

ARCL0094  
Geographic Information Systems in Archaeology and  
History)

2023–2024, Term 1  
Masters module, 15 credits

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Moodle: <https://moodle.ucl.ac.uk/course/view.php?id=39576>

The **coursework coversheet** is available on the course Moodle pages and here: <https://www.ucl.ac.uk/archaeology/current-students> under "Policies, Forms and Guidelines". Please enter **your five-digit candidate code on the coversheet and in the subject line** when you upload your work in Moodle.  
Please use **your five-digit candidate code as the name of the file** you submit.  
Please refer to <https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment>  
<https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide/referencing-effectively-and-ioa-guidelines>  
<https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity>  
<https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI>  
for instructions on coursework submission, IoA referencing guidelines and marking criteria, as well as UCL policies on penalties for late submission, over-length work, the use of text generation software (AI) and academic misconduct.

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# 1 Module overview

## 1.1 Module description

This module explores both the theoretical issues and practical methods associated with using Geographical Information Systems (GIS) for archaeological and historical research.

## 1.2 Module aims

The module aims to provide an:

- an introduction to the principles of archaeological and historical GIS and
- an introduction to the fundamentals of GIS
- an insight into the ways GIS is applied in archaeology and history
- a practical awareness of the techniques used to acquire, manage and visualise spatial data
- a familiarity with a range of computer software, particularly ArcGIS and QGIS
- a grounding for those wishing to take the more advanced GIS Approaches to Past Landscapes module (ARCL0095, not running this year)

On successful completion of this module a student :

- understand the theoretical implications that GIS and spatial analysis bring to archaeology as analytical and interpretative aids,
- be familiar with ArcGIS and ArcInfoWorkstation
- be able to navigate spatial data and build a GIS Project
- construct effective spatial and attribute queries
- be familiar with data generalisation and statistical pattern recognition
- be able to digitise vector datasets and conduct raster interpolations (e.g. DEMs)
- be familiar with viewsheds and distance functions
- construct effective map layouts

## 1.3 Methods of assessment

The course is assessed entirely by coursework, consisting of two assignments:-

	Weighting	Word Count	Submission Date(s)
1. Laboratory notebook	50%	-	3rd Nov, 29th Nov, 15th Dec
2. Essay	50%	2500	8th Jan

## 1.4 Communications

- The [Moodle pages](#) are the main hub for this course.
- Important information will be posted by staff in the Announcements section of the Moodle page and you will automatically receive an email notification for these.
- Please post any general queries relating to module content, assessments and administration in the Moodle discussion forum, or via email if you prefer. The forum will be checked regularly.
- For personal queries, please contact the co-ordinator by email.

## 1.5 Week-by-week summary

The course will be taught in Term 1. The first class will be held on 4th October and there will be no taught class in Reading Week.

Classes will be held on Wednesdays, commencing at 09:00 and lasting until 11:00 with further troubleshooting time till 12:00 as required, and additional consultation in my office hours later on Wednesday.

Week	Date	Subject
1	4 Oct	A Rough Guide to GIS
2	11 Oct	Data Structures and Geodesy
3	18 Oct	Vector Data: Acquisition and Manipulation
4	25 Oct	Operations for Vector Data
5	01 Nov	Raster Data: Acquisition and Manipulation
6	08 Nov	<i>Reading week</i>
7	15 Nov	Analysing Spatial Patterns
8	22 Nov	Maps and Digital Cartography
9	29 Nov	Operations for Raster Data
10	06 Dec	Advanced Functions
11	13 Dec	Review and Prospect

## 1.6 Lecturers

The course coordinator is:

**Prof Andrew Bevan**, who is available for consultation in room 108 from 12:00–14:00 on Thursdays, or by appointment.

Tel: +44 (0)20 7679 1508

Email / Teams calling: [a.bevan@ucl.ac.uk](mailto:a.bevan@ucl.ac.uk)

## 1.7 Weekly module plan

Teaching will be by a mixture of recorded lectures, online discussion and supervised practical exercises. Lectures and seminars will last for 1 hour whereas practicals may require up to two hours.

N.B. Participation in practical exercises is enabled via use of student's own laptops wherever possible, although suitably equipped computers can also be found in UCL computer cluster rooms and the AGIS laboratory.

## 1.8 Workload

This is a 15-credit module which equates to 150 hours of learning time including session preparation, background reading, and researching and writing your assignments. With that in mind you should expect to organise your time in roughly this way:

- 20 hours: staff-led teaching sessions (lectures, discussion, practical troubleshooting).
- 50 hours: self-guided preparation (tutorials, reading, listening), about 5 hours a week.
- 40 hours: completing the three assessments that make up the practical portfolio.
- 40 hours: reading for, and writing, the research essay.

## 2 Assessment

Each assignment and possible approaches to it will be discussed in class, in advance of the submission deadline. If students are unclear about the nature of an assignment, they should discuss this with the module co-ordinator in advance (via office hours or class Moodle forum). You will receive feedback on your written coursework via Moodle, and have the opportunity to discuss your marks and feedback with the co-ordinator in their office hours. For more details see the 'Assessment section on Moodle.

The coursework coversheet is available on the course Moodle pages and here: <https://www.ucl.ac.uk/archaeology/current-students> under "Policies, Forms and Guidelines". Please make sure you enter your five-digit candidate code on the coversheet and in the subject line when you upload your work in Moodle. Please use your five-digit candidate code as the name of the file you submit.

The [IoA marking criteria](#) can be found in the IoA Student Handbook (Section 13: Information on assessment). The [IoA Study Skills Guide](#) provides useful guidance on writing different types of assignment.

Please note that **late submission, exceeding the maximum word count and academic misconduct (unacknowledged use of text generation software and plagiarism) will be penalized and can significantly reduce the mark awarded for the assignment and/or overall module result.** Please do consult:

- <https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment> with sections 13.7–13.8: coursework submission, 13.10: word count, 13.12–14: academic integrity.
- <https://www.ucl.ac.uk/students/exams-and-assessments/academic-integrity> for UCL's guidance on academic integrity.
- <https://library-guides.ucl.ac.uk/referencing-plagiarism/acknowledging-AI> for UCL's guidance on how to acknowledge the use of text generation software.

**The use of software to generate content is not allowed for assessments for this course, except in a specific situation where the assessment rubric has asked for it.**

**The use of software for language and writing review and improvement is permitted**, but the software and the way it has been used **must be indicated in the relevant boxes on the coursework coversheet**. UCL defines language and writing review as checking "areas of academic writing such as structure, fluency, presentation, grammar, spelling, punctuation, and language translation".

**Assessment 1, Laboratory notebook.** A write-up of practical work which counts for 50% of your overall module grade. This is made up of 3 practicals which should be submitted individually, as follows:-

	Weight	Submission date
1a. GIS Project Construction	15%	3rd Nov
1b. Spatial Analysis	20%	29th Nov
1c. Cartographic Presentation	15%	15th Dec

The weighting above is the proportion of the overall module result. Further detailed instructions and advice will be provided in tandem with the relevant class practicals, including word counts and dedicated assessment criteria. Note that all illustrations should have informative captions. Where appropriate, maps should include indicators of scale and orientation, as well as a legend (key) based on sensible ranges of data values. Graphs should include informative labels for the X- and Y-axes.

**Assessment 2, Essay.** A **2500 word** essay which counts for 50% of your overall module grade. You will be asked to critically evaluate existing archaeological literature covered in the course and its syllabus. A list of questions will be provided for you to choose from, with some starter readings. The IoA marking criteria for essays can be found in the IoA Student Handbook ([Section 12.2](#)).

### 3 Resources and preparation for class

#### 3.1 Preparation for class

The practical element of teaching on this course makes heavy use of either ArcGIS or QGIS (your choice). These software packages are available in the Institute of Archaeology AGIS lab and ArcGIS is available on all UCL cluster machines. However, if you wish to use QGIS then you may wish to install it on your own computer as it is also freely available for most operating systems (MS Windows, MacOS, Linux). We will use the first class to troubleshoot installation on your own machines where necessary.

You are expected to read the essential readings as well as completing any online activities posted on Moodle each week. Completing the readings is essential for your effective participation in the activities and discussions that we will do, and it will greatly enhance your understanding of the material covered. Further readings are provided via the Online Reading List for you to get a sense of the range of current work on a given topic and for you to draw upon for your assessments. The online reading list is accessible through the Moodle page of the module and can be directly accessed [here](#).

### 3.2 Recommended basic texts and online resources

There is no single textbook covering the topics addressed in this module, but the following is nevertheless useful and available online:-

- Conolly, J and Lake, M 2006. *Geographical Information Systems in Archaeology*. Cambridge: Cambridge University Press. [INST ARCH AH CON].
- Wheatley, D. & M. Gillings. 2002. *Spatial Technology and Archaeology*. London: Taylor and Francis. [INST ARCH AH WHE]
- Bevan, A.H. & Lake, M. (Eds.) 2013. *Computational Approaches to Archaeological Spaces*. Walnut Creek, US: Left Coast Press. [INST ARCH AK 30 BEV]
- Gillings, M. et al. 2011. *GIS Guide to Good Practice* (Archaeology Data Service / Digital Antiquity Guides to Good Practice) URL: [http://guides.archaeologydataservice.ac.uk/g2gp/Gis\\_Toc](http://guides.archaeologydataservice.ac.uk/g2gp/Gis_Toc)
- Gillings, M., Haciguzeller, P. & Lock, G. 2020. *Archaeological Spatial Analysis. A Methodological Guide*, London: Routledge. [e-book and INST ARCH AK 30 GIL]
- de Smith MJ, Goodchild MF, Longley PA 2018 (6th edition). *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools*, London: Winchelsea [GEOGRAPHY D 68 DES; ENGINEERING D 80 SMI]
- Longley, P.A., M.F. Goodchild, D.J. Maguire & D.W. Rhind. 2002. *Geographic Information Systems and Science*. [INST ARCH AH LON; GEOGRAPHY D68 LON; TOWN PLANNING A 10 LON]

## 4 Syllabus

The following is an outline for the course as a whole. The syllabus identifies essential readings relevant to each session, which are also listed in the course .

### Session 1: A Rough Guide to GIS

This first week offers an introduction to GIS, including its history as a technique and discipline, its achievements so far and its current role in archaeology.

**Practical** Introduction to ArcGIS, navigation, basic data manipulation.

#### Essential reading

- Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.1-60) [INST ARCH AH CON].
- Wheatley, D. and M. Gillings. 2002. *Spatial Technology and Archaeology*. London: Taylor and Francis. (pp.1-18) [INST ARCH AH WHE]
- Wescott, K.L. and Brandon, R.J. 2000 *Practical Applications of GIS for Archaeologists: A Predictive Modelling Kit*, London: Taylor and Francis. (chapter 1).[INST ARCH AH WES]

## Session 2: Data Structures and Geodesy

We consider more of the basic principles underlying the use of GIS, concentrating on the types of data model currently used to describe spatial phenomena. We then explore the importance of geodesy and geographic coordinate systems.

**Practical** Moving between coordinate systems. Introduction to the Kythera dataset and to vector data models. Building ArcGIS projects. Principles for manipulating symbology.

### Essential reading

Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.16-32) [INST ARCH AH CON].

Longley, P.A., M.F. Goodchild, D.J. Maguire and D.W. Rhind. 2002. *Geographic Information Systems and Science* (pp.63-83, 109-126). [INST ARCH AH LON; GEOGRAPHY D68 LON; TOWN PLANNING A 10 LON]

Gupta, N. 2020. In Haciguzeller, P., Gillings, M. and G. Lock (eds.) *Archaeological Spatial Analysis: A Methodological Guide*: 17-40. London: Routledge. [<https://doi-org.libproxy.ucl.ac.uk/10.4324/9781351243858>]

## Session 3: Vector Data: Acquisition and Manipulation

We focus more closely on one type of data model (vector), exploring its main advantages, disadvantages, how it is acquired and the contexts in which it is most commonly used.

**Practical** Heads-up and tablet digitising, attribute editing, data cleaning, metadata

### Essential reading

Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.80-89) [INST ARCH AH CON].

Bell, T. and Bevan, A. 2004 *A Survey of GIS Standards for the English Archaeological Record Community*, Report Commissioned by English Heritage. <http://discovery.ucl.ac.uk/149398/> (For now, read mainly for the long tradition of preferring vector datasets in UK archaeological records)

Hope, S. and Hunter, G.J. 2007 'Testing the effects of positional uncertainty on spatial decision-making' *International Journal of Geographical Information Science* 21.6: 645-665.(Read mainly with regard to contemporary concerns over accuracy in vector datasets, particularly GPS).[UCL eJournals]

## Session 4: Operations for Vector Data

We explore how to go about asking interesting questions of information recorded in a GIS, particularly using vector data. In particular, we consider the great possibilities created by the combination of spatial and aspatial queries. Data generalisation is a related topic addressing the formal means by which we summarise, present and make sense of complex datasets.



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**Practical** Importing spreadsheet data, one-to-one attribute joins, spatial joins, many-to-one relations, attribute and spatial queries.

### Essential reading

Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.112-148) [INST ARCH AH CON].

Wheatley, D. and M. Gillings. 2002. *Spatial Technology and Archaeology*. London: Taylor and Francis. (pp.80-87) [INST ARCH AH WHE]

Dent, B.D. 2009. *Cartography: Thematic Map Design*, London: McGraw-Hill. (chapters 8-9) [INST ARCH ISSUE DESK; GEOGRAPHY QUARTOS D 40 DEN] (Useful for the position taken by cartographers on data generalisation long before the advent of GIS).

### Session 5: Raster Data: Acquisition and Manipulation

We focus more closely on raster data models, addressing how they are acquired and their contrasting strengths and weaknesses when compared to vector data.

**Practical** DEMs and derivative surfaces.

### Essential reading

Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.61-111) [INST ARCH AH CON].

Hageman, J B. and Bennett, D.A. 2000 Construction of digital elevation models for archaeological applications. In Westcott, K.L. and Brandon, R.J., editors, *Practical Applications of GIS for Archaeologists: A Predictive Modelling Kit*, pages 113–127. Taylor and Francis, London. [INST ARCH AH WES].

Wheatley, D. and M. Gillings. 2002. *Spatial Technology and Archaeology*. London: Taylor and Francis. (pp95-112) [INST ARCH AH WHE]

### Session 6: Analysing Patterns in Spatial Data

The formal analysis of spatial patterns is one of the great strengths of GIS, but one often ignored in the rush for more flashy GIS functionality. Here we consider the types of statistical treatment often used on zonal and point data, as well as the special treatment required for spatial data, which is often not provided by classical statistical models.

**Practical** Point pattern analysis, data export to spreadsheet packages, chi-square tests and statistical charts.

### Essential reading

- Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.112-186) [INST ARCH AH CON].
- Bevan, A. 2002 'The Rural Landscape of Neopalatial Kythera: a GIS perspective', *Journal of Mediterranean Archaeology* 15.2: 217-256. (already a bit dated, but an introduction to the part of the Greek island of Kythera that is considered in the third practical assessment and to some examples of landscape-scale pattern analysis) [IoA Pers, or from me directly]
- Orton, C. 2000 *Sampling in Archaeology*, Cambridge: Cambridge University Press. (Read early chapters for a view of spatial sampling and its importance). [INST ARCH AK 10 ORT]

### Session 7: Maps and Digital Cartography

This week we consider the role of cartography in recent human history, the principles behind modern maps, and the implications of new technologies such as internet-based map servers and collaborative mapping.

**Practical** The process of producing map layouts for printing or still digital capture, according to proper cartographic principles. Also the incorporation of 3D views.

### Essential reading

- Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.263-288) [INST ARCH AH CON].
- Dent, B.D. 2009 *Cartography: Thematic Map Design*, London: McGraw-Hill. [INST ARCH ISSUE DESK; GEOGRAPHY QUARTOS D 40 DEN] (Worth browsing several of the chapters for the main issues)
- Murrieta-Flores, P. and Gregory, I. 2015. Further Frontiers in GIS: Extending Spatial Analysis to Textual Sources in Archaeology, *Open Archaeology* 1.1. [<https://doi.org/10.1515/opar-2015-0010>]
- Gupta, N., Devillers, R. 2017. Geographic Visualization in Archaeology. *J Archaeol Method Theory* 24, 852–885. [<https://doi.org/10.1007/s10816-016-9298-7>]

### Session 8: Operations for Raster Data

Raster data can be a particularly powerful way of approaching spatial questions because of its support for a range of arithmetic, boolean, relational and zonal operators. We consider how such procedures have been used within GIS applications both in general and with particular regard to archaeological research.

**Practical** Map algebra, neighbourhood statistics, filtering, histograms

**Essential reading**

- Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.112-186) [INST ARCH AH CON].
- Burrough, P.A. and McDonnell, R.A. 1998 *Principles of Geographic Informations Systems*, Oxford: Oxford University Press. (186-7 and chapter 8) [INST ARCH AK20 BUR, GEOGRAPHY D 60 BUR, ENGINEERING D 80 BUR].
- Spikins, P. 2000 GIS models of past vegetation: An example from northern England, 10,000–5000 BP. *Journal of Archaeological Science* 27: 219–234. [UCL Ejournals].

**Session 9: Advanced Vector and Raster Functions**

This week tackles more advanced aspects of route- and region-based modelling, offering an introduction to topics such as hydrological models, viewshed analysis and cost surfaces that are treated in greater detail in the companion module GIS2 (ARCL0095, not running this year).

**Practical** An introduction to viewshed analysis, cost surfaces and least cost paths.

**Essential reading**

- Conolly, J. and Lake, M. 2006 *Geographical Information Systems in Archaeology*. Cambridge University Press: Cambridge. (pp.208-262) [INST ARCH AH CON].
- Bevan, A. 2011. Computational models for understanding movement and territory, in Mayoral Herrera, V and Celestino Pérez, S, (eds.) *Tecnologías de información geográfica y análisis arqueológico del territorio: Actas del V Simposio Internacional de Arqueología de Mérida*: 383-394. Consejo Superior de Investigaciones Científicas: Mérida. URL: <http://discovery.ucl.ac.uk/149233/>
- Lake, M.W. and Woodman, P.E. 2003. Visibility studies in archaeology: a review and case study. *Environment and Planning B: Planning and Design*, 30:689-707.

**Session 10: Review and Prospect**

The final week is an opportunity to review the topics covered by the module and also offers a chance to discuss in more detail some concrete strategies for addressing particular archaeological questions using GIS. We also discuss the future of GIS within the discipline of archaeology. There are no required readings, but students are encouraged to ask the coordinator for further reading on specific topics either ahead of or during the session.

**Practical** Review of practical skills based on a series of typical GIS workflows in archaeology.