

Performance-Driven Design using Grasshopper

Instructed by Nathan Miller

Since the advent of the 'computation movement' in architecture, designers have leveraged the power of advanced digital tools for a wide range of purposes. While many investigations have trended towards the search for new and exciting forms, advanced digital tools have also served as a means for enabling the designer to create performance-driven architecture. The digital tool, in the later case, becomes a means for exploring design ideas through the implementation of precise project parameters. The designer is tasked with creating a robust 'algorithm' which is used to choreograph a range of design criteria related to topics such as programmatic requirements, material properties, environmental analysis, and fabrication methodology. The implementation of the digital tool to this effect requires that the designer be inventive and methodical; creative and rigorous.

The Grasshopper Seminar is designed to expose participants to the world of parametric and generative techniques with an emphasis on performance-driven design. The seminar will build the participant's competency in the use of the Grasshopper Plug-In for Rhino by introducing the students to the key concepts of the interface. Students will be walked through step-by-step examples and assigned a series of weekly assignments to assess their progress in being able to solve design problems with the Grasshopper plug-in

The final project will task the student with creating a 'performance-driven' algorithm where they will encode their own unique parameters and criteria. They will then document and publish their Grasshopper algorithm as part of this wiki.

The students will focus their investigations on one or several of the following topics:

- Constraint-based Programming
- Structure and Skin Systems
- Environmental Analysis and Feedback
- Fabrication and Construction Methods

Seminar Project: A Performance-Driven Skyscraper Algorithm

Students will be involved in an ongoing project to design and document a Grasshopper skyscraper algorithm. The skyscraper algorithm will be driven by various performance criteria that can be categorized under the 4 topics below:

- Constraint-based Programming
- Structure and Skin Systems
- Environmental Analysis and Feedback
- Fabrication and Construction Methods

Each week, a new topic will be introduced followed by a step-by-step tutorial. The students will then develop their skyscraper algorithm based on the weekly topic and submit a progress file(s) to the **Student Labs** before the next class. Students are encouraged to experiment and be creative with their weekly explorations.

For the final product, the students will be responsible for documenting and publishing their work on their *personal page* in the **Student Labs**. The students will provide a vignette (diagram, drawing, or rendering) and the final grasshopper file.

In addition, each student will be assigned one **Course Topic** and they will provide a detailed process summary (visual and written) of how their skyscraper algorithm integrates the specific topic.

The results of the seminar project will be presented to the NBBJ Los Angeles Studio on the final day of class.

Grasshopper Exercises

Exercises are found under the **Course Resources** and are designed to build the students ability to problem solve and troubleshoot using the Grasshopper plug-in. One of two types of exercise will be issued every week during the course:

- **Debugging Exercises:** This type of assignment will challenge the students to *fix* a Grasshopper definition that *is not doing what it is supposed to be doing*. This will build the student's competency in reading a definition file and identifying common problems they will run into when working with the plug-in.
- **Problem-Solving Exercises:** This type of assignment will challenge the student to build a definition from scratch based on specific criteria. This will build the student's ability to think through conceptual-level problems using the plug-in

Assignment Parameters

- **Resources:** Students may use any resources available to them to complete the assignments. Students are encouraged to communicate via the discussion forums on this wiki or ask questions on the Grasshopper forums. Yes, the instructor is a valid resource.
- **Collaboration:** Teamwork and collaboration is highly encouraged. However, if students choose to work together on any assignment, they must cite the contributions of their collaborators within their submission.
- **Attribution:** Always credit your authorship of a given work. Likewise, If you use or modify materials that are not of your original creation, you must always cite proper authorship. This class has a zero-tolerance policy for plagiarism.

Grading

Who deserves an A?

The **A student** demonstrates proficiency and enthusiasm in using the Grasshopper plug-in and in the course content. This can be measured in a number of ways including the level of participation on the wiki.

The **A student** completes assignments, regularly posts explorations to their laboratory page, and contributes thoughtful content to the assigned topics page. The A student **initiates** conversations on the forum, helps others in need, and asks questions when they run into problems.

Schedule

TIME: 1:00 PM to 3:20 PM

DAYS: April 1, 8, 15, 22, 29

April 1, 2010

- Course Introduction
- Introduce Course Project, Assign Seminar Project Groups
- Grasshopper Overview

- *GRASSHOPPER TUTORIALS:* Constraint-Based Programming

- **ASSIGNMENTS:** 1. Join the Wiki, 2. Create Personal Labs Page, 3. Seminar Project Progress Submission, 4. Remake Basics Exercises 04 & 06

April 8, 2010

- Q&A: Assignments, Constraint-Based Programming

- *GRASSHOPPER TUTORIALS:* Structure and Skin Systems

- **ASSIGNMENTS:** Grasshopper Exercise 1, Seminar Project Progress Submission

April 15, 2010

- Q&A: Assignments, Structure and Skin Systems

- *GRASSHOPPER TUTORIALS:* Environmental Analysis and Feedback

- **ASSIGNMENTS:** Grasshopper Exercise 2, Seminar Project Progress Submission

April 22, 2010

- Q&A: Assignments, Environmental Analysis and Feedback

- *GRASSHOPPER TUTORIALS:* Fabrication and Construction Methods

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- **ASSIGNMENTS:** Finish Seminar Project (Algorithm + Topic Page), Prepare for Presentation

April 29, 2010

- Final Seminar projects and Wiki documentation are due before class starts.
- **FINAL COURSE REVIEW** Meet @ NBBJ Los Angeles
- 523 West 6th Street Suite 300, Downtown Los Angeles

Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA)

The University of Southern California is committed to full compliance with the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA). As part of the implementation of this law, the University will continue to provide reasonable accommodation of academically qualified students with disabilities so those student can participate fully in the University's educational programs and activities. Although USC is not required by law to change the "fundamental nature of essential curricular components of its programs in order to accommodate the needs of disabled students," the University will provide reasonable academic accommodations. The specific responsibility of the University administration and all faculty serving in a teaching capacity is to ensure the University's compliance with this policy.

The general definition of a student with a disability is any person who has "a physical or mental impairment which substantially limits one or more of such person's major life activities," and any person who has "a history of, or is regarded as having, such an impairment." Reasonable academic and physical accommodations include but are not limited to: extended time on examinations; substitution of similar or related work for a non-fundamental program requirement; time extensions on papers and projects; special testing procedures; advance notice regarding book list for visually impaired and some learning disabled students; use of academic aides in the classroom such as note takers and sign language interpreters; early advisement and assistance with registration; accessibility for students who use wheelchairs and those with mobility impairments; and need for special classroom furniture or special equipment in the classroom.

Obtaining Accommodations

Physical Accommodations

Students with physical disabilities should contact Disability Services and Programs (DSP) prior to or during the first week of class attendance or as early in the semester as possible. The office will work with classroom scheduling, the course instructors and their departments, and the students to arrange for reasonable accommodations.

Academic Accommodations

Students seeking academic accommodations due to a physical or learning disability should make the request to the course instructor prior to or during the first week of class attendance, as well as registering with DSP as early in the semester as possible. Course instructors should require that a student present verification of documentation when academic accommodations are being requested.

For assistance in how to provide reasonable accommodations for a particular disability, course instructors are encouraged to consult with Disability Services and Programs (DSP). Students requesting academic accommodations who do not have DSP documentation should be referred to that office. Disability Services & Programs contact: (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus*, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A:

<http://www.usc.edu/dept/publications/SCAMPUS/gov/>

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at:

<http://www.usc.edu/student-affairs/SJACS/>