UAB
Universitat Autònoma de Barcelona

Geographical Information Systems in Archaeology

Code: 106875
ECTS Credits: 6

2025/2026

Degree	Type	Year
Archaeology	OP	3

Contact

Name: Ermengol Gassiot Ballbe

Email: ermengol.gassiot@uab.cat

Teachers

Miquel Nieto i Conill

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Have completed and passed courses 106867 - Cartografia Digital (2024-25) i 106868 - Paisatge i Territori

Objectives and Contextualisation

Objectives

Geographic information systems are a very useful tool in archaeology in many ways: managing and consulting data from archaeological surveys and excavations, cartographic representation of results, spatial analysis (from micro to macro levels), etc.
In accordance with the subject's objectives, and building on the content of courses 106867 - Digital Cartography (2024-25) and 106868 - Landscape and Territory, this course has three specific objectives:
1. To provide the foundations for understanding the functioning and correct use of geographic information systems and database management systems, both alphanumeric and spatial.
2. To provide systematic knowledge of the main methodologies and operations of geographic information systems applicable to archaeological analysis, using examples and case studies specifically related to archaeology.
3. To analyze several cases of the use of Geographic Information Systems to solve archaeological problems in various periods of prehistory and history and geographical areas, and to introduce students to the basic aspects of these applications.

Learning Outcomes

1. CM16 (Competence) Apply space analysis and management tools to the methodological design of basic and applied archaeology work.
2. CM17 (Competence) Identify the construction processes of social spaces (territory, landscape) in the past, recognising the anthropic footprint on natural environments, so they can be integrated into explanations of the past.
3. KM26 (Knowledge) Recognise the contributions of architecture, geography, geology and paleoenvironmental disciplines, as well as developments in GIS resources and computer databases for the comprehensive development of archaeology.
4. KM27 (Knowledge) Archaeologically identify the expression in space of historical and social processes integrating a spatial perspective of analysis on various scales, from the regional level to that within the settlement.
5. SM26 (Skill) Analyse societies of the past from an understanding of the pattern of dispersion and spatial location of their archaeological remains.
6. SM28 (Skill) Apply cartographic, LIDAR, GIS and geobase resources for the representation and management of archaeological information, as well as the dissemination of heritage.
7. SM29 (Skill) Use geobases and GIS resources in archaeology fieldwork, as well as in the study of archaeological materials and contexts.

Content

Block I. Introduction

1. Introduction: Geographic Information Systems (GIS)

a. What are they?

b. Brief history

c. Principles of operation and analysis

2. Geographic Information Systems in archaeology: a brief history of their application

Block II. GIS and database management

3. Database management systems.

4. Spatial data management

a. Introduction to geodatabases

b. Geodatabases in archaeology

Block III. GIS and spatial data analysis in archaeology

5. Resources: thematic cartography

a. Main sources of thematic cartography useful in archaeology

b. Strengths and limitations of different types of thematic cartography for archaeological analysis

6. Analysis of settlement patterns and systems

a. Sites and deposits: multivariable characterization of their locations

b. Patterns of dispersion and agglomeration

7. Analysis of territorial control and visual landscapes

a. Visual conques

b. Intervisibility relationships

8. Analysis of settlements and resources: from catchment areas to cost distance areas

9. Mobility analysis:

a. Optimal paths or minimum cost paths

b. Network analysis

10. Micro-space analysis: activity areas

11. Models of archaeological presence probability. Brief introduction to spatial modeling in archaeology

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practice guided by teachers or through tutorials for monitoring and developing practical skills.	34	1.36	CM16, KM26, KM27, SM28, SM29, CM16
Individual and group work supervised by the teacher	20	0.8	CM16, KM27, SM28, SM29, CM16
Master classes with ICT support	50	2	CM16, KM27, SM26, SM28, SM29, CM16
Type: Autonomous			
Practical work using specific software and recommended reading. Personal study.	40	1.6	CM16, SM28, SM29, CM16

Theoretical and methodological subjects are introduced with concise lectures and are developed by the autonomous work done by the students, which includes studying specific course materials (class notes provided for all the subjectes) available at UAB Virtual Campus and general readings (bilbiography and web resources).

Technical abilities are acquired by a set of guided exercises done by the students in a computer lab during the teaching period or on their own.

For each subject students will do 1 or 2 exercises at an approximate rate of one exercise per week.

All the course resources (class notes, exercises, quizzes, documents and data) are available online at UAB Virtual Campus (a Moodle based e-learning platform).

The activities that cannot be done in person will be adapted to the possibilities offered by the UAB virtual tools. The exercises, projects and theoretical classes will be carried out through virtual tools, such as tutorials, videos, TEAMS sessions, etc. The teacher will ensure that the student can access or offer alternative means, when available.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Midterm theoretical exams	25%	2	0.08	KM26, KM27, SM26
Practical exercises handed out throughout the course	50	2	0.08	CM16, CM17, KM26, KM27, SM26, SM28, SM29
Practical midterm exams	25%	2	0.08	CM16, CM17, SM28, SM29

Evaluation of this course is continuous and is based on the outcome of the practical exercises, either guided or autonomous. All the execises should be submitted in the time scheduled. Assignments not submited in time can be

submited at the end of the semester (several days before the final exam).

All the exercises are mandatory and have to be done individually. The average of all assignment grades is the exercises grade. Exercises can not be retaken nor re-evaluated.

The exercises grade must be validated passing a final exam at the end of the semester (first week of June).

To pass the course students have to:

- ***submit at least 80% of the exercises assigned*** to have the right to attend to the final exam.

- ***pass the final (or recovery) exam with a minimum grade of 5 over 10***.

Once the final (or recovery exam) is passed, the final grade of the course will be the highest grade, either the exercises grade or the exam grade.

RECOVERY: Students that do not pass the final exam will have the right to do a recovery exam two weeks later, in the date scheduled by the school. Requirements for attending to the recovery exam are the same for attending to the final exam (80% of the exercises submitted).

In the event that tests or exams cannot be taken onsite, they will be adapted to an online format made available through the UAB's virtual tools (original weighting will be maintained). Homework, activities and class participation will be carried out through forums, wikis and/or discussion on Teams, etc. Lecturers will ensure that students are able to access these virtual tools, or will offer them feasible alternatives.

UAB regulations regarding plagiarism and other irregularities in the evaluation process:

In the event of a student committing any irregularity that may lead to a significant variation inthe grade awarded to an assessment activity, the student will be given a zero for this activity, regardless of any disciplinary process that may take place. In the event of several irregularities in assessment activities of the same subject, the student will be given a zero as the final grade for this subject.

This subject does not incorporate single assessment.

Bibliography

Brughmans, T., van Garderen, M., & Gillings, M. (2018). Introducing visual neighbourhood configurations for total viewsheds. *Journal of Archaeological Science*, *96*, 14-25. https://doi.org/10.1016/j.jas.2018.05.006

Carrero-Pazos, M. (2018). Modelando dinámicas de movilidad y visibilidad en los paisajes megalíticos gallegos. El caso del Monte de Santa Mariña y su entorno (Comarca de Sarria, Lugo). *Trabajos de Prehistoria*, *75* (2), Article 2. https://doi.org/10.3989/tp.2018.12216

Carrero-Pazos, M. (2023). *Arqueología computacional del territorio. Métodos y técnicas para estudiar decisiones humanas en paisajes pretéritos*. Archeopress. https://www.archaeopress.com/Archaeopress/download/9781803276328

Carroll, F., & Carroll, E. (2022). *Budget Travel in the Mediterranean: A Methodology for Reconstructing Ancient Journeys through Least Cost Networks* (1). *5*(1), https://doi.org/10.5334/jcaa.88

Conolly, James and Lake, Mark (2009) *Sistemas de información geográfica aplicados a la arqueología*. Barcelona: Ediciones Bellaterra. 456 pp. (ISBN 978-8472904408)

Čučković, Z. (2022). *QGIS Visibility Analysis* (v1.8) [Software]. https://landscapearchaeology.org/qgis-visibility-analysis/

Garcia Casas, D., & Gassiot Ballbè, E. (2023). The mobility of shepherds in the Upper Pyrenees: A spatial analysis of pathways and site-location differences from medieval times to the 20th century. *Quaternary International*, S1040618223002367. https://doi.org/10.1016/j.quaint.2023.07.007

Gassiot, E., Garcia, D. G., Nunes, J., & Salvador, G. (2020). Modelización de territorios ganaderos en la alta montaña al final del Neolítico: Una integración de análisis espacial e información etnográfica. Trabajos de Prehistoria, 77(1), https://doi.org/10.3989/tp.2020.12246

Gillings, M.; Hacıgüzeller, P. & Lock, G. (Eds.) (2020), *Archaeological Spatial Analysis A Methodological Guide* . Routledge.

Grau, I. (ed.) (2006) *La aplicación de los SIG en la arqueología del paisaje*. San Vicente del Raspeig: Universidad de Alicante. 259 pp. (ISBN: 978-847908863X)

Güimil-Fariña, A., & Parcero-Oubiña, C. (2015). "Dotting the joins": A non-reconstructive use of Least Cost Paths to approach ancient roads. The case of the Roman roads in the NW Iberian Peninsula. *Journal of Archaeological Science*, *54*, 31-44. https://doi.org/10.1016/j.jas.2014.11.030

Gustas, R., & Supernant, K. (2017). Least cost path analysis of early maritime movement on the Pacific Northwest Coast. *Journal of Archaeological Science*, *78*, 40-56. https://doi.org/10.1016/j.jas.2016.11.006

Herzog, I. (2022). Issues in Replication and Stability of Least-cost Path Calculations. *Studies in Digital Heritage* , *5*, 131-155. https://doi.org/10.14434/sdh.v5i2.33796

Manière, L., Crépy, M., & Redon, B. (2021). *Building a Model to Reconstruct the Hellenistic and Roman Road Networks of the Eastern Desert of Egypt, a Semi-Empirical Approach Based on Modern Travelers' Itineraries* (1). *4*(1), Article 1. https://doi.org/10.5334/jcaa.67

Mehrer, M. W. and Wescott, K. L. (eds.) (2005) *GIS and Archaeological Site Location Modeling*. Boca Raton, Florida: CRC Press. 496 pp. (ISBN: 978-0415315487)

Nunes, J. (2012) *Diccionari terminològic de sistemes d'informació geogràfica*. Barcelona: Enciclopèdia Catalana i Institut Cartogràfic i Geològic de Catalunya. 551 pp. (ISBN 978-84-393-8863-0) Consultable en línia a http://www.termcat.cat/ca/Diccionaris_En_Linia/197

Parcero-Oubina, C., Smart, C., & Fonte, J. (2023). *Remote Sensing and GIS Modelling of Roman Roads in South West Britain* (1). *6*(1), Article 1. https://doi.org/10.5334/jcaa.109

Pons, X. i Arcalís, A. (2012) *Diccionari terminològic de Teledetecció*. Barcelona: Enciclopèdia Catalana i Institut Cartogràfic i Geològic de Catalunya. 597 pp. (ISBN ISBN 978-84-393-9008-4) Consultable en línia a http://www.termcat.cat/ca/Diccionaris_En_Linia/197

Rabella, J. M.; Panareda, J. M. i Ramazzini, G. (2011) *Diccionari terminològic de cartografia*. Barcelona: Enciclopèdia Catalana i Institut Cartogràfic i Geològic de Catalunya. 417 pp. (ISBN 978-84-393-8690-2) Consultable en línia a http://www.termcat.cat/ca/Diccionaris_En_Linia/197

van Etten J (2017). "R Package gdistance: Distances and Routes on Geographical Grids." *Journal of Statistical Software*, 76(13), 1-21. https://doi.org/10.18637/jss.v076.i13

van Lanen, R. J., Groenewoudt, B. J., Spek, T., & Jansma, E. (2018). Route persistence. Modelling and quantifying historical route-network stability from the Roman period to early-modern times (AD 100-1600): A case study from the Netherlands. *Archaeological and Anthropological Sciences*, *10*(5), 1037-1052. https://doi.org/10.1007/s12520-016-0431-z

Verhagen, P., Nuninger, L., & Groenhuijzen, M. R. (2019). Modelling of Pathways and Movement Networks in Archaeology: An Overview of Current Approaches. En P. Verhagen, J. Joyce, & M. R. Groenhuijzen (Eds.), *Finding the Limits of the Limes: Modelling Demography, Economy and Transport on the Edge of the Roman Empire* (pp. 217-249). Springer International Publishing. https://doi.org/10.1007/978-3-030-04576-0_11

Wheatley, D., & Gillings, M. (2013). *Spatial Technology and Archaeology: The Archaeological Applications of GIS*. CRC Press.

White, D. A. (2015). The Basics of Least Cost Analysis for Archaeological Applications. *Advances in Archaeological Practice*, *3*(4), 407-414. https://doi.org/10.7183/2326-3768.3.4.407

White, D., & Surface-Evans, S. (Eds.) (2012), *Least Cost Analysis of Social Landscapes: Archaeological Case Studies* . University of Utah Press.

Zamora Merchán, M. (2011). Cálculos de visibilidad en Arqueología. La visibilidad del territorio desglosada en ángulos verticales y su aplicación al período ibérico tardío en Andalucía central. In V. Mayoral Herrera & S. Celestino Pérez (Eds.), *Tecnologías de información geográfica y análisis arqueológico del territorio: Actas del V Simposio Internacional de Arqueología de Mérida* (pp. 309-323). https://www.academia.edu/11462021/C%C3%A1lculos_de_visibilidad_en_Arqueolog%C3%ADa_La_visibilidad_d

Software

All practical work will be carried out using the following software:

- QGIS

https://qgis.org/ca/site/forusers/download.html

This is the website where you can follow the instructions for installing the QGIS program (free and open source).

Specifically, go to the section: "Long term release (most stable) - Standalone installation version QGIS 3.42 (64 bit) or (32 bit)". Most current computers run on 64 bits.

When asked to install SAGA and/or GRASS, accept. SAGA and GRASS are two programs that were independent of QGIS but whose owners decided to make them available to the QGIS community to gain visibility, and they have become algorithm providers in QGIS. We will use them in some exercises.

If you are using QGIS version 3.28 or higher, the SAGA tools will probably appear grayed out in the tool panel and you will not be able to use them initially. If this is the case, install the plug-in called "Processing SAGA nextGen provider."

- GIS: ArcGIS Pro with a nominal license (user of the GIS platform on the ArcGIS Online cloud). Students will have a license for ESRI GIS software for use both on and off campus. They will need to apply for and install the license using the following form

> License application > https://forms.office.com/r/1qijpdxh0a

> All information on resources and support for the GIS software Campus license > https://bit.ly/sigcampusuab

- DBMS: database management systems and other office applications. Students will work with the Microsoft 365 package, mainly with Access Database and Excel Spreadsheet.

> To obtain this software, follow the instructions found here > https://si-respostes.uab.cat/inici/correu/msop-microsoft-office

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed