Universitat Autònoma de Barcelona

2019/2020

Geographic Information Systems

Code: 43847
ECTS Credits: 6

Degree	Type	Year	Semester
4315985 Geoinformation	OB	0	1

Contact

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Use of Languages

Principal working language: spanish (spa)

Teachers

Joan Nunes Alonso

Prerequisites

This course has no specific requirements. Students should only have a basic knowledge of using general software such as Windows, Excel and Word.

Objectives and Contextualisation

The course provides both practical and theoretical understanding of the use of geospatial information and of the systems to manage it. It gives a consistent and complete view of the architecture of information systems (e.g., standalone, client-server and service-oriented) and of the different types of GIS software that are components of these architectures (e.g., desktop GIS software, spatial databases and web geospatial servers and clients).

Following the systematic review of architecture components the course addresses GIS client software functionality (e.g., data editing, structuring, manipulating, querying and analyzing) in depth and with regard to the different data structures available for geospatial information.

Finally the course covers the whole set of geoprocessing operations and the various means to automate operations and procedures (e.g., models, scripts, etc.).

Competences

- Continue the learning process, to a large extent autonomously.
- Design and manage geospatial information systems, integrating spatial and alphanumerical, relational and object-oriented data bases, in client-server distributed architectures, or those oriented to services.
- Develop and apply geospatial and alphanumeric information analysis methodologies to resolve urban or land management problems, generating useful information for the implementation of intelligent processes and for decision making.
- Develop imaginative, creative and innovative ideas in projects for geospatial information systems, services, products or applications.
- Differentiate between and use different data models and standard of geospatial information (digital cartography, spatial databases and metadata), and be able to recognise their respective components and capacities.

- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Learning Outcomes

1. Apply interpolation methods suited to the nature of the problem to be solved and to the available data.
2. Apply network analysis operations in a consistent way.
3. Apply the methods and techniques of spatial analysis judiciously and responsibly.
4. Apply the operations of cartographic analysis and maps algebra in a consistent way.
5. Apply the various structures of each data model.
6. Automate sequences of operations in procedures for analysing or constructing geospatial data, through different types of resources such as models or scripts, especially when processing large volumes of data.
7. Carry out complex data-conversion processes between geospatial data in different formats, structures and data models, using different programmes.
8. Choose suitable data, methods and spatial analysis operations to solve complex land-use problems.
9. Consistently apply terrain analysis operations based on digital elevation models.
10. Continue the learning process, to a large extent autonomously.
11. Develop imaginative, creative and innovative ideas in projects for geospatial information systems, services, products or applications.
12. Identify the nature and the parts of a complex land-use problem.
13. Know and apply the different forms of indirect georeferencing (geocoding, linear referencing) and their capacity for modelling the representation of entities with geographic localisation.
14. Know and apply the different ways of representing geographic position.
15. Know the principles of topology and their application in geographic information systems.
16. Know the principles, methods and techniques of spatial analysis.
17. Process the data in a way that ensures the highest levels of efficiency.
18. Recognise the components and capacities of the various structures of each data model.
19. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
20. Synthesise ideas and knowledge that help to develop new methodologies of land-use analysis.
21. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
22. Use the principal programmes for geographic information systems.
23. Use topological procedures in different programmes and implementation formats in order to verify the coherence of spatial data.

Content

Geographic information systems

1. Information systems logical architecture.

    Functional levels of an information system: data tier, logic tier, presentation tier.

    Standalone architecture, local or network: files, file servers.

    Client-server architecture: data servers.

    Three-tier architecture and Service Oriented Architecture (SOA): application servers, services, geospatial information services.

    Cloud platforms.

    Location-based services for mobile devices.

2. GIS software structural typology.

Client GIS software.

Data server GIS software.

Application server GIS software.

GIS software components and development frameworks.

Cloud GIS software.

3. GIS projects.

GIS for organizations.

GIS for projects.

4. GIS functionality.

Groups of GIS functions.

Client GIS software functional typology.

5. Data access, organization and visualization with client GIS software

Concept of layer.

Properties of layers: data source, queries, joins, simbology, labels.

Data layers.

Map service layers.

6. Spatial data structuring.

Geometric information: shapes.

Topological information: spatial relationships based on interior and boundary of shapes.

Association information: composition, aggregation and containment relationships.

Thematic information: attributes.

Data structures for spatial information implementation.

Types of topology: planar, rule-based, interactive.

Spatial data structuring processes.

7. Spatial data editing.

Editing methods suitable for each spatial data structure.

Creating and editing spatial data.

8. Transforming, converting and managing spatial data.

Data conversion between file formats and data structures.

Geoprocessing constructive operations.

Spatial data management.

9. Linking and managing tabular thematic data.

Join operation in GIS and DBMS software.

Link operation between tables.

Aggregate functions on tables.

10. Geocoding.

Address geocoding.

Linear referencing.

11. Querying alfanumeric and spatial data.

Selection by attributes.

Selection by spatial relationships.

Spatial join.

Geoprocessing

1. Introduction to geoprocessing functions.

Analysis and transformation operations vs query operations.

Groups of analysis and transformation operations.

2. Basic transformation functions.

Clipping of vector and raster data.

Mosaic of vector and raster data.

Spatial aggregation operations.

3. Vector overlay operations: geometric overlay.

Point on line overlay.

Point on polygon overlay.

Line on polygon overlay.

Polygon on polygon overlay.

4. Raster overlay operations: arithmetical overlay.

Logical overlay.

Arithmetical overlay.

5. Proximity analysis.

Vector proximity analysis.

Raster proximity analysis.

6. Process automation.

Model Builder.

7. Digital elevation models (DEM).

    DEM creation.

    DEM by-products.

    Visibility analysis.

8. Network analysis.

    Optimal path analysis.

    Service area analysis.

Methodology

Learning is achieved by means of three types of activities.

Directed activities: Directed activities are theoretical and practical lectures in a computer lab. They include solving case studies and practical exercises. Lectures are the common thread of the course. Lectures serve to systematize all the content, to present the state of the art of the different subjects, to provide methods and techniques for specific tasks, and to sum up the knowledge to learn. Lectures organize also the autonomous and complementary work done by the students

Supervised activities: Supervised activities are focused on the execution of a semester project, consisting of a real case study, carried out through workshop hours, autonomous work and tutorials. This semester project allows to apply together all the knowledge and technical skills learnt in all the courses of the semester. The semester project is a milestone for the students and the actual demonstration that they had achieved the learning goals of all the courses of the semester. It is also the main evidence for evaluation as students should have to submit at the end of the semester a report that summarizes the whole project and do an oral presentation.

Autonomous activities: Autonomous work of the students includes personal readings, data and documentation search, complementary exercises and the personal development of the semester project.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures and practical exercises in a computer lab	36	1.44	15, 16, 13, 14, 10, 18, 21
Type: Supervised			
Individual and group practical work guided by teachers	15	0.6	4, 2, 9, 3, 5, 1, 6, 15, 16, 13, 14, 11, 12, 19, 10, 7, 18, 17, 8, 20, 21, 22, 23
Type: Autonomous			
Solving practical exercies using specific software and suggested bibliography. Personal study	69	2.76	4, 2, 9, 3, 5, 1, 6, 15, 16, 13, 14, 11, 12, 19, 10, 7, 18, 17, 8, 20, 21, 22

Assessment

CONTINUOUS EVALUATION

a) Evaluation procedure and activities:

Evaluation of the course is based mostly on the semester project, that comprises two evaluation activities. The elaboration and submission of a synthesis report and the oral presentation of the project done. Given the technical content of the course, the weight assigned to the project report is 40% of the total course grading, assuming that it is the most appropriate means to explain all the technical details of the project, and a weight of 20% at the oral presentation. The course assessment is completed with the evaluation of the practical exercises done along the course, that account for another 40% of the total course grading.

Except when expressly noticed, all the evaluation activities (report and oral presentation of the semester project, as well as practical exercises) have to carried out individually.

Time assigned to each evaluation activity includes the time spent in making all the material evidences for evaluating each activity (e.g., writing of the report, preparing the presentation slides, etc.).

b) Evaluation schedule:

1st semester project report: Making during all the semester. Submission at the end of semester, on January 24 th 2020.

1st semester project oral presentation: Making during all the semester. Oral presentation at the end of semester, on January 30th and 31st 2020.

Course practical exercises: Making and submission weekly or biweekly along the semester.

c) Grade revision:

Once the grades obtained are published, students will have one week to apply for a grade revision by arranging an appointment with the corresponding teachers.

d) Procedure for reassessment:

1st semester project report: It could be reassessed in the following two weeks after the submission date scheduled. Reassessment will require the submission of a new whole report in case of negative evaluation of the former report submitted.

1st semester project oral presentation: It could be reassessed in the following week after the date scheduled for the oral presentation. Reassessment will require doing again the oral presentation in case of negative evaluation of the former presentation done.

Course practical exercises: Can not be reassessed.

To have right to a reassessment the student will have to have been previously evaluated in a set of activities that account for at least two thirds of the total course grading. Therefore he or she will have to have been evaluated of the 1st semester project report (40%) and of the 1st semester project oral presentation (20%) in the dates scheduled.

The right to a reassessment will only be granted to students that, having not passed the course (e.g., having a total course grade below 5 over 10), had obtained at least a total course grade above 3,5 over 10.

Plagiarism or copying in any activity will deserve a grade of 0 in this activity and could not be recovered. In case of repeated offence all the course grade will be FAIL. It is considered "copy" a work that reproduces all or a sunstantial part of another student's work. It is considered "Plagiarism" to present all or part of an author's published work without citation of the original sources, either analogic (e.g., paper) or digital. See more information over plagiarism at http://wuster.uab.es/web_argumenta_obert/unit_20/sot_2_01.html.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Oral presentations	20	6	0.24	11, 12, 20, 21
Practical exercises	40	12	0.48	4, 2, 9, 3, 5, 1, 6, 15, 16, 13, 14, 11, 12, 19, 10, 7, 18, 17, 8, 20, 22, 23
Report submissions	40	12	0.48	4, 2, 9, 3, 5, 1, 6, 15, 16, 13, 14, 11, 12, 19, 10, 7, 18, 17, 8, 20, 21, 22, 23

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