LSU | College of Art + Design

LA 7032 | Generative Landscapes

Brendan Harmon
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Spring 2021.
Tuesday & Thursday 1:00am–3:30pm.

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Course Description

This course is an introduction to generative design for landscape architects. In this course you will learn how to algorithmically model landscapes, numerically simulate physical processes like the flow of water and sediment, and digitally fabricate landforms. You will conduct surveys with drones and terrestrial lidar, parametrically model variations on landforms and planting using visual programming, photorealistically render your algorithmic planting patterns, and computer numerical control (CNC) mill your landforms. Through this course you will learn creative approaches to digital design and apply emerging technologies to landscape architecture.

Keywords

- Algorithmic architecture
- Generative design
- Parametric modeling
- Visual programming
- Digital fabrication
- 3D rendering
- Lidar analytics
- Drone photogrammetry
- Geospatial programming

Schedule

Generative Design		Digital Fabrication		Drone Analytics	
1	Design week	**6**	Parametric landforms I	**11**	Drone analytics I
2	Parametric paving	**7**	Parametric landforms II	**12**	Drone analytics II
3	Parametric planting I	**8**	Parametric landforms III	**13**	Geo. programming I
4	Parametric planting II	**9**	Digital fabrication I	**14**	Geo. programming II
5	Parametric planting III	**10**	Digital fabrication II	**15**	Geo. programming III

Online

This class will be taught online. All course content including tutorials, lectures, and datasets will be published on the course website at: https://baharmon.github.io/generative-landscapes. During our regularly scheduled class period on Tuesdays and Thursdays from 1:00-3:50 pm, we will meet on our Discord server at https://discord.gg/wvDneQJ48b for live streamed lectures, discussions, student presentations, and troubleshooting. Before each class please complete the assigned tutorial and homework. Post your tutorial work, homework, and project work on your channel on the Discord server. Each tutorial will have a page on the course website and a video on both Youtube and Vimeo.

Course website | https://baharmon.github.io/generative-landscapes
Discord | https://discord.gg/wvDneQJ48b
Youtube | https://www.youtube.com/c/BrendanHarmon
Vimeo | https://vimeo.com/showcase/7356098

Projects

Essay Read Mario Carpo's *The Alphabet and Algorithm* and then in response write a 500-word critical essay. How have digital tools and processes transformed the practice of landscape architecture and how do you think they will shape the future of the discipline? How do you envision using digital design tools and processes in your work?

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

Paving Matrix Use visual programming to generate a matrix of 16 algorithmically generated paving patterns.

Planting Matrix Use visual programming to generate a matrix of 16 algorithmically generated planting patterns.

Landform Matrix Use visual programming to generate a matrix of 16 algorithmically generated landforms.

3D Printed Landform 3D print an algorithmically generated landform.

CNC Milled Landforms CNC mill and thermoform a family of 16 algorithmically generated landforms.

Drone Survey Conduct a topographic survey of the landform at Hilltop Arboretum with a drone and automated ground control points. Use photogrammetry to generate a point cloud, digital surface model, and orthophoto.

Landform Analysis Use geospatial programming to calculate slope, solar irradiation, and water and sediment flows for 16 algorithmically generated landforms.

Grading

Essay	10%	3DP Landform	10%
Paving Matrix	10%	CNC Landforms	10%
Planting Matrix	10%	Drone Survey	10%
Landform Matrix	10%	Landform Analysis	10%
Tutorials	15%	Course Portfolio	5%

Software

Rhinoceros | https://www.rhino3d.com/
Grasshopper | http://grasshopper3d.com/
RhinoCAM | https://mecsoft.com/rhinocam-software/
Thea Render for Rhino | https://www.thearender.com/
Agisoft Metashape | https://www.agisoft.com/
GRASS GIS | https://grass.osgeo.org/
Python | https://www.python.org/

Plugins

Snapping Gecko | https://www.food4rhino.com/app/snappinggecko
Noise 4D | https://www.food4rhino.com/app/4d-noise
Elefront | https://www.food4rhino.com/app/elefront
Docofossor | https://www.food4rhino.com/app/docofossor

Resources

Grasshopper Basics | https://vimeo.com/channels/basicgh
Grasshopper Primer | http://grasshopperprimer.com

Required Readings

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

Dunn, Nick. *Digital Fabrication in Architecture*. Laurence King Publishing, 2012.

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

Recommended Readings

Stevens, J., and R. Nelson. *Digital Vernacular: Architectural Principles, Tools, and Processes*. EBL-Schweitzer. Taylor & Francis, 2015.

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

Neteler, Markus, and Helena Mitasova. *Open source GIS: a GRASS GIS approach*. Vol. 689. Springer Science & Business Media, 2013.

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

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

Network drives

Windows: `\\desn-knox.lsu.edu\Landscape-Classes\LA7032-S2020`

Macs: `smb://desn-knox.lsu.edu/Landscape-Classes/LA7032-S2020`

Terminology

Digital design

- Mass customization
- Generative design
- Parametric modeling
- Performative design
- Algorithm

Spatial data

- Raster & Vector
- Array
- Point cloud
- Mesh
- Triangulated irregular network (TIN)
- Plain text
- Comma separated values (CSV)
- Integer & floating point numbers
- Quadtree & octree
- Non-uniform rational basis spline (NURBS)

Geospatial

- Geographic information system (GIS)
- Digital terrain model (DTM)
- Digital elevation model (DEM)
- Digital surface model (DSM)
- Lidar
- Unmanned aerial system (UAS)
- Structure from motion (SfM)
- Delaunay triangulation
- Interpolation
- Regularized spline with tension (RST)
- Map algebra

3D rendering

- Ray tracing
- Diffuse shading
- Texture map
- Particle system
- Head mounted display (HMD)
- Cave automatic virtual environment (CAVE)

Digital fabrication

- 3D printing
- Computer numeric control (CNC)
- Collet & Bit
- High density urethane (HDU)
- Medium density fiberboard (MDF)

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.

Accreditation Expectations As an accredited Landscape Architecture program LSU's Robert Reich School of Landscape Architecture (RRSLA) must meet the accreditation requirements as stated by the Landscape Architectural Accreditation Board (LAAB) to ensure RRSLA is meeting the expectations of the field. The LAAB requires programs to provide digital copies of student work as part of this process. Students in this course will be expected to comply with the following requirements as 5% of their course grade: (1) Students must provide a course portfolio with work samples specified by the instructor before the end of the grading period. (2) Each student's course portfolio must be saved as a single, high resolution PDF file with multiple pages. (3) Files must follow the naming convention established by the school: department-coursenumber-semesteryear-username.pdf. Example: LA7032-S2021 -baharmon.pdf.