Chapter 1
Definitions

This is a book about the hybridity of computing and drawing. It would seem prudent, therefore, to begin by addressing, simply, "what is drawing?" and "what is computing?" However, both of those terms are associated with contested histories, multiple creative and scientific cultures, and various colloquial and literal definitions, which are often at odds with each other. Both computing and drawing are disciplines in their own right, and both terms define sub-cultures within the discipline of architecture. As a result, it is not possible to exhaustively explore both terms here, though it is possible for the hybridity between computing and drawing to bring clarity to each in terms of method, meaning, and knowledge.

Many of the most complete tomes about drawing in art and architectural history do not presume a single definition of such a vast and ever-evolving term. The gold standard for such a tome is Deanna Petherbridge's *The Primacy of Drawing, Histories and Theories of Practice.*[1] Petherbridge, an artist and curator as well as a scholar, agrees, noting at the onset that,

"It would be reasonable to expect that a book devoted to the exploration of drawing should begin with an authoritative definition of its subject. However, my examination of the many definitions of drawing, both contemporary and historical, has proved to me the futility of attempting such a task. Any formula would have to encompass the indefinable status and contradictory aspects of drawing, and therefore would immediately dissolve into a web of disclaimers."[2]

The difficulty involved when demarcating a clean line between painting and drawing, for example, is a perennial discussion. In contemporary discourse, matters are further complicated by computing's looming presence over the evolving definition of drawing. This presence pulls drawing away from matters of critical inquiry into an un-winnable and often personal debate over technology verses tradition. Thanks to the rise of digital technology, drawing is often understood as at risk of being supplanted by the computer. That discourse only serves, ironically, to dilute the already open boundary of "drawing." A 2012 symposium at the Yale School of Architecture titled, "Is Drawing Dead?" exposed many strong opinions on the future and past of representational practice in architecture,[3] but a working definition was never articulated by the participants. Various meanings could be inferred by the speakers and their work, but their wide variation rendered the eponymous question of the symposium moot. Effectively, many of the participants were implying, "your way—the old way—of drawing is dead, but my way of drawing is alive." At one point, a member of the audience held up a pencil case while protesting computers. His defensive comments seemed to reference drafting rather than drawing. (But isn't drafting a kind of drawing?) A member of the panel clarified, he was more concerned with sketching.

Further adding fuel to the fire of ambiguity surrounding the definition of drawing is rooted in language. The previous paragraph could have used multiple forms of "draw" in place of *"demarcating," "pulls," "articulated," and "rendered"* to describe actions and relationships that have nothing to do with lines on paper. At this moment it can be tempting to indulge in a cliché: a trip to the dictionary. However, the Oxford English Dictionary lists seventeen definitions of draw as a noun,[4] seventy-five as a verb,[5] and even more for "drawing" as noun and adjective (distinct from the verb form). All are relevant, even those that deal with archery and horse racing, and many are delightfully oblique to one another. Consider two verb forms of draw, "To bear, endure, suffer, undergo,"[6] and "To attract by moral force, persuasion, inclination, etc.; to induce to come (to a place); to attract by sympathy (to a person)."[7] One can hear drawing, as in a "drawing set," used in a professional architectural context to refer to digital output on paper. Drawing is an ordered collection of lines. Drawing is the pulling of an idea into material being. A drawing is an abstraction or a drawing is a neutral truth. A drawing is form.

Attempting to clarify any of those definitions leads us to Petherbridge's web. However, without limits, it's easy to see how almost anything can be a drawing. While Petherbridge proceeds by identifying a drawing continuum, another option is the definition of drawing not in terms of what it can be, mean, or do, but what it cannot.

What drawing is not and what computing cannot do

The choice to define in the negative, to create anti-definitions, is itself a philosophical and ideological position. It implies a recognition that either the term in question, at the moment, drawing, covers more ground than that which is not drawing, or that the term has become so loose that it is no longer possible to create a single working definition. Though the intellectual exercise of defining what drawing is not can become operative, from a cultural standpoint it nonetheless risks offending, because drawing—in most of its creative forms—is an elite activity that requires skill. The voice of the enforcer that proclaims, "That's not a drawing," is likely to be received as insult rather than critique because drawing places contemporary practice on an historic continuum. Furthermore, drawing implies difficulty. Drawing's anti-definitions are potentially problematic, conceits, and incomplete thought experiments. Nonetheless, they are necessary.

A drawing cannot be edited

Or, more specifically, it cannot be edited down or operated on, only built up. When one marks on paper, for example, one can erase those marks, but that is actually another kind of marking that involves the interaction of material. The pencil eraser is very different from what we might think of in digital software when we use the "undo" function. Although drawing involves the gradual evolution of effects and content, this adjustment is a matter of building up rather than editing down. Think about the difference, for example, between the layering up of many marks to refine the perceived geometry of a line as opposed to the editing of control points of a curve in digital drafting software. When drawing, one cannot post facto adjust the start point, end point, pressure, or speed of a mark. Once the mark is made, there is no going back.

This anti-definition is closely aligned with another term, "model." Both models and drawings can serve as representations, but while models exist for the purposes of operation, drawings exist for the purposes of perception. Most so called "digital drawings," in design software, are in fact models of lines, not drawings at all. What we see on the screen is not the actual drawing, but a stand in that allows us to manipulate, edit, create and delete lines. This brings some clarity about the role of drawing, but how does it help in practice? Thinking about drawing in this way suggests that computing technology can augment, but not replace, drawing technology. Rather than construct a virtual drawing and "print" it out, digital media can provide a model that can be used to compute, simulate or resolve geometry or procedures that can lead to or analyze drawing.

A computer cannot draw

A corollary of the "drawing cannot be edited" anti-definition is that drawings exist to be perceived, and that perception is often a key part of a drawing's making cycle. If drawing is understood as a formation, then a reading of a drawing must form in the mind, including the mind of the drawing maker. The drawing is never merely the collection of matter. In this way, a drawing is unlike a building, it must be read, or at least interpreted, for it to function. Many so-called "drawing machines," even those that process data from sensors, produce drawing matter, but because the apparatus does not have an internal representation of a reading of the drawing, the apparatus is not drawing.

Computers are neither fully autonomous nor do they meet most of the many definitions of intelligence.[8] This is not an anti-computational perspective, but an optimistic reality check. Computers are programmed by humans. A drawing can be mediated by computer, but ultimately a drawing is a human activity. This is one key difference between drawings and images. Ultimately, a drawing cannot be reduced to discrete elements, unlike the digital image, which is organized by pixels. Many millions of digital images are generated for computers by other computers. Even though programmed by humans, the majority of images exist to transmit information to computers and will never be seen directly by human eyes.

The pixels of the scan have begun to be sorted within each row based on hue.

A drawing is not final

All drawings are works in progress. Even when a drawing is done it's open to interpretation. The ambiguity of a line leaves open the capacity for multiple interpretations. This means that if one is working to "get it right," articulate something perfectly, or achieve an exact result, one may be "rendering," "communicating," "computing," or "simulating," but one is not drawing. Does this anti-definition mean that drawing can not be a disciplinary practice, that drawing is always in service of something else, a thing to think with, prepare with, or work out prior to the ultimate work? No, it does not. Drawing can certainly function as a discipline, but such a disciplinary practice would seem to require a conception of a work, or a project broader than an individual drawing.

The anti-definitions of drawing posited here expose a friction with contemporary ways of practicing architecture, art, or design. The non-operative nature of drawing would seem to make it less valuable to architects than a model. Its capacity to surprise can disrupt a goal-oriented design process; yet the reality that drawing always involves human engagement means that drawing demands a degree of design intention, especially with respect to drawing's position in the linage of a project.

Misunderstandings about Computing

Computing is also a complex and often misused term. Though the definition itself does not engender the same ambiguity as drawing, computing is often conflated with the personal computing era. Computing was used in literature as early as 1579,[9] which reinforces the notion that the kind of processing, calculation, procedures, reckoning, or reasoning that are normally associated with personal computers need not involve any machines whatsoever, and it certainly need not involve a digital personal computer. In architectural discourse, the digital turn often accurately describes the strategies and techniques associated with mainstream software and mass-customization that emerged for architects in the '90s and soon thereafter become ubiquitous. Mario Carpo uses an analogy of identification of currency to saliently position the digitally made relative to the machine made and hand made.

"The signature, the banknote, and the credit card: when objects are handmade, as a signature is, variability in the process of production generates differences and similarities between copies and identification is based on visual resemblance; when objects are machine-made as a banknote is, mass-produced, exactly repeatable mechanical imprints generate standardized products and identification is based on visual identicalness; when objects are digitally made, as are the latest machine-readable or chip-based credit cards, identification is based on the recognition of hidden patterns, on computational algorithms, or on other non-visual features."[10]

This analogy is unusually prescient to the realm of drawing, in that the digital marks the end of the visual, suggesting that a return trajectory to a re-engagement with the hand might flow in reverse, through machine-based production. In writing about the rise of electronic media in 1964, Marshall McLuhan posits,

"The effect of electronic technology had first been anxiety. Now it appears to create boredom. We have been through the three stages of alarm, resistance, and exhaustion that occur in every disease or stress of life, whether individual or collective. At least, our exhausted slump after the first encounter with the electric has inclined us to expect new problems."[11]

Can the same pattern apply to the state of digital media? Currently, conceptual practices that profess to be post-digital dominate much of the discourse, a signal that architecture has moved on from the digital as topic,

digital as provocation, or predominantly digital project (aka "paperless") as a feat. Perhaps we are bored. However, in recognizing the propensity for the post-digital to describe an aesthetic rather than an idea,[12] and by contrast to that reaction, this book uses computation rather than digital to make a connection to ideas and methods that pre-date mainstream use of digital technology in architecture, art, and design.

Another reason this book uses the term computation and embraces the cultural, historical, and ideological frameworks that go with it involves the dichotomy that digital media tends to bring to discourse. There is no doubt that digital media changed architecture and design. One can debate whether this change constitutes a revolution or a relatively minor shift in methods and practice. One can debate whether this change was positive, negative, or neutral. Unfortunately, these debates tend to occur with strong gravity. The digital turn happened relatively fast in architecture, over the course of less than a generation. Today, it's not uncommon for an institution to be made up of those who were educated and started to practice before, during, and after the digital turn. These three groups can have dramatically different takes on the role and meaning of digital tools and media. The debates that arise both from these frictions, while academically or intellectually interesting (and necessary from an historical perspective), do little to inform or motivate the way we make. This avoidance of the "digital versus x" (where x can be manual, transnational, hand, analog, or physical) does align with some of the principles of post-digital practice. However, this book deviates from the idea that moving on from an obsession over the digital means moving on from focused inquiry and attention towards craft, media, and methods.

It is important to note that contemporary computation does often involve the personal computer and is often digital in nature. The pixel-based image—a model, not a drawing, as has already been outlined—does play a substantial role in this work. The digital will be explored in depth in this chapter as a foil to the line and, later, pixel-based representations will transform, animate, and activate material drawings. But in this work the digital image comes before and after the material drawings. The drawings here are computational in nature but not inherently digital and they are not about being digital. Furthermore, they do not aim to participate in an argument about the role of the digital.

The definition-oriented discourse continues now with a focus on pixels and their relationship to drawings. Likely, readers will be comfortable with the idea and nature of a pixel, a term that was coined to mean "picture element."[13] It is hard to function in a digital world without encountering a pixel, even for those who do not work in the visual arts. Though pixels have no dimension,

their legibility is related to the size they are rendered. If drawing is distinct from a model in that it cannot be edited, we are most likely to encounter a drawing as a material artifact. The material can me moved around (including off the page) with new marks, but we cannot edit the marks on the terms of their perception. Pixels exist for just the opposite purpose—they can be changed infinitely with no implications on the appearance of the image.

Every computer screen, that is every collection of pixels, is a moving (or movable) image. In this sense, it can never be a drawing. As personal computers become more powerful, the quantity of pixels increases. Though increasingly rare, early computer artists operated on individual pixels. Computer programming functions that do nothing other than set or reference single pixels can be extremely valuable relative to drawings. Though digital images are not drawings, they can expose, transform or inform drawings because they are nimble in ways material cannot be: they are easily transformed, parsed, and transmitted. Pixels, in their nature, are elements of images, not elements of drawing. Even the highest resolution digital image, a digital scan of a material drawing for example, might capture detail finer than the human eye can perceive, but is structurally different from the original drawing. But this is not reason to shun the digital. Rather, the opposite is true: it is precisely because of this contrast in nature that we will find pixels a productive ally in drawing discourse.