Course guide
310648 - 310648 - Advanced Remote Sensing

Last modified: 28/07/2025

Unit in charge: Barcelona School of Building Construction
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: CAROLINA PUIG POLO

Others: CAROLINA PUIG POLO

REQUIREMENTS

Having taken and passed the subject of Remote Sensing.

TEACHING METHODOLOGY

The course is primarily practical in nature. Each content block will begin with a brief theoretical explanation, followed by the practical application of the concepts learned.
Attendance is considered essential for proper understanding, as the practical sessions are carried out collaboratively.

LEARNING OBJECTIVES OF THE SUBJECT

This course aims to delve into advanced techniques of remote sensing and large-scale geospatial data analysis, using cloud-based programming and the Python programming language.
The goal is for students to acquire the skills to process, analyze, and interpret satellite imagery in various environmental and geospatial contexts, including land cover change detection, vegetation analysis, natural disaster monitoring, and other topics related to climate change.

STUDY LOAD

Type	Hours	Percentage
Hours large group	12,0	16.00
Self study	45,0	60.00
Hours medium group	18,0	24.00

Total learning time: 75 h

CONTENTS

Introduction: Remote Sensing and Cloud-Based Programming

Description:
Review the fundamentals of remote sensing and explore its applications in geospatial analysis. Introduce Python programming applied to cloud environments.

Specific objectives:
- Overview of Remote Sensing
- Introduction to Python and Cloud-Based Data

Full-or-part-time: 4h
Laboratory classes: 2h
Self study : 2h

Python Environment Setup and Basic Data Handling in GEE

Description:
The setup process for working with the Python API of Google Earth Engine (GEE) will be covered, particularly in interactive platforms like Google Colab. Essential libraries such as ee and geemap will be introduced, and students will learn how to visualize raster and vector data on an interactive GEE map within a Python environment.

Specific objectives:
- Properly configure and authenticate the Python API of Google Earth Engine in a Jupyter Notebook environment such as Google Colab.
- Import and use the geemap library for interactive visualization of geospatial data in GEE.
- Load image collections from the GEE catalog.

Related activities:
- Explore the Google Earth Engine (GEE) data catalog to identify relevant image and vector datasets for remote sensing.
- Review the general GEE documentation on client and server concepts, and understand how GEE performs most computations on the server side.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study : 2h

Advanced Image Processing with Python

Description:
Methods for filtering image collections based on temporal, spatial, and metadata criteria will be explored. Preprocessing functions, such as cloud masking, will also be applied, and spectral index calculations will be performed to extract meaningful information from the imagery.

Specific objectives:
- Apply temporal and spatial filters to image collections to select relevant data for a specific study area and time period.
- Implement custom Python functions.
- Perform cloud and shadow masking using the QA bands of the images to ensure data quality.
- Compute advanced spectral indices (such as NDVI) and other attributes derived from image bands.

Full-or-part-time: 8h
Laboratory classes: 4h
Self study : 4h

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Advanced Operations with Vector Data and Integration in Python

Description:
Advanced Vector Data Management in GEE with the Python API

Full-or-part-time: 1h
Laboratory classes: 1h

title english

Description:
The objective of this topic is to explore the capabilities of Machine Learning (ML), with an emphasis on implementing supervised, unsupervised, and regression techniques.
The full cycle of an ML project will be studied: from the preparation of training and validation data, through the selection and training of classifiers (e.g., Random Forest), to the application of the models and the evaluation of their accuracy.

Specific objectives:
- Identify and apply supervised classifiers (e.g., Random Forest) and unsupervised classifiers (e.g., KMeans).
- Create and manage training and validation datasets for classification tasks.
- Evaluate the accuracy of the generated classifications using confusion matrices and overall accuracy metrics.

Full-or-part-time: 12h
Laboratory classes: 6h
Self study : 6h

Aplications

Description:
This section will cover real-world case studies applying the knowledge acquired in the previous topics.

Specific objectives:
Apply the acquired knowledge to extract and visualize information from time series, land use changes, and other applications.

Full-or-part-time: 32h
Laboratory classes: 13h
Guided activities: 6h
Self study : 13h

GRADING SYSTEM

The course grade is calculated as follows:
30% Submission of exercises or quizzes completed in class.
70% Submission and presentation of one or two synthesis projects.

EXAMINATION RULES.

English:
To pass the course, students must attend at least 80% of the classes and submit the assigned work within the established deadline.
Late submissions will not be accepted unless there is a justified reason communicated before the due date.
This course is passed through continuous assessment and does not include a resit exam.

BIBLIOGRAPHY

Basic:

- Wu, Qiusheng. Earth Engine and Geemap Geospatial Data Science with Python. Locate Press, ISBN 978-1-7387675-2-6.
- Jeffrey A. Cardille, Morgan A. Crowley, David Saah, Nicholas E. Clinton. Nou llibreCloud-Based Remote Sensing with Google Earth Engine. Springer Cham, ISBN 978-3-031-26588-4.