encoded matter

workshop in computational craft

Encoded Matter

A4801 Visual Studies Seminar

Graduate School of Architecture, Planning and Preservation

Columbia University - Spring 2017

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Course Meeting Pattern and Location: Tuesday 1-3pm Buell 200

"But in a building form that is static, where are the dynamics, what is the non-linearity? This is a difficult question. To my mind the answers lie deep in configuration. As we are made of patterns, both random and regular, both physical and emotional, probing the archetypes of pattern is important – in its recognition and resonance we may find an element of beauty. In the past beauty was conditioned by aspects of purity, fixed symmetries and pared minimal structure being accepted as norms. As long as our brain kept to tramlines of reasoning the model persisted. Now that the world is being accepted as not simple, the complex and oblique and the intertwining of logic strands gain favor. Reason itself is finally being understood as nascent structure, non-linear and dependent on feedback procedures. Beauty may lie in the actual processes o engagement and be more abstract than the aesthetic of objecthood. Ultimately it may really be a constructive process."

Cecil Balmond, Informal

Introduction:

Our world is increasingly being understood as an emergent outcome of complex systems. Similarly, both analytical and generative tools for the definition of spatial and architectural systems have been established within our discipline. Although this design approach is extremely sensitive to existing models of self-organization in material, biological and physical systems, our intention could not be further than the mere replication of 'matter' nor 'nature' . On the contrary, with the deployment of non-linear computational design methodologies this seminar seeks new singularities in the extended territory of contemporary architectural production. At the same time, this research allows for the transcendence of traditional disciplinary boundaries since research in complexity itself is an emergent language shared between multiple fields of scientific and artistic interest. Algorithmic architectural research has the unique capacity

to develop a deeper dialogue with a variety of scales, from the material and microscopic, to the emergent and macroscopic.

Course Objectives:

This seminar is devoted to the research of nonlinear computational generative systems for architectural design. Design research is not defined here as a linear scientific process with objective outcomes, but rather as the iterative, non-linear and speculative process with the ability to reassess and shift our disciplinary discourse. This research focuses on the inherent potential of computation to generate space and of algorithmic procedures to engage self-organization in the design process. Students will engage closely with encoded processes in order to develop an aesthetic and intuition of complexity that resides in a balance between design intent and emergent character. During the seminar, students will work in small teams and create their own custom algorithms appropriate to the research trajectories of choice. The output will be a book, a series of boards and animations.

This research focuses on the inherent potential of computation to generate space and of algorithmic procedures to engage self-organization in the design process. Student projects will develop encoded processes through an aesthetic and intuition of complexity that resides in a balance between design intent and emergent character. The critical parameter is to explore the potential beyond finite forms of explicit and parametric modeling towards non-linear algorithmic processes. The materialization of the research is non-linear: the computational system does not have a singular fabricated manifestation nor does it have a predefined notion on its translation into architecture.

Conceptual framework:

Our speculative condition is that computation is not solely digital but omnipresent. As such, beyond the correlation of simulation, this seminar positions different mediums onto a flat ontology and mines the collateral effects of the synchronicities and divergences between them. The primary territory of feedback between abstraction, matter and narration is pattern. We seek novel patterns of organization, structure and articulation as architectural expressions within the emergent properties of feedback loops and rule based systems.

Computational creations and specifically algorithmic architecture require a new ethics towards the work. While designing a system and a field of results instead of a single entity, it becomes a combinatory problematic on a meta-level: which processes are compatible to be codified together? How to orchestrate highly expressive phase spaces? Which abstract logics of self-replication are capable of infinite amounts of difference?

The success of this speculative and open-ended research is measured in the expressivity and pluralism of the phase spaces they produce as well as their architectural translatability. The results fold onto the next projects both by the means of exhaustive catalogues and in the creation of multi-authored and open source computational libraries. These 'languages', as they escape the digital inscription to

include other artifacts, sometimes notational and other physical and material, are always-already multiple, collective and non-linear.

Methodology:

Encoded Matter will run primarily under Python programming language for Rhinoceros 3D 5.0 & Grasshopper. The application of python as the cross-software coding platform opens up a new set of possibilities for the development of cutting edge techniques of digital representation, abstract and spatial organization as well as intricate geometric precision for robotic fabrication. Encoded Matter will test python for rhinoceros in an intensive format and will seek to produce innovative intersections between advanced explicit modeling and algorithmic logics. This seminar will accommodate both introductory and advanced levels. No previous scripting experience is necessary. It will consist of a series of introductory sessions, obligatory intensive workshops, lectures followed by suggested readings, and will gradually focus on individual projects. Students will be encouraged to investigate the limits of algorithmic design both theoretically and in practice through a scripting environment.

Schedule:

Class #0 Introduction

in class: Introduction to Python Syntax:

Variables, Loops, Lists, Conditional Statements, Functions.

Example: Mathematical Objects (sin/cos curves & surfaces).

required reading: Crossover by Cecil Balmond

suggested reading: Complexity a Guided Tour by Melanie Mitchell

Class #1 Recursion - Introduction to Functions

due: Basic Iteration Exercises. Initial Research Agenda Description and References.

in class: Recursive Tree Diagram. Rhino/Python User Input/Interface. Grasshopper Integration.

Vectors, Control Points, Vertices, Object Grips.

Basic Recursion Examples: Recursive Subdivision / Tiling of Plane

Frei Otto Wool Experiment

required reading: Self Made Tapestry by Philip Ball

suggested reading: The Fractal Geometry of Nature by Benoit Mandelbrot

Class #2 Introduction to Object Oriented Programming

due: Research Agenda Description, References & Pseudocode

Algorithmic Drawing Draft 1.

in class: Agent Class: Field Affected Movement

required reading: Storm in the Computer by Manuel Delanda

suggested reading: Crowds and Power by Elias Canetti

Class #3 Cellular Automata & Turing's Morphogenesis

due: Research Agenda Description, References & Pseudocode

Algorithmic Drawing Draft 2.

in class: Elementary Cellular Automaton

Game of Life + Totalistic 2d Cellular Automata

Reaction-Diffusion

required reading: Cellular Automata and Patterns of Flow by Manuel Delanda

suggested reading: A New Kind of Science by Stephen Wolfram

Class #4 Navigation with Environmental Feedback

due: Working Code Appropriate to Research Agenda

Computational Catalog & Algorithmic Drawing Draft 3.

in class: Turing Machines and Langton's Ant

required reading: Automated Architecture by Luciana Parisi

suggested reading: Metaphysics of Genetic Architecture by Karl Chu

Class #5 Deskcrits

due: Computational Catalog: 100 samples.

in class: Individual Meetings with Student Groups.

required reading: Form and Object by Tristan Garcia

suggested reading: Quadruple Object by Graham Harman

Class #6 MIDTERM REVIEW

due: Midterm Boards & Computational Catalog: 500 Samples.

suggested reading: Grid Index by Carsten Nicolai

Class #7 Context Sensitive Growth Systems

due: Computational Catalog: 100 samples. + Animation.

3d Printed Model 1.

in class: Venation Algorithm with Environmental Feedback.

suggested reading: Animate Form by Greg Lynn

Class #8 Physics Simulation

due: Computational Catalog: 100 samples. + Animation.

3d Printed Model 1.

in class: Nodes + Springs. Line-Network Relaxation.

required reading: Matter and Motion by James Clerk Maxwell

suggested reading: Simulations by Jean Baudrillard

Class #9 Active Polygon Manifolds

due: Working Code Appropriate to Research Agenda Computational Catalog: 500 samples. + Animation

3d Printed Model 2.

in class: Mesh Behaviors: Inflation, Relaxation, Edges as Springs

Mesh Topological Manipulation: Subdivision

required reading: Landscapes of Change by Sanford Kwinter

suggested reading: Structural Stability And Morphogenesis by Rene Thom

Class #10 Deskcrits

due: Catalog Book Draft: 500 samples.

3d Printed Model

in class: Individual Meetings with Student Groups.

required reading: Who's Afraid Of Formalism by Sanford Kwinter

suggested reading: On Formally Undecidable Propositions of Principia Mathematica by Kurt Godel

Class #11 Deskcrits

due: Final Book PDF is due: upload to blurb.com

required reading: The Origin Of Language by Michel Serres

suggested reading: Contagious Architecture: Computation, Aesthetics and Space by Luciana Parisi

Class #12 Optional Deskcrits

due: Final Boards Draft.

in class: Individual Meetings with Student Groups.

Class #X FINAL REVIEW

due: Final Boards and Book Printed. 3d Printed Models

Final Compiled Animation

Course Summary:

Date	Details

Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
25Previous month	26Previous month	27Previous month	28Previous month	29Previous month	30Previous month	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20Today	21	22
23	24	25	26	27	28	29
30	31	1Next month	2Next month	3Next month	4Next month	5Next month

Course assignments are not