

MCAS CSAR 360 syllabus

**Course Title: 3D Modeling for Archaeology and Cultural Heritage**

Course Code and Number of Credits: MCAS CSAR 360 (3 CREDITS)

Instructor: D Tanasi, PhD

**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.

Students learn computer science applications in archaeological research distinguishing between offered solutions and theoretical influences. They gain familiarity with the main outcomes of computer graphics applied to archaeology, which constitutes the new discipline of digital archaeology (virtual reassembly, digital restoration, 3D scanning, 3D modeling, virtual museum). Students are able to identify which kind of computer graphics technique is more appropriate for solving specific archaeological problems or issues related to dissemination of knowledge. Finally they learn how to deal with software and hardware state-of-the-art in this field completing 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).

This course provides a clear and concise introduction to the ultimate scientific approach to archaeological issues. Fieldwork, projects, and research of current archaeology can be connected with 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 they can influence the scholar's perspective. The analysis of main outcomes and different areas of application will be done using cases study related to Greek and Roman archaeology and the work of some international research teams. The agreement that the Mediterranean Center of Arts and Sciences has given, since 2010, with the Faculty of Sciences of University of Catania, the unique opportunity for students of using facilities of the Image Processing Laboratory of that university.

Prerequisites: No specific prerequisites are needed in the field of archaeology or computer science.

**Mandatory Fieldtrips:**

Image Processing Laboratory, Department of Math and Computer Science, University of Catania.

The Image Processing Laboratory of Catania University is 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'.

**Additional Fees Payable on Site:** None

**Assessment:**

- Paper 1 (15%)
- Mid-term test (30%)
- Paper 2 (15%)
- Final project (40%)

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. Class sizes remain relatively small at MCAS and all students are expected to contribute to the intellectual climate of the class through preparation and participation.

Paper 1 tests student's background knowledge on archaeological theory and solutions offered by computer science to current issues of archaeological research.

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 projects of virtual reassembly and digital restoration and it will test student's knowledge about the pipeline comprising these projects and the outcomes.

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.

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.

**Required Texts**

**1. Required texts:**

- 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.

**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

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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.

**Course Outline: (Semester)**

<b><u>Week 1</u></b>	<b>Class 1</b>	<i>Introduction to the course</i>
	<b>Class 2</b>	<i>The past and the future. Archaeology and Computer Science</i>  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.
<b><u>Week 2</u></b>	<b>Class 3</b>	<i>Digital archaeology</i>  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.
	<b>Class 4</b>	<i>From the field to the screen</i>  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.
<b><u>Week 3</u></b>	<b>Class 5</b>	<i>Monitoring the heritage</i>  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.  <b><u>Assignment paper 1: a 1,500 word essay</u></b>

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	<b>Class 6</b>	<p><i>Virtual museums and dissemination of knowledge: The Virtual Museum of Iraq</i></p> <p>Readings: F. Niccolucci, Virtual museums and archaeology: an international perspective, in Archeologia e Calcolatori, suppl. 1, 2007, pp. 15-30</p> <p>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.</p> <p><a href="http://www.virtualmuseumiraq.cnr.it">http://www.virtualmuseumiraq.cnr.it</a></p>
<b><u>Week 4</u></b>	<b>Class 7</b>	<p><i>Digital Restoration: Parthenon Project</i></p> <p>Readings: J. Stumpf 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.</p> <p><a href="http://www.debevec.org/Parthenon/film.html">http://www.debevec.org/Parthenon/film.html</a></p>
	<b>Class 8</b>	<p><i>Virtual reassembly: Forma Urbis Romae</i></p> <p>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.</p> <p><a href="http://formaurbis.stanford.edu">http://formaurbis.stanford.edu</a></p>
<b><u>Week 5</u></b>	<b>Class 9</b>	<p><i>Virtual reassembly: pottery and frescoes</i></p> <p>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.</p> <p>B.J. Brown, C. Toler-Franklin, D. Nehab, M. Burns, D. Dobkin, A. Vlachopoulos, C. Dumas, S. Rusinkiewicz, T. Weyrich, A System</p>

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		<p>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.</p> <p><b><u>Paper 1 due</u></b></p>
	<b>Class 10</b>	Review session for Midterm examination
<b><u>Week 6</u></b>	<b>Class 11-12</b>	MIDTERM examination
<b><u>Week 7</u></b>		Fall BREAK
<b><u>Week 8</u></b>	<b>Class 13</b>	<p><i>Rome reborn and Google Earth</i></p> <p>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.</p> <p>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.</p> <p><a href="http://www.romereborn.virginia.edu">http://www.romereborn.virginia.edu</a></p>
	<b>Class 14</b>	<p><i>3D modeling as cognitive tool</i></p> <p>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.</p>
<b><u>Week 9</u></b>	<b>Class 15</b>	<p><i>The Archeomatica Project: 3D modeling experience</i></p> <p>Readings: F. Stanco, D. Tanasi, Experiencing the Past. Computer</p>

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		<p>Graphics in Archaeology, in S. Battiato, G. Gallo, F. Stanco (eds.), Digital Imaging for Cultural Heritage, CRC Press, Boca Raton, 2011, pp. 10-39.</p> <p><a href="http://www.archeomatica.unict.it">www.archeomatica.unict.it</a></p>
	<b>Class 16</b>	<p><i>The Archeomatica Project: 3D scanning experience</i></p> <p>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.</p> <p><a href="http://www.archeomatica.unict.it">www.archeomatica.unict.it</a></p>
<b><u>Week 10</u></b>	<b>Class 17</b>	<p><i>The Archeomatica Project: computer vision experience</i></p> <p>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.</p> <p><a href="http://www.archeomatica.unict.it">www.archeomatica.unict.it</a></p>
	<b>Class 18</b>	<b>Fieldtrip to Image Processing Laboratory of University of Catania</b>
<b><u>Week 11</u></b>	<b>Class 19</b>	<p><i>Practical exercise with triangulation 3D scanner on archaeological artifacts</i></p> <p>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.</p>
	<b>Class 20</b>	<p><i>Practical exercise with triangulation 3D scanner on archaeological artifacts</i></p> <p>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.</p>

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<b><u>Week 12</u></b>	<b>Class 21</b>	<p><i>Practical exercise of data processing with Meshlab</i></p> <p>Readings: P. Cignoni et alii, Meshlab: an open-source mesh processing tool, in Sixth Eurographics Italian Chapter Conference, 2008, pp. 129–136.</p> <p><a href="http://meshlab.sourceforge.net/">http://meshlab.sourceforge.net/</a></p>
	<b>Class 22</b>	<p><i>Practical exercise of data processing with Meshlab</i></p> <p>Tutorial on <a href="http://meshlabstuff.blogspot.com">http://meshlabstuff.blogspot.com</a></p> <p><a href="http://meshlab.sourceforge.net/">http://meshlab.sourceforge.net/</a></p>
<b><u>Week 13</u></b>	<b>Class 23</b>	<p><i>Practical exercise of data processing with Blender</i></p> <p>Readings: G. Gallo et alii, Blender application in archaeological research, Blender Conference 2008, Amsterdam, 24-26 October 2008, online slides.</p> <p><a href="http://www.blender.org">http://www.blender.org</a></p> <p><b><u>Paper 2 due</u></b></p>
	<b>Class 24</b>	<p><i>Practical exercise of data processing with Blender</i></p> <p>Tutorial on <a href="http://www.redbaron85.com">http://www.redbaron85.com</a></p> <p><a href="http://www.blender.org">http://www.blender.org</a></p>
<b><u>Week 14</u></b>	<b>Class 25</b>	<p><i>Dealing with Image Data in Archaeology: new perspectives</i></p> <p>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.</p> <p>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.</p>
	<b>Class 26</b>	<p>Review session for Final examination</p>

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<b><u>Week 15</u></b>		FINAL examination

## Bibliography

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