Python for Remote Sensing

Course description sheet

Basic information

Field of study Remote Sensing and Geo Informatics **Major** All **Organisational unit** Faculty of Geo-Data Science, Geodesy, and Environmental Engineering **Study level** Second-cycle studies **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2026/2027 **Course code** DRSGIS.II1.15493.26 **Lecture languages** English **Mandatoriness** Obligatory **Block** Core Modules **Course related to scientific research** Yes

Course coordinator	Mariusz Twardowski
Lecturer	Mariusz Twardowski, Beata Hejmanowska, Urszula Marmol, Sławomir Mikrut, Ewa Głowienka, Wojciech Drzewiecki, Tomasz Pirowski, Natalia Borowiec, Antoni Rzonca

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 1	Exam **Activities and hours** Lectures: 10 Workshop classes: 140	10

Goals

C1	To acquire knowledge necessary for using Python language in processing data accumulated with remote sensing methods and learn how to interface self-developed applications with existing tools, then prepare a report and defend it in the form of an exam.

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	Python language and tools for remote sensing	RSGI2A_W04, RSGI2A_W05	Participation in a discussion, Examination, Involvement in teamwork
W2	algorithms for telemetry data processing	RSGI2A_W04, RSGI2A_W05	Participation in a discussion, Examination, Involvement in teamwork
W3	interfacing principles with external software	RSGI2A_W05	Participation in a discussion, Involvement in teamwork
Skills – Student can:			
U1	apply programming skills in practice	RSGI2A_U03, RSGI2A_U04	Examination, Involvement in teamwork
U2	use Python with remote sensing data	RSGI2A_U03, RSGI2A_U04	Examination, Involvement in teamwork
U3	perform spatial analysis within language framework	RSGI2A_U03, RSGI2A_U04	Examination, Involvement in teamwork
Social competences – Student is ready to:			
K1	intentionally select fit-to-use data	RSGI2A_K01	Participation in a discussion, Examination, Involvement in teamwork
K2	solve problems related to the use of spatial analysis in decision support	RSGI2A_K03	Participation in a discussion, Examination, Involvement in teamwork

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

The student will acquire advanced knowledge of the Python application in remote sensing. This course aims to build understanding of the underlying principles and equip future academics with basic skills to create computer programs. The course introduces libraries of available components and how to use them for building student’s own software.

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	10
Workshop classes	140
Realization of independently performed tasks	60
Preparation of project, presentation, essay, report	70

Contact hours	5
Examination or final test/colloquium	2

Student workload	**Hours** 287
Workload involving teacher	**Hours** 150

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	This course aims to build understanding of the underlying principles and equip future academics with basic skills to create computer programs. The same principles are needed for writing custom code in many simulation, modelling, and engineering tools. The course introduces libraries of available components and how to use them for building student's own software. Student chooses an individual project from the available selection of topics or proposes his/her own topic. Within the lecture part, the student is introduced to the knowledge of the performed topics. He or she learns the characteristics of data processing with tools and libraries available in Python: language syntax and structure, basic file processing, algorithms for data extraction, ready to use libraries for CLI and GUI application, Python integration with existing tools. The workshop part consists of performing comprehensive work to solve the selected problem. The work includes the design part, data collection, data pre-processing, preparation of an application in Python, preparation of a report. During the workshop, the student consults the results of his research with the supervisor. The class ends with the defense of the interim work at the exam.	W1, W2, W3, U1, U2, U3, K1, K2	Lectures, Workshop classes

Extended information/Additional elements

Teaching methods and techniques :

Remote learning (webinar), Lectures, Discussion, E-learning, Case study, Group work, Design thinking, Problem Based Learning, Mentoring, Workshop

Activities	Methods of verification	Credit conditions
Lectures	Participation in a discussion, Examination	Lectures are optional, verification of the knowledge during the exam as part of the transitional work passing.
Workshop	Participation in a discussion, Examination, Involvement in teamwork	Workshops are mandatory. Credit is based on student's activity.

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 lecture - based on a positive mark of the exam. Credit of the project - on the basis of attendance at classes and a positive evaluation of the individual project report.

Method of determining the final grade

Final grade = average of exam and workshop assignments.

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-realization of exercises with the help of individual consultations with the instructor.

Prerequisites and additional requirements

Computer usage, Text editor, Basic programming principles

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

Classes in the semester are conducted in blocks. Transitional work is preceded by blocks: Lecture topics are related to the workshop but expand the knowledge in the topic. Lectures are optional. The student is obliged to learn using the lecture method or by himself. Workshops include the training of practical application of the knowledge and is compulsory.

Literature

Obligatory

1. Official language documentation and online courses: http://pl.python.org
2. PyQT documentation: https://doc.qt.io/qtforpython
3. Zed A. Shaw: Python 3 The Hard Way, https://learnpythonthehardway.org/python3

Scientific research and publications

Research

1. 2020-2022 Integration of remote sensing data for control in the agricultural direct payments system (IACS), Excellence Initiative - Research University - AGH

Publications

1. Hejmanowska, B.; Kramarczyk, P.; Głowienka, E.; Mikrut, S. Reliable Crops Classification Using Limited Number of Sentinel-2 and Sentinel-1 Images. Remote Sens. 2021, 13, 3176. https://doi.org/10.3390/rs13163176 3.
2. Hejmanowska, B., Twardowski, M., & Żądło, A. (2021). An Application of the “Traffic Lights” Idea to Crop Control in Integrated Administration Control System. Geomatics and Environmental Engineering, 15(4), 129–152. https://doi.org/10.7494/geom.2021.15.4.129
3. Hejmanowska B., Glowienka E., Michalowska K., Mikrut S., Kramarczyk P., Opalinski P., Twardowski M., Guidi G., Gonizzi Barsanti S., Micoli L., Shafqat Malik U., Gonzalez-Aguilera D., Sanchez-Aparicio L.J., Rodríguez-Gonzálveza P.R.,, Muñoz-Nieto A.L., , Mills J., Peppa M.V., 2019 - “The Comparison of the Web GIS Applications Relevant for 4D Models Sharing” - IOP Earth and Environmental Sciences
4. Rodríguez-Gonzálvez P., Muñoz-Nieto A.L, del Pozo S., Sanchez-Aparicio L.J, GonzalezAguilera D., Micoli L., Barsanti S.G, Guidi G., Mills J., Fieber K., Haynes J., Hejmanowska B. 2017 - “4D reconstruction and visualization of cultural heritage: Analyzing our legacy through time”, The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. 42, Copernicus GmbH
5. Michałowska K., Głowienka E., Hejmanowska B., 2017- "Remote Sensing Methods in the Study of the Impact of Long-Term Process of Sulphur Mining on Environmental Changes of the Carpathian Foreland," 2017 Baltic Geodetic Congress (BGC Geomatics), Gdansk, 2017, pp. 292-296. doi: 10.1109/BGC.Geomatics.2017.80

Learning outcomes prescribed to a field of study

Code	Content
RSGI2A_K01	is ready to resolve conflicts, negotiate, work in a team
RSGI2A_K03	maintain an ethical attitude while performing and presenting the results of assigned tasks
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_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