LA 7032

Geospatial modeling and fabrication

Brendan Harmon
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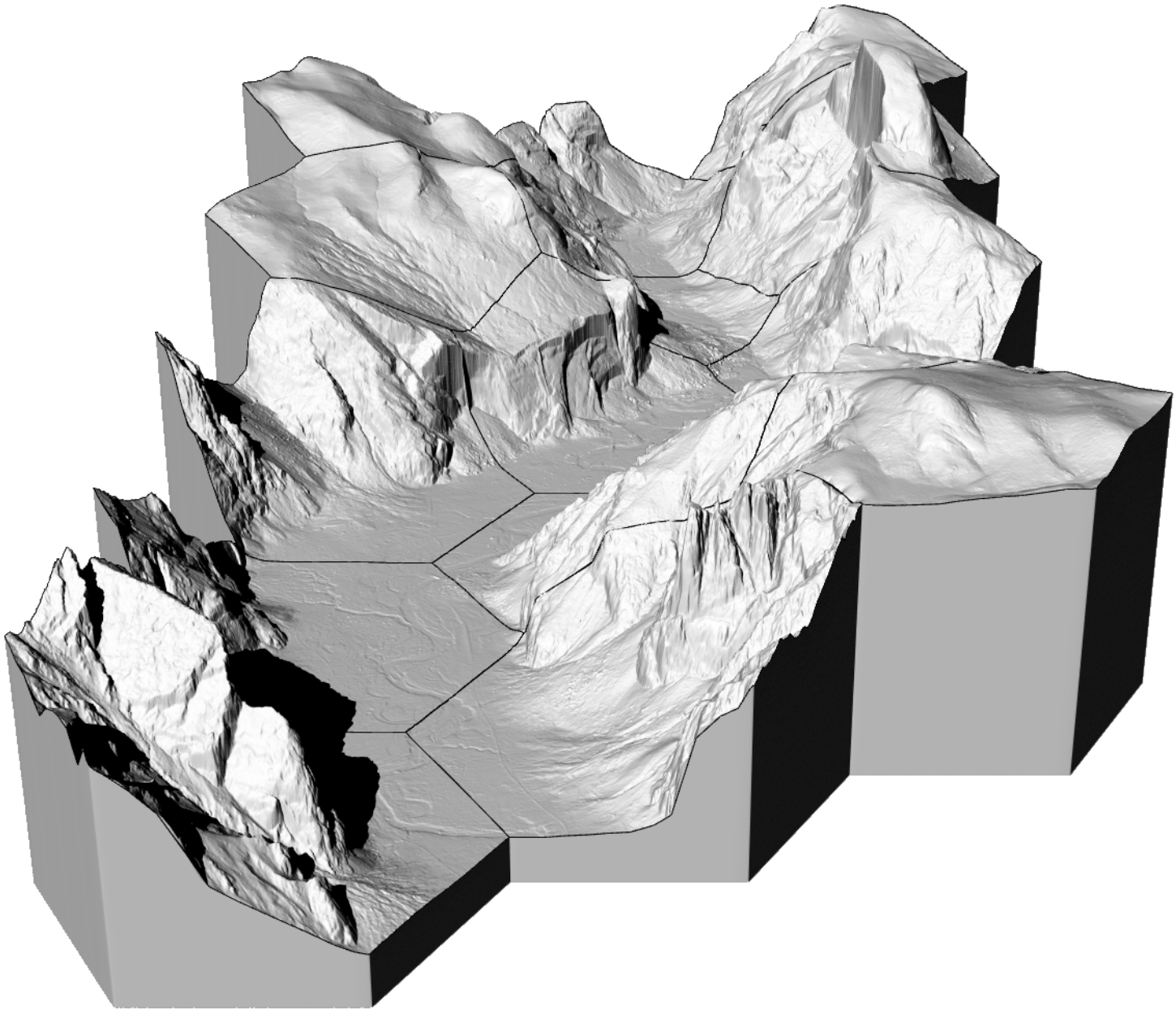
Fall 2017. Design 217.
Tuesday & Thursday 1:30am–5:20pm.



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Course Description

This course is an introduction to digital design for landscape architects. In this course you will develop a creative digital design process seamlessly integrating research and design using geographic information systems (GIS), 3D modeling and rendering, and visual programming. You will learn how to use geospatial data to model and analyze landscapes and visual programming to parametrically model and transform new landforms. You will learn how to model plants – from trees to grasses – in 3D, automatically distribute them across your digital landscape, and render photorealistic scenes. Through a series of 3D modeling projects you will design the restoration of a highly eroded landscape with a deep gully. Each week you will spend a day in a workshop learning new methods and a day developing your projects. You will work in small teams and present an exhibition of your models and renderings at the end of the course.

Course Schedule

08.24.2017	**Lecture |** Introduction	**Paper assigned:** The Alphabet & Algorithm
09.05.2017	**Workshop |** Terrain modeling	**Paper due:** The Alphabet & Algorithm
09.07.2017	**Studio |** Terran modeling	**Project assigned:** Geospatial modeling
09.12.2017	**Workshop |** Digital fabrication	
09.14.2017	**Studio |** Digital fabrication	
09.19.2017	**Workshop |** Geospatial analysis	
09.21.2017	**Studio |** Geospatial analysis	
09.23.2017	**Workshop |** Lost foam casting	
09.26.2017	**Workshop |** Geospatial simulation	
09.28.2017	**Studio |** Geospatial simulation	**Project due:** Geospatial modeling
10.03.2017	**Workshop |** Surface modeling	**Project assigned:** Generative design
10.05.2017	**Studio |** Surface modeling	
10.10.2017	**Workshop |** Visual programming	
10.12.2017	**Studio |** Visual programming	
10.17.2017	**Workshop |** Families of form	
10.24.2017	**Workshop |** Generative processes	
10.26.2017	**Studio |** Generative processes	**Project due:** Generative design
10.31.2017	**Workshop |** Image classification	**Project assigned:** Ecosystem modeling
11.02.2017	**Studio |** Image classification	
11.07.2017	**Workshop |** 3D plants	
11.09.2017	**Studio |** 3D plants	
11.14.2017	**Workshop |** Particle systems	
11.16.2017	**Studio |** Particle systems	
11.21.2017	**Workshop |** Rendering & physics	
11.28.2017	**Studio |** Exhibition	**Project due:** Ecosystem modeling
11.30.2017	**Gallery |** Exhibition	

Paper

The Alphabet and Algorithm Read Mario Carpo's book *The Alphabet and Algorithm* and write a 2000-word critical essay about the evolving nature of architectural authorship. Address how digital tools have transformed the practice of landscape architecture and envision how they will shape the future of the discipline.

Carpo, Mario. 2011. *The alphabet and the algorithm*. Cambridge, MA: MIT Press.

Projects

Geospatial modeling Using lidar data you will model, analyze, and digitally fabricate the topography of the study landscape. Each group will CNC mill a physical model of the landscape in a different media – either medium density fiberboard, polystyrene foam, or urethane foam. Then each group will prepare a different set of – either topographic, hydrologic, or sedimentation – analyses and simulations.

Generative design Using visual programming you will generatively design erosion control features to restore your degraded study landscape. Through a series of algorithmically generated design interventions you will explore interactions between topographic form and hydrologic processes. Your goal is to catalyze topographic changes that will restore the landscape to a dynamic equilibrium. You will produce 3D printed models of your designs and augment these with projected water flow and sediment flux.

Ecosystem modeling After mapping the existing vegetation you will design, model, and render in 3D a planting plan to restore this degraded landscape. You will produce beautiful, photorealistic 3D renderings of the existing landscape and your design.

Sessions

Terrain modeling Model topography in 3D from lidar data.

Digital fabrication Use computer numerical control (CNC) machining to carve physical models of topography. Learn how to cast a topographic model in aluminum.

Beorkrem, C. 2013. *Material Strategies in Digital Fabrication*. Taylor & Francis.

Thompson, R. 2007. *Manufacturing Processes for Design Professionals*. Thames & Hudson.

Geospatial analysis Model and analyze topographic parameters including contours, slope, hillshading, and landforms and hydrologic parameters including watersheds and flow accumulation.

Geospatial simulation Simulate the physical processes that shape landscapes including water flow, sediment flux, erosion-deposition, and landscape evolution.

Surface modeling Model complex, continuous, 3D surfaces using non-uniform rational basis splines (NURBS).

Visual programming Use visual programming to automatically generate patterns and forms.

Tedeschi, A. 2014. *AAD Algorithms-aided Design: Parametric Strategies Using Grasshopper*. Le Penseur.

Terzidis, Kostas. 2006. *Algorithmic architecture*. Elsevier Architectural Press.

Families of form Use visual programming to procedurally generate families of form based on parametric variations.

Choma, J. 2015. *Morphing: A Guide to Mathematical Transformations for Architects and Designers*. Laurence King Publishing.

Cache, B, and C Barrett. 2011. *Projectiles*. AA words. Architectural Association.

Generative processes Procedurally generate dynamic forms using parametric equations and attractors.

Image classification Use aerial photography to automatically classify different types of landcover.

3D plants Procedurally model unique specimens of trees and other plants in 3D. Model an ecosystem in 3D using 3D plant libraries.

Deussen, Oliver, and Bernd Lintermann. 2010. *Digital Design of Nature: Computer Generated Plants and Organics*. Springer. doi:10.1007/b138606.

Particle systems Generate fields of plants using particle systems.

Rendering Setup lights, prepare materials and textures, and render 3D scenes with raytracing.

Physics Simulate processes like water flow and rock fall using a physics engine.

Software

GRASS GIS | https://grass.osgeo.org/
Rhinoceros | https://www.rhino3d.com/
RhinoTerrain | http://www.rhinoterrain.com/
RhinoCAM | https://mecsoft.com/rhinocam-software/
Grasshopper | http://grasshopper3d.com/
Blender | https://www.blender.org/

Resources

Intro to GRASS GIS | https://ncsu-geoforall-lab.github.io/grass-intro-workshop/
Hydrology in GRASS GIS | https://grasswiki.osgeo.org/wiki/Hydrological_Sciences
Grasshopper Primer | http://grasshopperprimer.com
BlenderGIS tutorial | https://github.com/ptabriz/ICC_2017_Workshop

Readings

Choma, J. 2015. *Morphing: A Guide to Mathematical Transformations for Architects and Designers*. Laurence King Publishing.

Tedeschi, A. 2014. *AAD Algorithms-aided Design: Parametric Strategies Using Grasshopper*. Le Penseur.

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Carpo, Mario. 2011. *The alphabet and the algorithm*. Cambridge, MA: MIT Press.

Deussen, Oliver, and Bernd Lintermann. 2010. *Digital Design of Nature: Computer Generated Plants and Organics*. Springer. doi:10.1007/b138606.

Picon, Antoine. 2010. *Digital culture in architecture: an introduction for the design professions*. 224. Boston, MA: Birkhaeuser.

Thompson, R. 2007. *Manufacturing Processes for Design Professionals*. Thames & Hudson.

Terzidis, Kostas. 2006. *Algorithmic architecture*. Elsevier Architectural Press.

Policies

Time Commitment Expectations LSU's general policy states that for each credit hour, you (the student) should plan to spend at least two hours working on course related activities outside of class. Since this course is for three credit hours, you should expect to spend a minimum of six hours outside of class each week working on assignments for this course. For more information see: http://catalog.lsu.edu/content.php?catoid=12&navoid=822.

LSU student code of conduct The LSU student code of conduct explains student rights, excused absences, and what is expected of student behavior. Students are expected to understand this code: http://students.lsu.edu/saa/students/code.

Disability Code The University is committed to making reasonable efforts to assist individuals with disabilities in their efforts to avail themselves of services and programs offered by the University. To this end, Louisiana State University will provide reasonable accommodations for persons with documented qualifying disabilities. If you have a disability and feel you need accommodations in this course, you must present a letter to me from Disability Services in 115 Johnston Hall, indicating the existence of a disability and the suggested accommodations.

Academic Integrity According to section 10.1 of the LSU Code of Student Conduct, "A student may be charged with Academic Misconduct" for a variety of offenses, including the following: unauthorized copying, collusion, or collaboration; "falsifying" data or citations; "assisting someone in the commission or attempted commission of an offense"; and plagiarism, which is defined in section 10.1.H as a "lack of appropriate citation, or the unacknowledged inclusion of someone else's words, structure, ideas, or data; failure to identify a source, or the submission of essentially the same work for two assignments without permission of the instructor(s)."

Plagiarism and Citation Method Plagiarism is the "lack of appropriate citation, or the unacknowledged inclusion of someone else's words, structure, ideas, or data; failure to identify a source, or the submission of essentially the same work for two assignments without permission of the instructor(s)" (Sec. 10.1.H of the LSU Code of Student Conduct). As a student at LSU, it is your responsibility to refrain from plagiarizing the academic property of another and to utilize appropriate citation method for all coursework. In this class, it is recommended that you use Chicago Style author-date citations. Ignorance of the citation method is not an excuse for academic misconduct.

Graduate Certificate in GIS This course counts as an applied topics course for the Graduate Certificate in Geographic Information Science. The Graduate Certificate in Geographic Information Science at LSU is a 12 credit hour standalone certificate with courses offered in the Department of Geography and Anthropology, College of Art and Design, Department of Economics, School of the Coast and Environment, Department of Civil and Environmental Engineering, and Department of Computer Science. For more information about the Graduate Certificate in GIS visit: http://ga.lsu.edu/gis-certificate/.

Grading

Paper | Alphabet and Algorithm	20%
Project | Geospatial modeling	20%
Project | Generative design	20%
Project | Ecosystem modeling	20%
Exhibition	20%