

Advanced GIS

Code: 43381
ECTS Credits: 9

Degree	Type	Year	Semester
4314828 Remote Sensing and Geographical Information Systems	OT	0	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)

Other comments on languages

Approximately 30 % of the classes are in Catalan and 70 % in Spanish. Most of the literature is in English

Teachers

Alaitz Zabala Torres

External teachers

Joan Masó Pau

Jordi Vayreda

Núria Julià

Prerequisites

Prerequisites are not required

Objectives and Contextualisation

This optional module, increases the knowledge acquired in the spatial analysis module of the same master, focusing on the exploitation of geographic databases from the SQL language, as well as in specific practical cases. In addition, it adds concepts associated with the publication of cartography on the Internet taking into account international standards for data and metadata that allow interoperability including semantic, technologic, information, etc.

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

1. Use different cartography publication tools on the Internet.
2. Know the advantages and limitations of the use of standards in the GIS world.
3. Apply international standards to the edition and publication of data and metadata on the Internet.

4. Master queries in databases using SQL language.
5. Design appropriately information systems for the use of data in a scientific, professional or informative context.

Competences

- Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.
- Design and apply solutions based on GIS tools for managing and exploiting natural resources or administrative information with a spatial component.
- Handle different data and metadata formats appropriately and take the importance of international standards into account when storing them and publishing them on internet.
- Take a holistic approach to problems, offering innovative solutions and taking appropriate decisions based on knowledge and judgement.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use different specialised GIS and remote sensing software, and other related software.

Learning Outcomes

1. Apply international standards for editing and publishing data and metadata on internet.
2. Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.
3. Design suitable information systems for handling data in scientific, professional or general-interest contexts.
4. Handle different tools for publishing cartography on internet.
5. Know the advantages and limitations of the use of standards in the GIS field.
6. Show expertise in querying databases using the SQL language.
7. Take a holistic approach to problems, offering innovative solutions and taking appropriate decisions based on knowledge and judgement.
8. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Content

RELATIONAL DATABASES. SQL

1. Introduction to relational databases
2. Conceptual design of a relational database: entity-relationship model
 - 2.1 Foundations of relational databases
 - 2.2 Entities, attributes, instances
 - 2.3 Primary keys and foreign keys
 - 2.4 Types of relationships and classification
 - 2.5 Three-valued logic
3. Logical design of a database
4. The sample database: IEFC_Garrotxa.mdb
 - 4.1 The Ecological and Forest Inventory of Catalonia (IEFC de la Garrotxa)
5. Conceptual, logical and physical model of the IEFC database
6. Physical design of a database (standardization)
7. Practical example of designing a database for a Library
8. Advantages of a relational database: integrity of entities and referential integrity
9. Features of a Database Management System (SGDB)
10. Introduction to the SQL language (management of a BD)
 - 10.1 What is SQL?
 - 10.2 Advantages of SQL
11. Introduction to DML (Data Management Language) and DDL (Data Definition Language)
12. Recovery of data with SQL: SELECT statement
13. Simple inquiries (SELECT ... FROM)
 - 13.1 Management practices with SQL databases (1)
14. Union consultations (UNION)

- 14.1 Database management practices with SQL (2)
- 15. Multi-table questions: compositions
 - 15.1 Multi-table queries in SQL1
 - 15.2 Internal compositions (INNER JOIN)
 - 15.3 External compositions (LEFT, RIGHT and OUTER JOIN)
 - 15.4 Self-composition
 - 15.5 Management practices with SQL databases (3)
- 16. Summary queries
 - 16.1 Column functions (GROUP BY)
 - 16.2 Conditions in summary queries (HAVING)
 - 16.3 Database management practices with SQL (4)
- 17. Subqueries
 - 17.1 Comparison test with subquery
 - 17.2 Proof of belonging to a subset of a subquery
 - 17.3 Test of existence
 - 17.4 Quantitative comparison test
 - 17.5 Database management practices with SQL (5)
- 18. Nested consultations
 - 18.1 Database management practices with SQL (6)
- 19. ODBC Link of a GIS layer with a SQL query (DSN file)
 - 19.1 Creation of a DSN file for the database
 - 19.2 Creation of a layer of points from the database
 - 19.3 Creation of a link via ODBC of a SQL query with MiraMon's point layer
 - 19.4 Creation of a link via ODBC from a SQL query with a layer of MiraMon polygons
- 20. Transactions (COMMIT ROLLBACK)
- 21. Update records:
 - 21.1 Insertion of records (INSERT)
 - 21.2 Delete and delete with subquery (DELETE)
 - 21.3 Modification and modification with subquery (UPDATE)
 - 21.4 Database management practices with SQL (7)
- 22. DDL (Data Definition Language)
 - 22.1 Definition and creation of databases
 - 22.2 Definition of tables and views
 - 22.3 Definition of fields
 - 22.4 Definition of restrictions
 - 22.5 Definition of indexes
 - 22.6 Changes in the structure of the database
 - 22.7 Database management practices with SQL (8)

CASE STUDIES IN GIS IMPLEMENTATIONS

Contents based on a series of conferences by representatives of different public and/or private organizations that explain the design and use of the GIS in their work environments

STANDARDS FOR DISTRIBUTED GEOSERVICES

- 1. Introduction
 - 1.1 Interoperability and IDES
 - 1.2 Standardization organizations
 - 1.3 UML and XML
 Exercise 1: Introduction to XML and XML Schema (Enterprise Architect XML Validator Buddy)
- 2. Metadata standards
 - 2.1 Introduction
 - 2.2 Dublin Core
 - 2.3 FGDC

- 2.4 ISO (19115, 19139)
- 2.5 IDEC profile
- 2.6 Profile NEM
- 2.7 INSPIRE profile
- 2.8 Metadata management applications
- Exercise 2: Metadata documentation

- 3. Format standards
- 3.1 Modeling of data: UML and GML
- Exercise 3: Introduction to GML, generation schemes from UML
- 3.2 Other format standards (SHP, MMZx, KML, GeoJSON, SWE Common, WaterML, ...)
- Exercise 4: Google Earth, Google Maps and KML

- 4. GEOSERVICES STANDARDS
- 4.1 Catalog services: CSW
- 4.2 Display services: WMS, WMTS, OWS Context
- 4.3 Download service: WCS, WFS, SOS
- 4.4 Processing service: WPS
- Exercise 5: Connection with external WMS servers.

PUBLISHING CARTOGRAPHY ON THE INTERNET

- 1. Introduction
 - 1.1 Protocols
 - 1.1.1 Layers of protocol
 - 1.1.2 Client server architecture
 - 1.1.3 Most commonly used protocol layers
 - 1.2 Technological evolution of distributed GIS
 - 1.2.1 Static maps (theory for exercise 0)
 - 1.2.2 Static webpages (theory for exercise 1)
 - 1.2.3 Interactive web maps (theory for exercise 2)
 - 1.2.3.a Accelerated JavaScript and JSON
 - 1.2.4 Geoservices distributed
 - 1.3 Nearby technological examples
- 2. ISO and OGC standards
 - 2.1 Introduction to WxS or OWS
 - 2.2 Services for the evaluation of information
 - 2.2.1 Review of the Web Map Service (theory for exercises 3, 4, 5)
 - 2.2.2 Use of several WMS clients
 - 2.3 Services in the cloud (exercise 6)
- 3. Practice
 - 3.1 Introduction to IIS
 - 3.2 Static mappublication
 - 3.2.1 Exercise 1: Publish an HTML Map (Vec2Map)
 - 3.3 Dynamic map publication
 - 3.3.2 Exercise 2: Leaflet API
 - 3.3.3 Tools of the big manufacturers
 - 3.3.4 Exercise 3: Map Publishing with the Map Server
 - 3.3.5 Exercise 4: MapServer
 - 3.3.6 Exercise 5: GeoServer

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	49	1.96	1, 5, 7, 2, 3, 6, 4, 8
Type: Supervised			
Classroom practices	60	2.4	1, 5, 7, 2, 3, 6, 4, 8
Tutorials	4	0.16	1, 5, 7, 2, 3, 6, 4, 8
Type: Autonomous			
Personal study	21	0.84	1, 5, 7, 2, 3, 6, 4, 8
Preparation of works	90	3.6	1, 5, 7, 2, 3, 6, 4, 8
Reading of articles / reports of interest	1	0.04	1, 5, 7, 2, 3, 6, 4, 8

Assessment

The evaluation of this subject consists of the following system:

- The accomplishment of different writings reports proposed throughout the teaching of the module and delivered within the fixed term, that will be worth the 100% of the final note. A correct formal presentation and careful preparation will be assessed.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Writing reports	100	0	0	1, 5, 7, 2, 3, 6, 4, 8

Bibliography

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the Internet and Wireless Networks. Wiley. 679p.

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Standards Guide ISO/TC211 Geographic Information/Geomatics
http://www.isotc211.org/Outreach/ISO_TC%20_211_Standards_Guide.pdf

OGC Reference Model (ORM) <http://www.opengeospatial.org/standards/orm>

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OpenGIS® Geography Markup Language (GML) Encoding Specification v.3.2.1
http://portal.opengeospatial.org/files/?artifact_id=20509

GML 3.1.1 simple features profile v.1.0.0 http://portal.opengeospatial.org/files/?artifact_id=15201

OGC KML v.2.2.0 http://portal.opengeospatial.org/files/?artifact_id=27810

OpenGIS® Web Service (OWS) Common v.2.0.0 http://portal.opengeospatial.org/files/?artifact_id=38867

OpenGIS® Web Map Service (WMS) Implementation Specification v.1.3.0
http://portal.opengeospatial.org/files/?artifact_id=4756

OpenGIS® Web Coverage Service (WCS) Implementation Specification v.1.1.2
http://portal.opengeospatial.org/files/?artifact_id=27297

OpenGIS® Web Feature Service (WFS) Implementation Specification v.1.1.0
http://portal.opengeospatial.org/files/?artifact_id=8339

OpenGIS® Web Map Tile Service (WMTS) Standard v.1.0.0
http://portal.opengeospatial.org/files/?artifact_id=35326

Software

MiraMon, ArcGIS, QGIS, MiraBosc, Enterprise Architech, XML Validator, GeoServer, MiraMonMapServer, Office Microsoft