

## ARCH 310 | Introduction to Digital Archaeology and Virtual Reality Spring Semester 2025

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### 1. Course Description

Archaeological methodology has undergone a revolutionary transformation over the past decade. Traditional techniques for recording and interpreting archaeological data are increasingly supplanted by digital and computational methods, which have become integral to both archaeological projects and cultural heritage management (CHM). This course explores the latest state-of-the-art advancements in 3D modeling and photogrammetry, GIS-based spatial archaeological analysis, database management, digital archaeological illustration, remote sensing, and more.

Through a blend of lectures, hands-on projects, and student presentations, students will engage with cutting-edge technologies and methodologies, developing both theoretical knowledge and practical skills. The curriculum culminates with an examination of the ethics surrounding digital archaeology and a discussion of contemporary critical approaches to its practice. This ensures that students not only master technological tools but also critically assess the broader implications and responsibilities inherent in the digital transformation of archaeological work.

### 2. Learning Objectives

The main aim of this course is for the student to develop a comprehensive understanding of the new possibilities offered by the most recent tools and methods in analyzing the past, as well as to acquire a practical skill set, which will be useful in both archaeological fieldwork and cultural heritage management projects. Upon the successful completion of the course requirements by the end of the semester, students will have gained theoretical knowledge on and develop familiarity with:

- archaeological databases and data management;
- tablet-based digital excavation recording systems;
- nondestructive methods of archaeological exploration and remote-sensing such as LIDAR, Ground Penetrating Radar, and Thermal Imaging;
- airborne imaging and its uses in archaeology;
- international digital archaeology case studies, such as Kaymakçı, Keros, SCIP;
- the role of Geographical Information Systems (GIS) in archaeological research and interpretation of spatial data;
- online and digital publication of archaeological projects;
- the potential of AI in archaeological research;
- *big data* analysis utilizing formal ontologies and *semantics*;
- the impact of archaeological sciences in modern analysis and interpretation of the past (e.g. aDNA studies, micromorphology, zooarchaeology, paleoethnobotany).

Students will also gain practical experience in 3D modeling and photogrammetry, which is fast becoming the norm on fieldwork projects. They will also have hands-on practice of spatial recording using a total station. Upon the successful completion of the course requirements, they will be able to:

- create 3D models of excavation trenches or buildings;
- create 3D models of archaeological artifacts (statues, weapons, etc.);
- digitally record and illustrate architecture using photogrammetry-based orthophotos;
- digitally illustrate (a.k.a. ink) small archaeological artifacts like potsherds.
- fly a drone and take aerial photos;
- set-up and use a Total Station for spatial recording;
- create orthomaps and DEMs (digital elevation models), using drone photographs.

This course requires no previous archaeological fieldwork experience; however, since it is designed as a higher-level archaeology class, a substantial level of archaeological, historical, or anthropological knowledge is expected.

### 2. Course Resources and Activities

Given the ever-changing nature of the subject matter, rather than a particular textbook, we will be using chapters and articles from recent and up-to-date publications and online sources. The state of the discipline is such that half of the reading list changes every year. The readings, lecture slides, and workflows/technical tutorials for the computer-based projects will be regularly posted on Moodle as PDFs.

For the computer-based projects, the students may choose to use the computers in the CYA ARCHLab or their own computers. For the 3D modeling assignments, they can use their own DSLR cameras, or a camera provided by CYA. At

the end of the semester the instructor will have the three best models 3D-printed and proudly present them to the winners.

### 3. Course Requirements

- a) Large object / Area 3D modeling:** Using the tutorial provided, you will create a 3D model of a large object or an area, such as a statue, garbage bin, the interior of your room, a tombstone or memorial monument from a cemetery, your incredibly motionless friend's body, the slope of a hill, an ancient wall from the Philopappos Hill, etc...
- b) Small object 3D modeling:** Using the tutorial provided, you will create a 3D model of a small object, such as a stone artifact or a piece of jewelry. As archaeological objects in museums cannot be photographed from all angles, neither would it be legal to do so without a permit, you will need to choose a modern object.
- c) 2D digital recording of architectural features or trench sections:** The days of architectural illustrators using their plumb bobs and rulers have long gone. In this assignment, you will learn how to use photogrammetry-based orthomosaic plans to create publication-quality 2D stone plan illustrations of architectural features or vertical trench sections.
- d) 2D digitization of Small Finds:** Professional archaeological illustrators are still very important in documenting small finds and -especially- potsherds. A second important step is to digitize these illustrations. In this assignment, you will be provided with real pottery drawings and create their publication-quality, digitized versions.
- e) Group Project - Grant Application:** Together with your group members, you will write an official grant application for a fictional archaeological project. You will need to: i) come up with a methodology incorporating the knowledge you acquired in our course, ii) determine which advanced tools or techniques to utilize, iii) calculate your expenses, iv) justify your choices regarding the terrain, geology, topography, and history of the fictional research area, v) hopefully convince the grant committee, which consists of the instructor. No budget limits. The group members will present their projects on the last class day and submit the written version to the instructor, which will be ca. 1000 words.
- f) In-class Final Exam:** Your knowledge on both technical (e.g. how do we use *thermal imaging* as a remote sensing tool in archaeology?) and theoretical/ethical (e.g. do digital methods and the pace and accuracy they provided prevent us from thinking deeply about fundamental issues?) aspects of the course will be assessed.
- g) Class participation:** The frequency and quality of the questions raised and contributions to in-class discussions and practice will determine your class participation grade.

### 4. Grading and Evaluation

Your grade for this course will be based on the following distribution:

Assignment	%
Large object / Area 3D modeling	10%
Small object 3D modeling	15%
2D architectural / trench section illustration	15%
Pottery Digitization	10%
Group Project - Grant Application	15%
Final Exam	25%
Class participation	10%

- If you intend to upgrade the course to 400-level, one additional 3D model and a research paper (4000 words) will be required, in which case the Archaeological Project Grant Application assignment will become mandatory.

### 7) Use of Laptops and Tablets

In-class or on-site use of laptops and other devices is permitted if that facilitates course-related activities such as note-taking, looking up references, etc. Laptop or other device privileges will be suspended if there are indications that they are not being used for class-related work.

## 8) Attendance Policy

Only one unexcused absence will be allowed in accordance with the CYA policy. Further unexcused absences will lower your final grade. Please contact the Director of Academic Affairs in the case of an absence due to illness.

## 9) Accommodations for Students with Disabilities

If you are a registered (with your home institution) student with a disability and you are entitled to learning accommodation, please inform the Director of Academic Affairs and make sure that your school forwards the necessary documentation.

### Class Schedule

- 1. Introduction to Digital Archaeology**  
Introduction to Course  
Introduction to fieldwork methodology
- 2. Basic Principles of Photography & 3D Modeling**  
Aperture, Shutter Speed, ISO  
Exposure Triangle  
Archaeological Photography  
Intro to 3D Modeling
- 3. Photogrammetry I**  
Introduction to photogrammetry  
Large Object and Area photogrammetry with handheld cameras  
*Metashape Workflow for Photogrammetrical Models*
- 4. Photogrammetry II - Fieldwork**  
Principles of Archaeological Stratigraphy  
Stratigraphical recording  
3D recording and field archaeology
- 5. Remote Sensing in Archaeology**  
Geophysical Methods of Remote Sensing  
LIDAR  
Thermal Imaging  
Satellite Imagery
- 6. Ancient History, Archaeology, and Computer Gaming**  
A Trip to the Nerdy Pastures of Gamerland  
**Photogrammetry III**  
*Small Object photogrammetry workflow* – Lab practice
- 7. The use of drones in archaeology**  
History of aerial photography and archaeology  
Aerial imagery as a remote sensing tool  
Types of drones  
Drones and macro-scale 3D modeling  
Topographic Maps
- 8. Digital documentation of archaeological fieldwork I**  
Archaeological Fordism: The paper form revolution  
History of archaeological databases  
Archaeological databases: what to record?  
Software solutions
- 9. Digital documentation of archaeological fieldwork II**  
Real-time tablet-based digital documentation.  
Case Studies: SCIP & GAP  
Kaymakçı, Keros, Agora - iDIG
- 10. Field day - Old School Archaeological Illustration**  
Introduction to analog architectural drawing methods
- 11. Archaeological Illustration and the Digital Age I**

Photogrammetrical orthomosaic trench plans and architectural illustration  
 Photogrammetry and trench section drawings  
*Workflow for 2D digital recording of architectural features and trench sections*

**12. Cultural Heritage Management and Digital Age I**

3D reconstructions of ancient artifacts and monuments  
 Did a virtual museum save Palmyra?  
 New Media: museums & archaeological sites  
 Ethics of digital cultural heritage

**13. Cultural Heritage Management and Digital Age II**

The Internet, social media, and ancient studies  
 Pseudoarchaeology wars and public outreach

**14. GIS and Spatial archaeology I**

GIS and spatial recording in archaeology  
 GIS software solutions: an overview

**15. 02.11 GIS and Spatial archaeology II**

GIS and Survey & Excavation Methodologies  
 Case Studies

**16. Archaeological Illustration and the Digital Age II**

History of archaeological illustration  
 Small object (pottery, stone tool, etc.) illustration and digitization  
 Automated Small Object illustration  
*Pottery Illustration Workflow*

**17. Field day - Total Station and d-GPS**

Setting up a Total Station  
 Recording with d-GPS

**18. New approaches in Archaeological Sciences I**

Zooarchaeology, Paleoethnobotany, Physical Anthropology  
*Introduction to micromorphology and geo-archaeology*

**19. New Approaches in Archaeological Sciences II**

Ancient-DNA Revolution and a new understanding of the human past  
 Archaeological critique

**20. Big Data in Cultural Heritage Management and Archaeology I**

Introduction to formal ontologies, semantics, and archaeology  
 The potential of semantics and its application

**21. AI and Archaeology**

AI as a research tool in archaeology and humanities  
 Site detection & Find Analysis

**22. Theorizing Digital Archaeology I**

Critical approaches  
 Efficiency vs Slow Archaeology Debate

**23. Theorizing Digital Archaeology II**

General Review and Class Discussion

**24. Student Presentations**

**Readings**

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