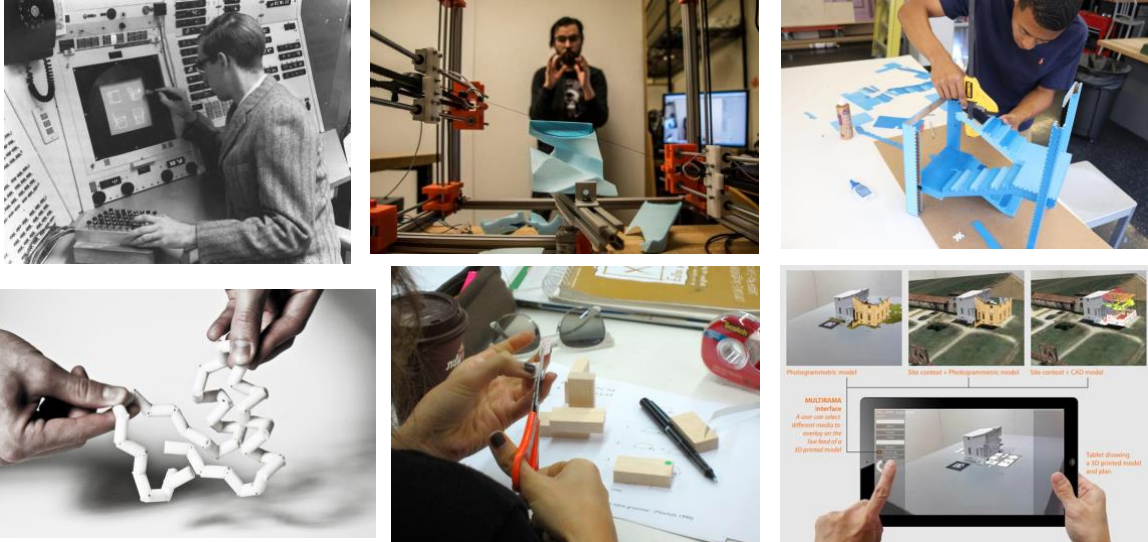# 4.580 Inquiry into Computation and Design

Fall '24   Units 3-0-9 (G)   Tuesday 9:30-12:30   Room 5-231
Instructor: Terry Knight   tknight@mit.edu
TA Carolina M. R. S. Menezes   cmnzs@mit.edu@mit.edu

In the beginning there was Sketchpad by Ivan Sutherland, 1963 (top left)….

And now there is: *Making Gestures* Diego Pinochet (top middle); *Plane Objectives* Larry Sass & Lujie Chen (top right); *Self-Assembly* Skylar Tibbits (bottom left); *Shape Grammars/Making Grammars* George Stiny, Terry Knight (bottom middle); *Ramalytique* Takehiko Nagakura and Woong-Ki Sung (bottom right)

In this course, we explore the varied nature and practices of computation in design – in particular, the ways in which design meaning, intentions, and knowledge are developed and communicated through sensing, thinking, representing, understanding, and making computationally. We consider the notion of computation broadly to include computing done by machine as well computing done by hand. The goal is for students to develop a view of computation and design beyond the specifics of tools and technical skills, and a critical understanding of some of the history of ideas leading to work today.

The course is also an introduction to the different perspectives and research being done by faculty within the Computation Group in the Department of Architecture. Different faculty in the group will visit us during the semester.

An additional aim of the course is to introduce academic research, in particular, to the structure and elements of a good research paper. Students practice reading and responding to academic papers on topics introduced in class.

The semester will be divided into 1-week and 2-week modules. Each module will explore a particular computational design theme and may include a guest faculty speaker. In each module, readings and/or a short, team-based project expand on the theme introduced.

Prerequisites
None. This is a required subject for first year SMArchS students in Computation. **Other students are welcome, but enrollment will be limited to 12 students.**

Requirements and Grading
Class attendance and participation: 20%
Completion of weekly assignments and readings: 80%

Canvas website *https://canvas.mit.edu/courses/28034*

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Calendar
(subject to change)

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Sept. 10   **Introduction**
Assignment 1: Worldmaking (readings)

Sept 17, 24   **Worldmaking** (Porter)
This module focuses on the making of conceptual design "worlds" and how design meaning and intent are constructed and communicated within and between worlds. Games and rules that simulate very abstract, simplified design worlds are introduced as a research paradigm for formulating and testing a hypothesis about the nature and activity of design.
We will play a variation of the *Silent Game* in class.

Assignment 2: Silent Game Redesign (project)
Assignment 3: More Worldmakings: Spatial Representation and Design Intelligence I (readings/videos)

Oct 1, Oct. 8   **More Worldmakings: Spatial Representation and Design Intelligence** (Nagakura)
In this module, we extend the concept of worldmaking using simple games and rules to worldmaking using contemporary technologies. We are introduced to advanced digital technologies and AI for spatial representation and design intelligence. How do AI and advanced computational techniques help us perceive, understand, represent, and communicate architectural (or other) objects? What new kinds of representations or "ways" are possible or effective, and for what purposes?

Assignment 4: Spatial Representation and Design Intelligence (project)

Assignment 5: Academic Research - Reading and Writing
Our approach to readings from this point on will sometimes be at two levels. You may be asked to understand and evaluate a reading in terms of its specific content and/or you may be asked to evaluate a reading in terms of its structure and coherence as a research paper. Questions relating to the latter are designed to help you understand better the nature of academic research – what makes a good research question and how to explore it. We start with a structural evaluation of a reading for this assignment.

Assignment 6: Visual Caculating I (readings)

Oct 22, Oct 29   **Visual Calculating** (Stiny)
In this module, we continue our inquiry into understanding and representing design and designing. We revisit the theme of rules and rule-making, in particular. We consider the related themes of framing, reformulation, and redescription as essential aspects of design. All are about new and different ways of conceptualizing the world (or "worlds", in Goodman's terms). In this module, these themes are examined in a very specific visual and perceptual computational context.

Assignment 7: Visual Calculating II (project)
Assignment 8: Calculating the Way We Make I (project)

Nov 5, Nov 12   **Calculating the Way We Make** (Sass)
In this session, we transition to new territory to consider computation for *making* physical, real-world things, as opposed to computation for *representing* real-world things or the designs for them. We revisit the perceptual aspects of design and designing in the context of physical making. We consider questions related to design learning (cognition) and making (embodiment) by doing. We reflect on design through physical artifact making.

Assignment 9: Calculating the Way We Make II (project)
Assignment 10: Self-Assembly and Programmable Materials (readings)

Nov 19   **Self-Assembly & Programmable Materials** (Tibbits)
In this module, we continue the theme of physical making. However, in contrast to the previous module, we explore the production and making of physical things as a self-governing process: in other words, things that make themselves. We are introduced to self-assembly, programmable materials, and 4D printing as autonomous means of production. In these different systems, building information is embedded directly into components and materials which self-configure or transform into structures or shapes without machine or human intervention.

Assignment 11: Computing Histories (readings)

Nov 26   **Human|Machine Computing: Some Foundational Issues and Histories**
This session gives a small taste of some of the foundational issues and histories of computation, including the beginnings of CAD, AI, and Cybernetics. Much of this history is rooted at MIT. We examine the assumptions and aims embedded in different computational approaches and paradigms, and their implications for the way we think about and do computational design today.

Assignment 12: Design Knowledge I/ In the Mind and in the Making (readings)

Dec 3, 10   **Design Knowledge: In the Mind and in the Making**
This module concerns the nature of design knowledge – professional, expert, tacit, or otherwise. What is it? How is it? Where is it? Is it in the mind? Is it in the making? We consider the roles of context and culture in acquiring and communicating design knowledge, especially in relation to computational ideas and practices. We examine the sensory, experiential, and material aspects of design knowledge and its relation to physical doing and making.

Assignment 13: Design Knowledge II/ In the Mind and in the Making (project)

The Writing and Communication Center (WCC)

MIT Writing and Communication Center offers free one-on-one professional advice from communication specialists with advanced degrees and publishing experience. The WCC can help you learn about all types of academic and professional writing and further develop your oral communication skills. You can learn more about WCC consultations at http://cmsw.mit.edu/writing-and-communication-center and register with the online scheduler to make appointments through https://mit.mywconline.com. Please note that WCC hours are offered Monday-Friday, 9:00 a.m.-6:00 p.m. during the semester, and fill up fast.

Marilyn Levine is also a great departmental writing resource for everyone, and is available for workshops, advice, one-on-one student meetings, and more. Sign up for an appointment with her at https://calendly.com/maynew/writing-consultations-arch. Her contact info is maynew@mit.edu.