Graduate School of Architecture, Planning and Preservation
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APPROACHING CONVERGENCE 2012: ADVANCING EXCHANGE IN GRASSHOPPER

Instructor: Biayna Bogosian / bb2466@columbia.edu
Research Coordinator: Steven Garcia / steven@thediscontinuum.net
Teaching Assistant: Phillip Crupi / pwc2110@columbia.edu

Course Website: **http://www.thediscontinuum.net/ac2012**

// Overview

Have we reached a *stasis* in the long-heralded potential of the parametric?

The architect—as mediator between immaterial and material, human and technology—has always operated across a multitude of domains at once, and with an array of strategies at hand. The digital age has only accelerated the multiplicity; each novel tool introduced to the architect's toolbox has struck a new vector of architectural narration, and with it opened further possibilities of conveyance of concept and method. With the advent of the performance-based paradigm, however, a reliance upon the perceived purity of data-driven results has emerged, clouding the once-explicit role of the designer in process. Parametric design is commonly perceived to be the objective end result of a software's processing of predetermined databases through complex algorithms, compelling experiments to act within their computational capabilities. Often overlooked, however, are the inescapability of embedded presuppositions in software and subjective determinations of fitness objectives that ultimately drive the construction and determination of the system. Architects have indeed acknowledged these challenges as limitations of performative design, and along the way ambitions have shifted to the study of generative and non-linear potentials. As a result, exploiting control over the efficiency, fluidity and substantive analyses of the parametric system in order to close the gap in the exchange of information—and thus championing a re-insertion of the designer into process—has remained largely unexplored.

The term convergence in mathematics refers to the idea that certain functions and algorithmic relationships approach a limit when arriving at certain conditions. In evolutionary computing, the term refers to the tendency of a tested population to reach stabilization over time. This course, however, propose that a convergence of interoperational toolsets holds the potential to unlock an even deeper exploration of the designer's agenda. At this conflux of methodologies, where the distance between generation and evaluation substantively compresses, dexterity across multiple digital platforms amplifies the designer's ability to both explore options across an expanding design-space and achieve depth and speed of analysis. The agile designer must traverse a broad spectrum of generation, testing, and evaluation methodologies in orchestrating the complex collaborations of the process of design. Imagine if we could teach our machines to think the same!

This course emerges from the assertion that the architect of the very near future will design workflow and software as integrally as projects and buildings. Navigating explorations through, between, and within multiple applications, our students launch into agenda-driven opportunities for advanced and fluid interoperations. The working methodology advocated in this course encourages versatility and interchangeability in the human-machine relationship while aiming to build subjectivity and reprogrammability into the design process. The goal is to approach a convergence of varied and disparate computational platforms of design, with a specific focus on integrating techniques of digital and human craft and analysis into a near-seamless and active coexistence.

// Software Explorations: Toolsets and Workflow

Base modeling: Rhino, Grasshopper (beta 0.8 or current)
Workflow automation and customization: VB.NET, Rhinoscript, Processing, Java, MEL, Python, Lua
Cross-platform communication: Text file I/O, Excel events and subroutines, User Datagram Protocol (UDP)

The primary explorations of this course will focus on advancing techniques within the Grasshopper plug-in for Rhinoceros toward expansion of the base GH toolset via add-on GHA plug-ins and custom Visual Basic dotNET scripting. We will swiftly build a robust foundation of operational moves within Grasshopper as means to establish information/logics and geometric manipulations of external data. Grasshopper will serve as our primary engine for both ***interoperative*** control of various platforms and ***intraoperative*** drivers of systems built within GH itself (see Research Focii below). Additionally, participants will be expected to post work and images throughout the semester to the course website, **http://www.thediscontinuum.net** . The online component of the course is key to fueling collaborative exchange and will form the basis for research documentation and internal resources.

// Software Explorations: Research Focii

Participants will work collaboratively under a specified topic of investigation distributed during the first week of the semester based on student interest and background. Anticipated areas of research/exploration include:

intraOperative Toolsets:
Workflow Tools (and/or) Image Mapping and Production [vRay and render engines, ModeTools, Photoshop, Illustrator] (and/or) Force-based Simulations [Kangaroo] (and/or) Mesh/NURBS Topology [Weaverbird] (and/or) Evolutionary Solvers [Galapagos] (and/or) L-Systems and Cellular Automata [Rabbit] (and/or) Environmental [Geco] (and/or) Sensory and Physical Inputs [Firefly] (and/or) Extended Communication with Applications and Physical Devices [gHowl] (and/or) …

interOperative Datasets:
Agents and Behaviors [processing] (and/or) Physics and Dynamics [Autodesk Maya]
Sensory and Physical Inputs [Arduino] (and/or) XML and Streaming Data [web-based sourcing, GIS, Excel] (and/or) Environmental [Autodesk EcoTect Analysis] (and/or) …

Students are encouraged to bring their own software interests to the course in terms of development of the interoperable workflow; the list above is intended as a resource of opportunities for dynamic software communication.

// Laboratory Approach: Collaborative Workshop

As Grasshopper is currently a software in beta form, a primary intent of this course is to make a significant contribution to the current efforts of an ever-growing community of users, through the creation and development of an online catalogue and forum devoted specifically to the topic of automated workflow strategies (@ www.thediscontinuum.net). Fueled by several modes of internal collaboration, we will work systematically to develop a diverse library of customized tools in and ultimately for an open-source environment. The schedule will incorporate laboratory sessions specific to this collaborative goal.

Tools and components collaboratively developed in Grasshopper will merge to generate complex super-operations, comprising a collective virtual workshop. Students will construct mechanisms within Grasshopper to gain real-time access to operations and plug-in functionalities of Rhino beyond the standard Grasshopper toolset, then build advanced scripts to dynamically weave these super-operations into and out of our other primary software platforms, in an effort to develop truly intricate and efficient digital constructs for synchronized generation and analysis.

// Assignments

OPERATION #0: *Concept Sketching and Warmup Tutorials*
Students are expected to complete a series of base tutorials (available online) as the primary mode of introduction to the Grasshopper toolset (augmenting week01 discussion). Additionally, students are asked to sketch an initial design problem to study through various methodologies throughout the course. The design agenda will consist of a parametrically derived architectural component and a devised automated workflow.
DELIVERABLES: Sketches, diagrams, and posted description of the proposed design problem.

OPERATION #1A: *inSourced Operations (Accessing Rhino and Plug-ins)*
Students are expected to integrate custom VB.NET script modules within Grasshopper to access Rhino operations beyond the base Grasshopper toolset as well as plug-ins and rendering/animation software, thereby expanding the generation and visualization functionality of the tool. The scripts will be applied to the design problem proposed by the student in Operation #0.
DELIVERABLES: Initial workflow diagram; matrix of initial possibilities; operational pseudocode; GH definitions (noted definitions - no Rhino Files) posted to course website.

OPERATION #1B: *outsourced Operations (Cross-Platform Scripts and Data Streams)*
Students are expected to build custom, cross-platform workflows (using provided scripts as groundwork) to dynamically connect Rhino/Grasshopper as a modeling platform with generative and/or evaluation software for testing of component designs. Workflow connections will be explored using various methodologies for intercommunication. Additionally, students will be asked to produce an animation/video of dynamic processes in action (via CamStudio or similar recording software) and final renderings of output.
DELIVERABLES: Workflow diagram of dynamic system; matrix of final interoperable designs; animation/video of dynamic processes and rendering; GH definitions (noted definitions – no Rhino files) and associated software files posted to course website.

// Attendance/Participation and Grading

As we aim for a richly interactive workshop, participants will be required to both present both progress and final work (per assignment) to the workshop group at large at periods throughout the semester, via web documentation and in-class review. As such, consistent and interactive attendance is required. Attendance and participation will be reflected in final grades.

Course assignments will be graded according to quality, clarity, intricacy and depth of operations, and creativity. On-time posting of deliverables is key to the progression of the research as a whole and will be reflected as such in individual grades.

PROPOSED SCHEDULE

Week01 **ORIENTATION / NAVIGATION**

Course Overview: Thinking Explicitly
Introduction to Online Resources and Course Website and Catalogue
http://www.thediscontinuum.net
Grasshopper Demo: Download/Plug-in, Interface Overview
http://www.grasshopper3d.com
+
Operation #0 Assigned: Concept Sketching and Warm-up Tutorials

Week02 **GH OPERATIONS + GH LOGICS + GH LISTS**

Operation #0 Due (Student Documentation)
+
Components and Operations: Math, Vector, Curve, Surface, Intersect, Xform
Data Management: Data Matching, Data Trees, Logics
Conditional Statements: Functions / Expressions / Booleans / Dispatches

Week03 **GH EXTENSIONS: intraOPERATIONS**

Introduction to Rhino SDK
http://en.wiki.mcneel.com/default.aspx/McNeel/DotNetPluginEssentials.html
http://en.wiki.mcneel.com/default.aspx/McNeel/Rhino4DotNetPlugIns.html
Toolset Extensions: Accessing Plug-ins, Introduction to Kangaroo and various plug-ins
+
Operation #1A Assigned: inSourced Operations
(Accessing Rhino and Building Custom Modules)

Week04 **DYNAMIC SYSTEMS: interOPERATIONS**

Data Streaming: Read/write to Excel, .csv, VB Modules / Subroutines, Read/write to
Processing w/ gHowl User Datagram Protocol (UDP)
Dynamic Text File I/O: Processing and Maya

Week05 **AUTOMATED PRODUCTIONS**

Operation #1A Due (Student Documentation)
+
Scripted IntraOperations: Layer Control, AutoBakes, Rendering and Animation
Representation + Documentation Overview: Camtasia Demo
+
Operation #1B Assigned: outSourced Operations
(Cross-Platform Scripts and Evaluation/Analytics)

Week06 **WORK SESSION 1.0**

Operation #1B Checkpoint

Week07 **RESEARCH REVIEW**

Operation #1B Research Review (Student Presentations and Documentation)
+
Collective Tool Library Assessment and Development

POST-BREAK **FINAL SUBMITTALS**

Posting and Submittal of Final Work