ARCADIA UNIVERSITY
THE COLLEGE OF GLOBAL STUDIES

Instructor (s):	Davide Tanasi
Email:	tanasid@arcadia.edu
Course Title:	**3D Modeling for Archaeology and Cultural Heritage**
Course Code:	**MCAS CSAR 360**
Credits:	**3**
Semester/Term:	☒ **Spring** ☒ **Fall** ☐ **Summer**
Course Description:	This course focuses on application of computer graphics on archaeological research taking into account theoretical assumptions and most popular outcomes as virtual reassembly, digital restoration, 3D scanning, 3D modeling, and virtual museums. It includes practical exercises of 3D scanning of archaeological artifacts, processing and editing of scanner data. This course provides a clear and concise introduction to the ultimate scientific approach to archaeological issues. Fieldwork, projects, and research of contemporary Archaeology will be connected to Computer Science, and specifically to its more popular branch, Computer Graphics. Students will learn how computer techniques can support the archaeological interpretation as well as their influence on the scholar's perspective. The analysis of main outcomes and different areas of application will be done using case studies related to Greek and Roman archaeology and the work of some international research teams.
Course Requirements:	**Required Text** - T.L. Evans, P. Daly (eds.), Digital Archaeology. Bridging Method and Theory, Routledge, London, 2006. **ISBN**: 9780415310505; **Cost**: To Be Determined. - S. Battiato, G. Gallo, F. Stanco (eds.), Digital Imaging for Cultural Heritage, CRC Press, Boca Raton, 2011. **ISBN**: 1439821739; **Cost**: To Be Determined. **Grading Scale**

Letter Grade	Percentage	Numerical Scale
A	95 – 100%	3.5 – 4.0
A-	90 – 94%	3.0 – 3.4
B+	87 - 89%	2.7 – 2.9
B	83 - 86%	2.3 – 2.6
B-	80 - 82%	2.1 – 2.2
C+	77 – 79%	1.7 – 1.9

C	73 – 76%	1.3 – 1.6
C-	70 – 72%	1.1 – 1.2
D+	65 – 69%	.5 - .9
D	60 – 64%	.0 - .6
F	0 – 59%	0.0

Assignments

Course Requirements	Percentages
1. Paper 1	15 %
2. Mid-term test	30 %
3. Paper 2	15 %
4. Final project	40 %
Total	100%

Student attendance at classes and fieldwork is compulsory. Penalties for unexcused absences from class range from 10% being deducted from the overall grade (for missing more than one class meeting) for the appropriate class to enforced withdrawal.

1. Paper 1 tests student's background knowledge on archaeological theory and solutions offered by computer science to current issues of archaeological research.
2. Paper 2 focuses on a specific branch of digital archaeology and to the description of one of the cases study presented in class or in the readings. Mid-term test is a project of virtual reassembly and digital restoration and it will test student's knowledge about the pipeline comprising these projects and the outcomes.
3. Final project consists in a personal work of each student including the acquisition with the laser scanner of an original Greek vessel, the processing and editing of the data via Blender and Meshlab, the development of a complete 3D replica of the vessel, realized in the second part of the semester.
4. In the final test students must be present in a detailed way the pipeline of their work and the possible use of the outcome in a digital archaeology project.

Mandatory Field Studies:
Image Processing Laboratory, Department of Math and Computer Science, University of Catania.

	The Image Processing Laboratory of Catania University is of one of the few Italian research centers specialized in developing digital archaeology projects. In 2007, a team of computer scientists, archaeologists and technicians founded a research program, named 'Archeomatica Project', aimed to produce innovative applications for solving problems coming from the interpretation of archaeological data. Connected with several national and international academic institutions and local Cultural Heritage Offices, the Lab is equipped with the software and hardware state-of-the-art available even for all students attending stages in the 'Archeomatica Project'.
Learning Outcomes and/or Expected Student Competencies:	On completion of the course, students should be able to: **Learning Outcome** 1. Use computer science applications in archaeological research to distinguish between offered solutions and theoretical influences. 2. Demonstrate familiarity with the main outcomes of computer graphics applied to archaeology; virtual reassembly, digital restoration, 3D scanning, 3D modeling, virtual museum. 3. Appropriately choose which kind of computer graphics technique is more appropriate for solving specific archaeological problems or issues related to dissemination of knowledge 4. Use state-of-the-art software and hardware in this field to complete a digital archaeology project including practical 3D scanning of archaeological artifacts (with a triangulation laser scanner Next Engine), 3D modeling (with the software Blender) and data processing and editing (with the software Meshlab).
Course Outline:	**Session** / **Topic** ***Session 1*** — Introduction to the course ***Session 2*** — The past and the future. Archaeology and Computer Science Readings: P. Daly and T. L. Evans, Archaeological Theory and Digital Pasts. in T.L. Evans, P. Daly (eds.), Digital Archaeology. Bridging Method and Theory, Routledge, London, 2006, pp. 3-9. ***Session 3*** — Digital archaeology Readings: E. B. W. Zubrow, Digital Archaeology. A Historical Context. in T. L. Evans, P. Daly (eds.), Digital

	Archaeology. Bridging Method and Theory, Routledge, London, 2006, pp. 10-31. S. Moser, Archaeological Representation. The virtual Conventions for Constructing Knowledge about the Past, in I. Hodder (ed.), Archaeological Theory Today, Polity Press, Malden, 2005, pp. 262-283.
Session 4	From the field to the screen Readings: M. Doneu, W. Neubauer, Laser scanners for 3D documentation of stratigraphic excavations, in M. Baltsavias, A. Gruen, L. Van Gool, M. Pateraki (eds.), Recording, Modelling and Visualization of Cultural Heritage, Taylor and Francis London, 2006, pp. 193-204.
Session 5	Monitoring the heritage Readings: D. Pletinckx, Virtual Archaeology as an Integrated Preservation Method, in Arqueológica 2.0. Proceedings of 1st International Meeting on Graphic Archaeology and Informatics, Cultural Heritage and Innovation, Sevilla-La Rinconada, Spain, 17- 20 June 2009, pp. 51-55. **Assignment paper 1: a 1,500 word essay**
Session 6	Virtual museums and dissemination of knowledge: The Virtual Museum of Iraq Readings: F. Niccolucci, Virtual museums and archaeology: an international perspective, in Archeologia e Calcolatori, suppl. 1, 2007, pp. 15-30 M. Cultraro, F. Gabellone, G. Scarrozzi, The virtual musealization of archaeological sites: between documentation and communication, in F. Remondino, S. El-Hakim, L. Gonzo (eds.), 3D Virtual Reconstruction and Visualization of Complex Architectures, International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences Volume XXXVIII-5/W1, 2009. http://www.virtualmuseumiraq.cnr.it
Session 7	Digital Restoration: Parthenon Project Readings: J. Stumpfel et alii, Digital Reunification of the Parthenon and its Sculptures, in D. Arnold, A. Chalmers,

	F. Niccolucci (eds.), 4th International Symposium on Virtual Reality, Archaeology and Intelligent Cultural Heritage (2003), pp. 1-10. http://www.debevec.org/Parthenon/film.html
Session 8	Virtual reassembly: Forma Urbis Romae Readings: D. Koller, J. Trimble, T. Najbjerg, N. Gelfand, M. Levoy, Fragments of the city: Stanford's digital Forma Urbis Romae project, in Journal of Roman Archaeology Suppl. 61, 2006, pp. 237–252. http://formaurbis.stanford.edu
Session 9	Virtual reassembly: pottery and frescoes Readings: A. Willis, D. Cooper, Assembling virtual pots from 3D measurements of their fragments, in Proceedings of International Symposium on Virtual Reality Archaeology and Cultural Heritage (VAST), Glyfada 2001, pp. 241–253. B.J. Brown, C. Toler-Franklin, D. Nehab, M. Burns, D. Dobkin, A. Vlachopoulos, C. Doumas, S. Rusinkiewicz, T. Weyrich, A System for High-Volume Acquisition and Matching of Fresco Fragments: Reassembling Theran Wall Paintings, in Transactions on Graphics 27:3, 2008, pp. 84:1-84:9. **Paper 1 due**
Session 10	Review session for Midterm examination
Session 11	MIDTERM examination
Session 12	BREAK
Session 13	Rome reborn and Google Earth Readings: K. Dylla et alii, Rome Reborn 2.0: A Case Study of Virtual City Reconstruction Using Procedural Modeling Techniques, in CAA 2009. Online Proceedings of the 37th Annual Computer Applications and Quantitative Methods in Archaeology Conference, March 22-26, Williamsburg, Virginia, pp. 62-66. S.Wells et alii, Rome Reborn in Google Earth, in CAA 2009. Online Proceedings of the 37th Annual Computer

	Applications and Quantitative Methods in Archaeology Conference, March 22-26, Williamsburg, Virginia, pp. 365-371. http://www.romereborn.virginia.edu
Session 14	3D modeling as cognitive tool Readings: F. Stanco, D. Tanasi, Experiencing the Past. Computer Graphics in Archaeology, in S. Battiato, G. Gallo, F. Stanco (eds.), Digital Imaging for Cultural Heritage, CRC Press, Boca Raton, 2011, pp. 10-39.
Session 15	The Archeomatica Project: 3D modeling experience Readings: F. Stanco, D. Tanasi, Experiencing the Past. Computer Graphics in Archaeology, in S. Battiato, G. Gallo, F. Stanco (eds.), Digital Imaging for Cultural Heritage, CRC Press, Boca Raton, 2011, pp. 10-39. www.archeomatica.unict.it
Session 16	The Archeomatica Project: 3D scanning experience Readings: F. Stanco, D. Tanasi, Experiencing the Past. Computer Graphics in Archaeology, in S. Battiato, G. Gallo, F. Stanco (eds.), Digital Imaging for Cultural Heritage, CRC Press, Bocas Raton, 2011, pp. 10-39. www.archeomatica.unict.it
Session 17	The Archeomatica Project: computer vision experience F. Stanco, D. Tanasi, C. Guarnera, G. Gallo, Automatic classification of decorative patterns in the Minoan pottery of Kamares style, in C. Papaodysseus (ed.), Pattern Recognition and Signal Processing in Archeometry: Mathematical and Computational Solutions for Archeology, IGI Global, Hershey, 2001, pp. 11-31. www.archeomatica.unict.it
Session 18	**Field Study - Image Processing Laboratory of University of Catania**
Session 19	Practical exercise with triangulation 3D scanner on archaeological artifacts Readings: J.A. Esquivel, I. Alemán, F.J. Esquivel, Geometrical 3D Laser Scanner Model of a Chalcolithic

	Vessel (Gor, Granada, Spain), in Archeologia e Calcolatori 18, 2007, pp. 293-324.
Session 20	Practical exercise with triangulation 3D scanner on archaeological artifacts Readings: M. Moser et alii, Digital documentation and visualization of archaeological excavations and finds using 3D scanning technology, in Virtual Archaeology Review 1.2, 2009, pp. 126-132.
Session 21	Practical exercise of data processing with Meshlab Readings: P. Cignoni et alii, Meshlab: an open-source mesh processing tool, in Sixth Eurographics Italian Chapter Conference, 2008, pp. 129–136. http://meshlab.sourceforge.net/
Session 22	Practical exercise of data processing with Meshlab Tutorial on http://meshlabstuff.blogspot.com http://meshlab.sourceforge.net/
Session 23	Practical exercise of data processing with Blender Readings: G. Gallo et alii, Blender application in archaeological research, Blender Conference 2008, Amsterdam, 24-26 October 2008, online slides. http://www.blender.org **Paper 2 due**
Session 24	Practical exercise of data processing with Blender Tutorial on http://www.redbaron85.com http://www.blender.org
Session 25	Dealing with Image Data in Archaeology: new perspectives Readings: M. Mudge et alii, A Digital Future for Cultural Heritage, in A. Georgopoulos, N. Agriantonis (eds.), AntiCIPAting the Future of the Cultural Past, Proceedings of the XXI International CIPA Symposium, Athens, 1-6 October 2007, pp. 1-6. N. Magnenat-Thalmann, G. Papagiannakis, Virtual worlds and augmented reality in cultural heritage applications, in M. Baltsavias, A. Gruen, L. Van Gool, M. Pateraki (eds.), Recording, Modeling and Visualization of Cultural Heritage, London, Taylor and Francis, pp. 419-430

	Session 26 — Review session for Final examination **Session 27** — FINAL examination
Other Policies:	**Expectations** Professional behavior is expected of all students. This includes preparation for classes, on-time attendance at classes, attendance at all group sessions and appropriate participation in the form of attentiveness and contributions to the course. Respect for the academic process is the major guiding principle for professional behavior and extends to all communications, including e-mail. **Attendance/Participation** Prompt attendance, full preparation, and active participation in class discussions are expected from every student in every class session. **Course Policies** For e-mail communications, students must use their Arcadia University e-mail account. Students are responsible for any information provided by e-mail or through Intranet postings. **Plagiarism** Representation of another's work or ideas as one's own in academic submissions is plagiarism, and is cause for disciplinary action. *Cheating* is actual or attempted use of resources not authorized by the instructor(s) for academic submissions. Students caught cheating in this course will receive a failing grade. *Fabrication* is the falsification or creation of data, research or resources to support academic submissions, and cause for disciplinary action. **Late or Missed Assignments** Will not be accepted for grading. **Students with Disabilities** Persons with documented disabilities requiring accommodations to meet the expectations of this course should disclose this information while enrolling into the program, and before leaving the United States so that appropriate arrangements can be made.
Prerequisites:	No specific prerequisites are needed in the field of archaeology or computer science.
Country and Program Connection:	The Mediterranean Center for Arts and Sciences of Syracuse has an agreement with the Faculty of Sciences of University of Catania. Thanks to this, students can easily and freely access to facilities of Image Processing Laboratory of that University, where a multidisciplinary team of scholar

	carries on a digital archaeology research program called 'Archeomatica Project.' This Lab includes the software and hardware which are state-of-the-art in this field and thanks to its recent scientific outcomes and connections with other national and international academic groups is considered one of the most advanced in Italian academic scenario.