Python praxis in photogrammetry and remote sensing

Course description sheet

Basic information

Field of study Geodesy, Surveying and Cartography **Major** Geoinformation, Photogrammetry and Remote Sensing **Organisational unit** Faculty of Geo-Data Science, Geodesy, and Environmental Engineering **Study level** Second-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2024/2025 **Course code** DGIKGFS.IIi4.05942.24 **Lecture languages** English **Mandatoriness** Elective **Block** Elective Modules in Foreign Language **Course related to scientific research** Yes

Course coordinator	Mariusz Twardowski
Lecturer	Mariusz Twardowski

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 3	Completing the classes **Activities and hours** Project classes: 30	3

Goals

G1	Course aims for student to acquire practical 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.

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	principles of programming in the Python language	GIK2A_W05, GIK2A_W06	Activity during classes, Execution of exercises, Execution of a project
Skills – Student can:			
U1	to create programs in the Python language	GIK2A_U11	Activity during classes, Execution of exercises, Execution of a project
U2	to extend the functionality of geoinformatics tools using the Python language	GIK2A_U06, GIK2A_U11	Activity during classes, Execution of exercises, Execution of a project
Social competences – Student is ready to:			
K1	creativity in approaching programming	GIK2A_K01	Activity during classes, Execution of a project

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

The module allows for familiarizing oneself with the principles of programming in the Python language, utilizing its selected libraries, and designing and practically implementing a graphical interface. It then teaches how to apply the acquired principles to create a graphical application using object-oriented programming.

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Project classes	30
Preparation for classes	30
Realization of independently performed tasks	10
Examination or final test/colloquium	2
Contact hours	2
Preparation of project, presentation, essay, report	15
Student workload	**Hours** 89
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	Project exercises 1. Introduction to the Python Language Getting acquainted with the language interpreter. Comparison with other programming languages. Variable assignments, mathematical and logical operators. Basic data types and their representation. Keywords and fundamental language concepts. Complex structures. Understanding immutable objects. 2. Scripts and Program Flow Control Formatting correct scripts and executing them. Conditional and looping structures, function definitions controlling program flow. Differences between an interpreter and a compiler. Handling exceptions in a program. Input/output handling for different devices. Defining functions of different types. 3. Classes, Objects, and Modules Introduction to object-oriented programming in Python. Building classes, objects, and methods, their inheritance and polymorphism. Ways to modularize scripts and import libraries. 4. Selected Language Libraries Discussion of important elements of standard libraries. Libraries containing geospatial transformations: GDAL, OGR, OSR. Methods for reading, writing, and processing raster and vector data. 5. QT Interface Design Utilizing tools for rapid application development (RAD), automatic code generation, connecting interface elements with executable code. Introduction to the concept of event-driven programming. Familiarization with libraries for building graphical interfaces. 6. Practical Implementations Sample applications using Python and QT. Implementation of photogrammetric and remote sensing algorithms for data processing. Manipulating images through direct I/O and libraries. Data visualization methods Selected topics may require webinar (online) atenndance.	W1, U1, U2, K1	Project classes

Extended information/Additional elements

Teaching methods and techniques :

webinars and online environment for e-learning: UPEL, BigBlueButton, Clickmeeting or MS Teams., E-learning

Activities	Methods of verification	Credit conditions
Project classes	Activity during classes, Execution of exercises, Execution of a project	

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

Design exercises are passed on the basis of a colloquium. In the absence of a pass, there will be an opportunity to improve.

Method of determining the final grade

Evaluation of the student's activity on exercises, assignments and the final project.

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

The student makes up the arrears on his own.

Prerequisites and additional requirements

General x86 computer usage
Text editor familiarity
Fluent common english language

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

Project exercises: Students carry out practical work aimed at obtaining the competences assumed by the syllabus. The method of project implementation and the final effect are assessed.

Literature

Obligatory

1. Python documentation: https://docs.python.org/3/
2. Qt documentation: https://doc.qt.io/qtforpython-5/contents.html

Optional

1. Summerfield Mark: “Rapid GUI Programming with Python and Qt”. Prentice Hall 2008
2. Dawson Michael: “Python dla każdego.Podstawy programowania”. Helion 2014

Scientific research and publications

Publications

1. K. Pyka, M. Twardowski: "Miejsce wolnego oprogramowania w nauczaniu geoinformatyki". Archiwum Fotogrametrii, Kartografii i Teledetekcji. 2007.
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. Rzonca A., Twardowski M., 2022, The lidargrammetric model deformation method for altimetric UAV-ALS data enhancement

Learning outcomes prescribed to a field of study

Code	Content
GIK2A_K01	działania w sposób kreatywny i przesiębiorczy z uwzględnieniem krytycznej oceny posiadanej wiedzy i potrzeby konsultacji eksperckich
GIK2A_U06	posługiwać się technikami informacyjno-komunikacyjnymi właściwymi do realizacji zadań typowych dla działalności inżynierskiej,
GIK2A_U11	zapisywać obiekty świata rzeczywistego w systemie informacji przestrzennej oraz tworzyć i realizować procedury postępowania w języku formalnym za pomocą złożonych narzędzi programowych, dokonując krytycznej analizy stosowanych metod, uwzględniając komponent badawczy i aspekty pozatechniczne
GIK2A_W05	metody, techniki, narzędzia i materiały stosowane przy rozwiązywaniu złożonych zadań inżynierskich z dziedziny geodezja i kartografia oraz dziedzin pokrewnych
GIK2A_W06	specjalistyczne metody pozyskiwania, analizowania, modelowania i wizualizowania danych przestrzennych i zmian tych danych spowodowanych procesami naturalnymi i technologicznymi