

Spatial Analysis

Code: 43379
ECTS Credits: 9

Degree	Type	Year	Semester
4314828 Remote Sensing and Geographical Information Systems	OB	0	1

Contact

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Use of Languages

Principal working language: spanish (spa)

Other comments on languages

Approximately 25% of the classes are in Catalan and 75% in Spanish. Most of the literature is in English

Teachers

Joan Pino Pino Vilalta

Lluís Pesquer Mayos

Pere Serra Ruiz

External teachers

Oscar Mora

Prerequisites

Prerequisites are not required

Objectives and Contextualisation

At the end of the course, the student will be able to:

Dominant at the practical level the different tools related to the interpolation and terrain analysis.
Use the main applications for the generation of new information from GIS data.
Identify the concepts associated with spatial analysis, its applications and its limitations.

Competences

- Analyse and exploit geographic data from different sources to generate new information from pre-existing data.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.

- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Use different specialised GIS and remote sensing software, and other related software.
- Use different techniques and concepts for generating useful information in spatial analysis.
- Write up and publicly present work done individually or in a team in a scientific, professional context.

Learning Outcomes

1. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
2. Continue the learning process, to a large extent autonomously.
3. Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.
4. Exploit geographic data through map algebra, layer combination, network analysis and other techniques, taking the right decisions for each problem area based on the knowledge acquired.
5. Identify the concepts associated with spatial analysis, their applications and their limitations.
6. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
7. Show expertise in using the different tools of terrain analysis and interpolation.
8. Use the main applications for generating new information from GIS data.
9. Write up and publicly present work done individually or in a team in a scientific, professional context.

Content

ANALYSIS IN GIS

1. General Concepts of GIS Analysis
 - 1.1 Introduction
 - 1.2 Specifications regarding the data model
 - 1.3 Combining raster-vector analysis
2. Layers combinations
 - 2.1 Variants and possibilities
 - 2.2 Vector overlay
 - 2.3 Transfer of attributes
 - 2.4 Categorical data
3. Map algebra
 - 3.1 Previous conditions
 - 3.2 Characteristics
 - 3.3 NODATA
 - 3.4 Multicriteria decision analysis
4. Propagation of errors
 - 4.1 Geometric quality criteria
 - 4.2 Thematic quality criteria
 - 4.3 Elimination of results by criteria of geographical insignificance
5. Analysis of the landscape
 - 5.1 Introduction to the conceptual and methodological framework of landscape ecology
 - 5.2 Calculation and analysis of landscape indexes at various scales
 - 5.3 Analysis of the ecological connectivity of the landscape
6. Space interpolation
 - 6.1 Concepts
 - 6.2 Polygons of Thiessen
 - 6.3 Trend surfaces
 - 6.4 Kriging
7. Logistic regression
 - 7.1 Characteristics
 - 7.2 Spatial applications
 - 7.3 Limitations and adjustments of models
- 8 Analysis of distances

- 8.1 Cartesian distances and geodesic distances
- 8.2 Generation of continuous and buffer maps
- 8.3 Anisotropic distances and cost analysis
- 8.4 Introduction to network analysis

DIGITAL TERRAIN MODELS

- 1. Concepts
 - 1.1 Fundamental concepts and terminology (DTM, DEM, DSM, etc.)
 - 1.2 Models of data: raster, TIN, isolines, etc
 - 1.3 Vertical and geoid duck
- 2. Collection of data. Primary (field, photogrammetry, lidar, InSAR, etc.) and Secondary
- 3. Generation of DTM
 - 3.1 Interpolation from points: Inverse of the weighted distance (IDW), splines, kriging
 - 3.2 Interpolation from isolines
 - 3.3 Generation of TIN models
- 4. Quality of MDT
 - 4.1 Altimeter quality
 - 4.2 Control of the error in the DTM
 - 4.3 Propagation of error in derivative models
- 5. Derived models
 - 5.1 Slope, orientations, curvatures, etc.
 - 5.2 Hydrographic basins, drainage network
 - 5.3 Illumination, shading and solar radiation
- 6. Applications
 - 6.1 Applications in the processing of remote sensing images: geometric and radiometric image rectification.
 - 6.2 Topographical profiles and visibility analysis
 - 6.3 Three-dimensional perspectives

INTERFEROMETRY

- 1. Introduction
 - 1.1. Image sensors
 - 1.2. Spectral window
 - 1.3. SAR missions (Synthetic Aperture Radar)
- 2. SAR concept
 - 2.1. Classical radar
 - 2.2. SAR technical concepts
- 3. SAR image
 - 3.1. Spectral and reflection characteristics
 - 3.2. Geometric distortions
 - 3.3. Georeferencing on SAR imagery
- 4. SAR Interferometry (InSAR)
 - 4.1. Basic formulation
 - 4.2. Coherence and noise sources
 - 4.3. How to create an Elevation Map using InSAR
- 5. Differential Interferometry SAR (DInSAR)
 - 5.1. Basic formulation
 - 5.2. How to create a ground motion map with DInSAR
 - 5.3. Characteristics of DInSAR products
- 6. PSI Techniques (Persistent Scatterer Interferometry)
 - 6.1. Basic concepts
 - 6.2. PSI Processor Components
 - 6.3. Scatterers
 - 6.4. Examples of ground motion measurements with PSI

Methodology

In this module there are 3 groups of learning activities:

Targeted activities consist of classes of theory and practices that will be carried out in a specialized computer room. At the beginning of each of the subjects that make up the module, the teachers will explain the structure of the theoretical-practical contents, as well as the evaluation method.

Supervised activities consist of classroom practices that will allow you to prepare the work and exercises of each subject, as well as tutorial sessions with the teachers in case the students request it.

Autonomous activities are a set of activities related to the elaboration of works, exercises and exams, such as the study of different material in the form of journal articles, reports, data, etc., defined according to the needs of autonomous work of each student

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes / exhibitions	51	2.04	3, 7, 4, 5, 6, 1, 2, 9, 8
Type: Supervised			
Oral presentation	1	0.04	3, 7, 4, 5, 6, 1, 2, 9, 8
Practical works	58	2.32	3, 7, 4, 5, 6, 1, 2, 9, 8
Tutorials	2	0.08	3, 7, 4, 5, 6, 1, 2, 9, 8
Type: Autonomous			
Personal study	15	0.6	3, 7, 4, 5, 6, 1, 2, 9, 8
Reading of articles / reports of interest	3	0.12	3, 7, 4, 5, 6, 1, 2, 9, 8
Writing reports	94	3.76	3, 7, 4, 5, 6, 1, 2, 9, 8

Assessment

The evaluation of this subject consists of the following system:

- The realization of 2 exams (a test and an oral presentation), that will be between 60 % and 70 % of the final note and that will include the theoretical and practical subject carried out.
- The accomplishment of different practical works proposed throughout the teaching of the module and delivered within the fixed term, that will be between 30 % and 40 % of the final note. A correct formal presentation and careful preparation will be assessed.

Aspects to take into account.

- Regular class attendance is highly recommended in order to follow the lessons properly. Follow on through streaming is only justified in cases of physical impossibility for face-to-face assistance, since an important part of the experiences and learning are fully achieved through contact with the teaching staff and classmates.
- If you have to deliver practical work, this delivery must be done within the deadlines for them to be evaluated.
- On carrying out each evaluation activity, Lecturers will inform of the procedures to be followed for reviewing all grades awarded, and the date on which such a review will take place.

Extraordinary exams.

- The exams or other evaluation procedures not reaching the minimum mark of 5 out of 10 must be repeated. This extraordinary exam is unique.
- Students will have the opportunity to take a extraordinary exam the day or days scheduled by the faculty.

Cheating: Copies and plagiarisms.

By copies, we refer to the evidence that the work, project, exam, etc has been partially or totally created/answered without the intellectual contribution of the author. In this definition, we also include the proven attempt to copy in the exams and delivered works and projects and the violation of the laws that assure intellectual authorship. Plagiarisms refer to the works and texts from other authors that someone pretends to be his/her own creation. It is a crime against intellectual property. In order to avoid committing plagiarism, quote all the sources that you use when writing the report of a project. According to UAB's law, copies and plagiarisms or any other attempt to alter the results of one's own evaluation or someone else's -allowing to copy, for example- implies a result in the corresponding part (theory, problems or practical tasks) of a 0 and, in this case, the student will fail the subject. This does not limit the right to take academic and legal actions against those who have participated. See UAB documentation about copies and plagiarisms

http://wuster.uab.es/web_argumenta_obert/unit_20/sot_2_01.html

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Theoretical exam and oral presentation	60%-70%	1	0.04	3, 7, 4, 5, 6, 1, 2, 9, 8
Writing reports	40%-60%	0	0	3, 7, 4, 5, 6, 1, 2, 9, 8

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Software

MiraMon, ArcGIS, QGIS, MATLAB, ENVI, SNAP, LAStools, Office Microsoft