Creative Computation
Collective Assemblies : Generative Methods for Distributed Making

MIT Architecture
4.117 / 4.118
3-0-9 U / 3-0-6 G
Spring 2025 W 2pm-5pm, 3-442
Instructor : Danniely Staback Rodríguez dstaback@mit.edu
Assistant Instructor : Diana Mykhaylychenko diana_mk@mit.edu

Overview

The CAD revolutions of the 80's and 90's accelerated the ability of designers to conceive and realize complex architectural forms. Digital design then turned its attention to mass customization and, through the domestication of parts, cheaper materials, ever-more-powerful personal computing, and CNC fabrication, it promised consumers unique and smooth objects, while promising architects complete control: from design to execution. However, computational design in architecture has arguably become synonymous with a particular aesthetic and a particular kind of project *(M. Carpo)*, alienating the technology itself, along with architects, from the rest of the world– squandering its potential to contribute to society's biggest challenges, and to invert our culture of making from one of few to one of many. Computational power in main-stream architecture is currently being harnessed by BIM on the one hand, and by AI on the other. The former, persuades us to consume standardized components and accept their predetermined aggregation. The latter invites us to swipe left or right, to feed image or text to processes that have less grasp of the world than we do, and leave a questionable balance of gains versus losses.

This course invites students to harness computational tools to recenter questions of meaning, material embodiment and shared processes. We will explore ***distributed*** methods of digital design and fabrication, and shift our attention: *from the final outcome, to the process; from the final form, to the potential interactions; from the precision, to the tolerance; from the constraints, to the variables; from single authorship, to shared meaning*– and to welcome uncertainty as an asset.

Introduction

The term Generative (1) for this course refers to the open-ended, undetermined nature of the design that students should embrace from day one, challenging the normative top-down design ethos that has dominated both architecture at large and digital fabrication as a sub-culture of architecture. The term Distributed (2) means spread out, divided among the many agents involved in a process.

Students will engage in a semester-long investigation, broken down into discrete assignments, that will allow students to develop a focused, speculative narrative around material interactions. These fast-paced exercises will ask students to examine and respond to vernacular material aggregations through different lenses, and to understand them as *proto-architectures*, which are not explicitly concerned with program, volume, enclosure, or users. Through these material aggregations, we will establish a focused dialogue of material transformation and parametrization. In each prompt, students will produce a computational artifact and hone in on a process of digital iteration, physical prototyping, and creative dialogue. Students will gradually embed collective design "values" and performance metrics, spanning between the practical and the speculative, in the ever-expansive, underlying logic of their assemblies.

Schedule

Session		***Deliverables***
Feb 05	*Course Introduction*	
Feb 12	*L: Parametric Workflows*	*Reading Discussion*
Feb 19	*L/T: Parametric Drawing*	*P01*
Feb 26	*L/T : Optimization & Solvers*	*P02*
Mar 5		*P03*
Mar 12		*Progress*
Mar 19	*Midterm Presentations*	*P04*
Mar 26	*Spring Break*	*No class.*
Apr 2		*Reading Discussion*
Apr 9	*T : Feedback and Recursion*	*Progress*
Apr 16		*Progress*
Apr 23		*P05*
Apr 30		*Progress*
May 7		*Progress*
May 14	*Last Day of Class*	*Group Assembly Completed*
May 21		*P06 : Final Presentations (TBC)*

**Course Schedule may be subject to modifications., which will be announced ahead of time. L: Lecture T: Tutorial*

Assignments

Process 01

Absorb. In teams, students will select, isolate, and analyze a *vernacular* assembly that displays a system of material aggregation. For this analysis, we will break down its relevant history, applications, materials, modules, dimensional ranges, assumed constraints, specific graphic notations, and generally understood processes of the selected assembly. Students will present their findings to class, using a series of found images and authored drawings. Each team-member will declare specific aspects of interest for further research.

Process 02

Translate. The teams will rationalize their material assembly and aggregation process(es) and translate it to parametric 2D drawing(s) that explore both *control and speculation* within the chosen system. Students will create a *Projective Map* (24x24) of their *assembly space* using found and invented notations, instructions, conventions and abstractions. On this *Map*, each student will then digitally overlay an array of potential parametric specimens of the assembly.

Process 03

Transform. Having deciphered the genetics to their material aggregations, teams will move into 3D space and introduce *values* to their constructive *narrative* and push the logics of the original vernacular precedents. These values will be tested through selected performance metrics, such as: equilibrium, ease of assembly, center of mass, responsiveness, orientation, porosity ratio, water captation, musical pitch, etc. This experimental *palisade* will be roughly 18ft long and 6ft tall. Students will share drawings and animations to communicate their transformations.

Process 04

Generate. For mid-semester presentations, teams will fabricate two objects: a physical, hand-held *charting device* that builds off of their *Projective Map*, and a material prototype at 1:2 scale. This charting device should aim to embody the shared knowledge of the developed process(es) and aid in, though not limit, its fabrication. This fabricated prototype should embody material qualities, fabrication constraints and a design narrative.

Process 05

Distribute. Teams will form groups, and each will now “open” and “hack” their inherited algorithms and invite new variables and voices to inform their construction processes towards a more complex outcome in which each of the original assemblies is able to *interact*. This exercise will prompt teams to re-evaluate tolerances and formal expectations, as well as develop the chosen performance metrics and design values of their assembly process within a larger, shared agenda. The extent, meaning and rules of this interaction will be determined by each group. Groups will develop the assemblies through digital and physical prototypes.

Process 06

Engage. The final assignment will build on previous prototypes and processes, bringing together all research groups into the *Collective Assembly* of simultaneously built and interconnected aggregations that will attempt to engage in a material and spatial dialogue with each other. Scale TBD.

Course Objectives

Through this elective, student will

- Gain awareness of computational design and fabrication technologies in architecture
- Explore alternative processes in which digital design methods can make architecture more open, participatory and culturally grounded
- Learn and incorporate parametric design techniques into design processes
- Learn and incorporate objective-driven design algorithms
- Learn and incorporate recursive definitions to digital and physical computational process
- Propose new and relevant metrics for the evaluation for computational design and fabrication
- Incorporate quick prototyping into the digital design process

Evaluation Criteria and Grading

The following criteria will be used for the evaluation of your work through the semester:

- Inquiry: How rigorous is your investigative process?
- Conceptual translation: How clear are your findings communicated in the presentations of your design work?
- Iteration: How effectively are you able to develop your work through consistent iteration, in response to feedback from your instructor, your peers and yourself?
- Technique: To what degree do your presentation materials convey what they ought to with quality and clarity?
- Participation: How actively and how constructively are you involved in all aspects of the class?
- Contribution: To what degree do your findings constitute a contribution to the class, field, or larger context?

  A: Excellent - Project is thought-provoking and surpasses expectations in terms of inventiveness, appropriateness, verbal and visual ability, conceptual rigor, craft, and development. Student pursues concepts and techniques above and beyond what is discussed in class.
  B: Above Average - Project is thorough, well researched, diligently pursued, and successfully completed. Student pursues ideas and suggestions presented in class and puts in effort to resolve required projects. Project is complete on all levels and demonstrates potential for excellence.
  C: Average - Project meets the minimum requirements. Suggestions made in class are not pursued with dedication or rigor. Project is incomplete in one or more areas.
  D: Poor - Project is incomplete. Basic skills including graphic skills, model-making skills, verbal clarity or logic of presentation are not level appropriate. Student does not demonstrate the required design skill and knowledge base.
  F: Failure - Project is unresolved. Minimum objectives are not met. Performance is not acceptable. This grade will be assigned when you have more than two unexcused absences.

The work will be weighted as follows:

5% = P01 10% = P02 20% = P03 20% = P04 15% = P05 20% = P06
5% = Participation (evaluated at the end of the semester)
5% = Documentation (evaluated at the end of the semester)

Software Requirements
This course requires the primary use of Rhino and Grasshopper (various plug-ins to be assigned). The use of additional, complementary software is also encouraged.

Materials
Model-making and fabrication materials specific to each student interest and project.
Physical printing and physical prototyping may be required for scheduled revisions.

Shop Training
A significant portion of this course will rely on physical making and iteration. Students are expected to gain access to the laser-cutters, the wood shop, and CNC equipment (at least one student per team) during the first weeks of class, and to complete the necessary shop training outside of course hours. Students are expected to use the department fabrication facilities as required for their projects.

Policies
Attendance at all class meetings is mandatory. If any meeting (lecture or workshop session) is to be missed, please notify the instructor prior to the scheduled class. Please remember to silence cell phones and be courteous when using laptops in class. Most importantly, be respectful and engage during lectures, discussions, and fellow students' presentations.

This course is committed to the principle of equal access. Students who need disability accommodations are encouraged to speak with the faculty member/department administrator early in the semester so that accommodations can be implemented in a timely fashion.

Undergraduates: If anything is getting in the way of your academics, please consult with S3 (s3-suppport@mit.edu). The walk-in queue is open from 10-12 and 2-4 on weekdays. Appointments can be virtual or in-person, depending on your comfort and convenience.

Graduates: A variety of issues may impact your academic career including faculty/student relationships, funding, and interpersonal concerns. In the Office of Graduate Education (OGE), GradSupport provides consultation, coaching, and advocacy to graduate students on matters related to academic and life challenges. If you are dealing with an issue that is impacting your ability to attend class, complete work, or take an exam, you may contact GradSupport by email at gradsupport@mit.edu or via phone at (617) 253-4860.

Canvas, the MIT online course management system, will be used exclusively in the course. Lecture handouts and exercise descriptions will be available there shortly after class is held. Students will also be submitting exercises and materials through this system and must do so by the assigned due date.

Please review MIT's expectations and policies regarding Academic Integrity and related resources.

Office hours will be held by appointment on Wednesdays, from 5pm to 6pm.

Assigned Readings (TBC)

Arendt, H. (1998) *The Human Condition*. 2nd ed. Chicago: University of Chicago Press.

Carpo, M. (2004) ‘10 Years of Folding’, in G. Lynn (ed.) *Folding in architecture*. Rev. ed. Chichester, West Sussex ; Hoboken, NJ: Wiley-Academy (Architectural design). Available at: https://monoskop.org/images/6/6b/AD_63_Folding_in_Architecture_1993_parts_missing.pdf.

Carpo, M. (2017a) ‘Introduction’, in *The second digital turn: design beyond intelligence*. Cambridge, Massachusetts London, England: The MIT Press (Writing architecture series).

Carpo, M. (2017b) ‘The Second Digital Turn’, in *The second digital turn: design beyond intelligence*. Cambridge, Massachusetts London, England: The MIT Press (Writing architecture series), pp. 32–89.

Carpo, M. (2020) *A Very Short History of the Digital Turn in Architecture (Draft)*, *Mario Carpo*. Available at: https://mariocarpo.com/essays/a-very-short-story-of-the-digital-turn-in-architecture (Accessed: 29 October 2023).

Clifford, B. (2021a) ‘Preface’, in *The Cannibal’s Cookbook: Mining Myths of Cyclopean Constructions*. Second edition. Novato, California: Oro Editions.

Clifford, B. (2021b) ‘The Cannibalist Manifesto’, in *The Cannibal’s Cookbook: Mining Myths of Cyclopean Constructions*. Second edition. Novato, California: Oro Editions.

Höweler, E. and Yoon, J.M. (2021a) ‘Introduction’, in *Verify in Field: Projects and Conversations Höweler + Yoon*. Zürich: Park Books.

Höweler, E. and Yoon, J.M. (2021b) ‘Means and Methods’, in *Verify in Field: Projects and Conversations Höweler + Yoon*. Zürich: Park Books.

Jarzombek, M. (2023) *Architecture constructed: notes on a discipline*. London ; New York: Bloomsbury Visual Arts.

Knight, T. and Stiny, G. (2015) ‘Making Grammars: From Computing with Shapes to Computing with Things’, *Design Studies*, 41, pp. 8–28. Available at: https://doi.org/10.1016/j.destud.2015.08.006.

Knight, T. and Vardouli, T. (2015) ‘Computational Making (Editorial)’, *Design Studies*, 41, pp. 1–7. Available at: https://doi.org/10.1016/j.destud.2015.09.003.

Lasch and Aranda (2008) ‘What is Parametric?’, in T. Sakamoto and A. Ferré (eds) *From control to design: parametric/algorithmic architecture*. Barcelona: Actar-D.

Lecture: Gilles Retsin (2023). Available at: https://www.youtube.com/watch?v=1YMg409W0PQ (Accessed: 21 January 2024).

Lewis, P., Tsurumaki, M. and Lewis, D.J. (2022) *Manual of biogenic house sections*. First edition. Novato, California: ORO Editions.

Lynn, G. (2004) 'Introduction', in G. Lynn (ed.) *Folding in architecture*. Rev. ed. Chichester, West Sussex ; Hoboken, NJ: Wiley-Academy (Architectural design). Available at: https://monoskop.org/images/6/6b/AD_63_Folding_in_Architecture_1993_parts_missing.pdf.

Meredith, M. (2008a) 'Intro', in T. Sakamoto and A. Ferré (eds) *From control to design: parametric/algorithmic architecture*. Barcelona: Actar-D.

Meredith, M. (2008b) 'Never Enough (transform, repeat ad nausea)', in T. Sakamoto and A. Ferré (eds) *From control to design: parametric/algorithmic architecture*. Barcelona: Actar-D.

Mitchell, W.J. (1999) 'A Tale of Two Cities: Architecture and the Digital Revolution', *Science*, 285(5429), pp. 839–841. Available at: https://doi.org/10.1126/science.285.5429.839.

ROBERTS, B. (2019) 'Bad Translation: Drawing by Contact', *PRAXIS: Journal of Writing + Building*, (15), pp. 27–36.

Vardouli, T. (2015) 'Making use: Attitudes to human-artifact engagements', 41.

Additional Resources

Allen, E. and Iano, J. (2019) Fundamentals of Building Construction: Materials and Methods. John Wiley & Sons.

Aranda, B. and Lasch, C. (2006) Tooling. New York: Princeton Architectural Press (Pamphlet architecture, 27).

'Chapter 5: Wall Systems' (2014) in Ching, F. D. K., Building construction illustrated. Fifth edition. Hoboken, New Jersey: John Wiley & Sons, Inc.

Ching, F.D.K. (2014) Building construction illustrated. Fifth edition. Hoboken, New Jersey: John Wiley & Sons, Inc.

Lewis, P., Tsurumaki, M. and Lewis, D.J. (2022) Manual of biogenic house sections. First edition. Novato, California: ORO Editions.

Stiny, G. (2006) Shape: Talking about Seeing and Doing. Cambridge, Mass: MIT Press.

Storm King : Exhibition : Martin Puryear: Lookout [EXH.149] (no date). Available at: https://collections.stormking.org/Detail/occurrences/204 (Accessed: 31 October 2023).