LSU | College of Art + Design

LA 7032 | Generative Landscapes

Brendan Harmon
baharmon@lsu.edu

Spring 2022.
Tuesday & Thursday 1:00–3:30pm.

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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	Laser scanning I	**6**	Visual programming	**11**	Parametric landforms I
2	Laser scanning II	**7**	Parametric paving I	**12**	Parametric landforms II
3	Drones I	**8**	Parametric paving II	**13**	Terrain modeling
4	Drones II	**9**	Parametric planting I	**14**	Digital fabrication
5	Drones III	**10**	Parametric planting II	**15**	Geospatial simulation

Server

During our regularly scheduled class period on Tuesdays and Thursdays from 1:00-3:50 pm, we will meet in person, while also posting on our Discord server at https://discord.gg/vxGqbANbBQ. The discord server will be used for posting announcements, student work in progress, reading responses, projects, and troubleshooting. All course content including tutorials, lectures, and datasets will be published on the course website at: https://baharmon.github.io/generative-landscapes.

Course website | https://baharmon.github.io/generative-landscapes
Discord | https://discord.gg/vxGqbANbBQ
Youtube | https://www.youtube.com/c/BrendanHarmon

Projects

Essay: Cloudism Read Christophe Girot's essay *Cloudism* and write a 500-word critical response. What potential do you see in point clouds as a medium for landscape architecture? What makes point clouds different from other modes of representation?

Girot, Christophe. "Cloudism." In *Routledge Research Companion to Landscape Architecture*, ed. by Ellen Braae and Henriette Steiner. London: Routledge, 2019. https://doi.org/https://doi.org/10.4324/9781315613116.

Essay: The Alphabet and Algorithm 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.

Laser Scanned Tree Use laser scanning to record a heritage tree as a point cloud. Publish the point cloud to the web in an interactive viewer.

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.

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

Planting Matrix Laser scan a collection of trees and use visual programming to generate a matrix of 16 algorithmically generated planting patterns of point cloud trees.

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

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

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

Grading

Essays	10%	Landforms Matrix	15%
Laser Scanning	10%	CNC Landform	10%
Drone Survey	10%	Landform Analysis	10%
Paving Matrix	15%	Course Portfolio	5%
Planting Matrix	15%		

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/
Faro Scene | https://www.faro.com/
CloudCompare | https://www.danielgm.net/cc/
GRASS GIS | https://grass.osgeo.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
Hydrology in GRASS GIS | https://grasswiki.osgeo.org/wiki/Hydrological_Sciences

Required Readings

Girot, Christophe. "Cloudism." In *Routledge Research Companion to Landscape Architecture*, ed. by Ellen Braae and Henriette Steiner. London: Routledge, 2019. https://doi.org/https://doi.org/10.4324/9781315613116.

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

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.

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

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

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.