturer** | Wojciech Drzewiecki, Karolina Pargieła, Anna Malczewska |

| **Period** | **Method of verification of the learning outcomes** | **Number of ECTS credits** |
|---|---|---|
| Semester 2 | Completing the classes<br><br>**Activities and hours**<br>Lectures: 10<br>Workshop classes: 40 | 4 |

## Goals

| | |
|---|---|
| C1 | The aim of the module is to familiarize students with IT tools used in geoinformation applications. |

## Course's learning outcomes

| Code | Outcomes in terms of | Learning outcomes prescribed to a field of study | Methods of verification |
|---|---|---|---|
| **Knowledge – Student knows and understands:** | | | |
| W1 | methods and algorithms and their theoretical basis in geo-information tools | RSGI2A_W01, RSGI2A_W03, RSGI2A_W04, RSGI2A_W05 | Activity during classes, Participation in a discussion, Test, Case study |
| **Skills – Student can:** | | | |
| U1 | process data in the field of geoinformation | RSGI2A_U01, RSGI2A_U02, RSGI2A_U03, RSGI2A_U04, RSGI2A_U05 | Activity during classes, Test, Case study |
| U2 | apply geo-information tools in remote sensing and geoscience | RSGI2A_U02, RSGI2A_U03, RSGI2A_U04 | Activity during classes, Test, Case study |
| **Social competences – Student is ready to:** | | | |
| K1 | responsible use of process data in the field of geoinformation in practice, while being aware of their capabilities and limitations | RSGI2A_K01, RSGI2A_K02, RSGI2A_K03 | Activity during classes, Participation in a discussion, Test, Case study |

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

Students obtains knowledge about free and commercial remote sensing and spatial data processing software.  The student will be aware of the capabilities and limitations of readymade geo-informatics tools (free and commercial) compared to Python libraries used in raster processing, vectors and cloud work.

## Student workload

| Activity form | Average amount of hours* needed to complete each activity form |
|---|---|
| Lectures | 10 |
| Workshop classes | 40 |
| Realization of independently performed tasks | 30 |
| Preparation of project, presentation, essay, report | 30 |
| Contact hours | 2 |
| | |
| **Student workload** | **Hours**<br>112 |
| **Workload involving teacher** | **Hours**<br>50 |

* hour means 45 minutes

## Program content

| No. | Program content | Course's learning outcomes | Activities |
|---|---|---|---|
| 1. | An introduction to Geo-Information Tools. Oberview of Geo-Informatio tools applications in sample projects.<br><br>Overview of free and commercial remote sensing and spatial data processing software (non-exhaustive examples: Sentinel Toolbox, QGIS Semi-Automatic Classification Plugin (SCP), SAGA GIS: System for Automated Geoscientific Analyses, ORFEO Toolbox (OTB): Optical and Radar Federated Earth Observation, GRASS: Geographic Resources Analysis Support System, E-foto, Agisoft Metashape, Pix4D, ENVI, ArcGIS).<br><br>Practical use of selected tools in remote sensing data processing, image classification, photogrammetry and lidar data processing, GIS applications. Comparison with Python libraries, eg.:<br><br>For ESRI Enviroments - ArcPy, ArcGIS API for Python.<br><br>For Raster Data - GDAL, rasterio, RSGISLib, Rasterstats, Rasterframes, For Vector Data - OGR, Shapely, Fiona, PyProj, GePandas, GeoMesa.<br><br>For Point Clouds - PDAL, LASPy, NumPy, Mtaplotlib, Ipyleaflet, Folium. | W1, U1, U2, K1 | Lectures, Workshop classes |

## Extended information/Additional elements

### Teaching methods and techniques :

Workshop, Case study, E-learning, Discussion, Lectures

| Activities | Methods of verification | Credit conditions |
|---|---|---|
| Lectures | Activity during classes, Participation in a discussion | participation in the discussion or passing the test |
| Workshop | Test, Case study | passing the test and presentation and approval of the report on the completed project (case study) task |

### 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

Credit of the workshop classes on the basis of attendance at classes and a positive evaluation of the project (case study) reports and test scores. In case of workshop classes a final grade is calculated as an average of individual project grades and tests. A student who fails the project report evaluation or test may proceed to a resit twice.

### Method of determining the final grade

Final grade = 0.7*workshop classes grade + 0.3* final test grade Both, workshop and final test, has to be graded at least 3.0

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

Compensating for the backlog caused by absence: depending on the classes subject – self-realisation of excercises with the help of individual consultations with the instructor.

## Prerequisites and additional requirements

Basic knowledge of mathematics

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

Lectures: students participate in the class by learning the subsequent teaching content according to the course syllabus. Students should ask questions and clarify doubts on an ongoing basis. Audio-visual recording of the lecture requires the consent of the instructor. Attendance at lectures is not obligatory. Workshop classes: students perform practical work aimed at achieving the competencies assumed by the syllabus.

## Literature

#### Obligatory

1. Henrikki Tenkanen, Vuokko Heikinheimo & David Whipp 'Introduction to Python for Geographic Data Analysis' (available at https://pythongis.org/)

#### Optional

1. Wolfgang Kresse, David Danko (eds.): Springer Handbook of Geographic Information. Springer Nature Switzerland AG 2022
2. Joel Lawhead "Learning Geospatial Analysis with Python. Unleash the power of Python 3 with practical techniques for learning GIS and remote sensing - Fourth Edition" 2023 Pact Publishing

## Scientific research and publications

#### Publications

1. Assessment of the impact of waste fires on air quality and atmospheric aerosol optical depth: a case study in Poland / Robert OLENIACZ, Wojciech DRZEWIECKI, Tomasz GORZELNIK, Katarzyna GRZESIK, Ryszard KOZAKIEWICZ, Zbigniew KOWALEWSKI, Karolina KOSSAKOWSKA // Energy Reports [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 2352-4847. — 2023 — vol. 9 suppl. 5, s. 16–38
2. Change detection in multispectral VHR images using spatialized Hölder exponent / Sebastian Aleksandrowicz, Anna Wawrzaszek, Wojciech DRZEWIECKI, Michał Krupiński, Małgorzata Jenerowicz // IEEE Geoscience and Remote Sensing Letters ; ISSN 1545-598X. — 2022 — vol. 19, s. 1–5.
3. Registration of objects for 3D cadastre: an integrated approach / Kornelia GRZELKA, Karolina PARGIEŁA, Aleksandra JASIŃSKA, Artur Warchoł, Jarosław BYDŁOSZ // Land [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 2073-445X. — 2024 — vol. 13 iss. 12 art. no. 2070, s. 1-19
4. Semantic segmentation-driven integration of point clouds from mobile scanning platforms in urban environments / Joanna KOSZYK, Aleksandra JASIŃSKA, Karolina PARGIEŁA, Anna MALCZEWSKA, Kornelia GRZELKA, Agnieszka BIEDA, Łukasz AMBROZIŃSKI // Remote Sensing [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 2072-4292. — 2024 — vol. 16 iss. 18 art. no. 3434, s. 1–18.
5. How does super-resolution for satellite imagery affect different types of land cover? : Sentinel-2 case / Anna MALCZEWSKA, Maciej WIELGOSZ // IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing ; ISSN 1939-1404. — 2024 — vol. 17, s. 340–363

## Learning outcomes prescribed to a field of study

| Code | Content |
|---|---|
| RSGI2A_K01 | is ready to resolve conflicts, negotiate, work in a team |
| RSGI2A_K02 | is ready for creative time management, working under time pressure |
| RSGI2A_K03 | maintain an ethical attitude while performing and presenting the results of assigned tasks |
| RSGI2A_U01 | can apply knowledge of mathematics and physics to analyze geospatial data |
| RSGI2A_U02 | can acquire remote environmental data |
| RSGI2A_U03 | is able to process geospatial data and automate data processing in an advanced manner |
| RSGI2A_U04 | is able to use IT tools for spatial data processing |
| RSGI2A_U05 | can work both individually and in teams; can prepare a proposal for a research project |
| RSGI2A_W01 | has a deep knowledge of mathematics in remote sensing data analysis |
| RSGI2A_W03 | has a deep understanding of remote environmental data acquisition methods |
| RSGI2A_W04 | has a deep understanding of methods, algorithms and automation of spatial data processing |
| RSGI2A_W05 | has an enhanced knowledge of the use of computer science in geoscience |