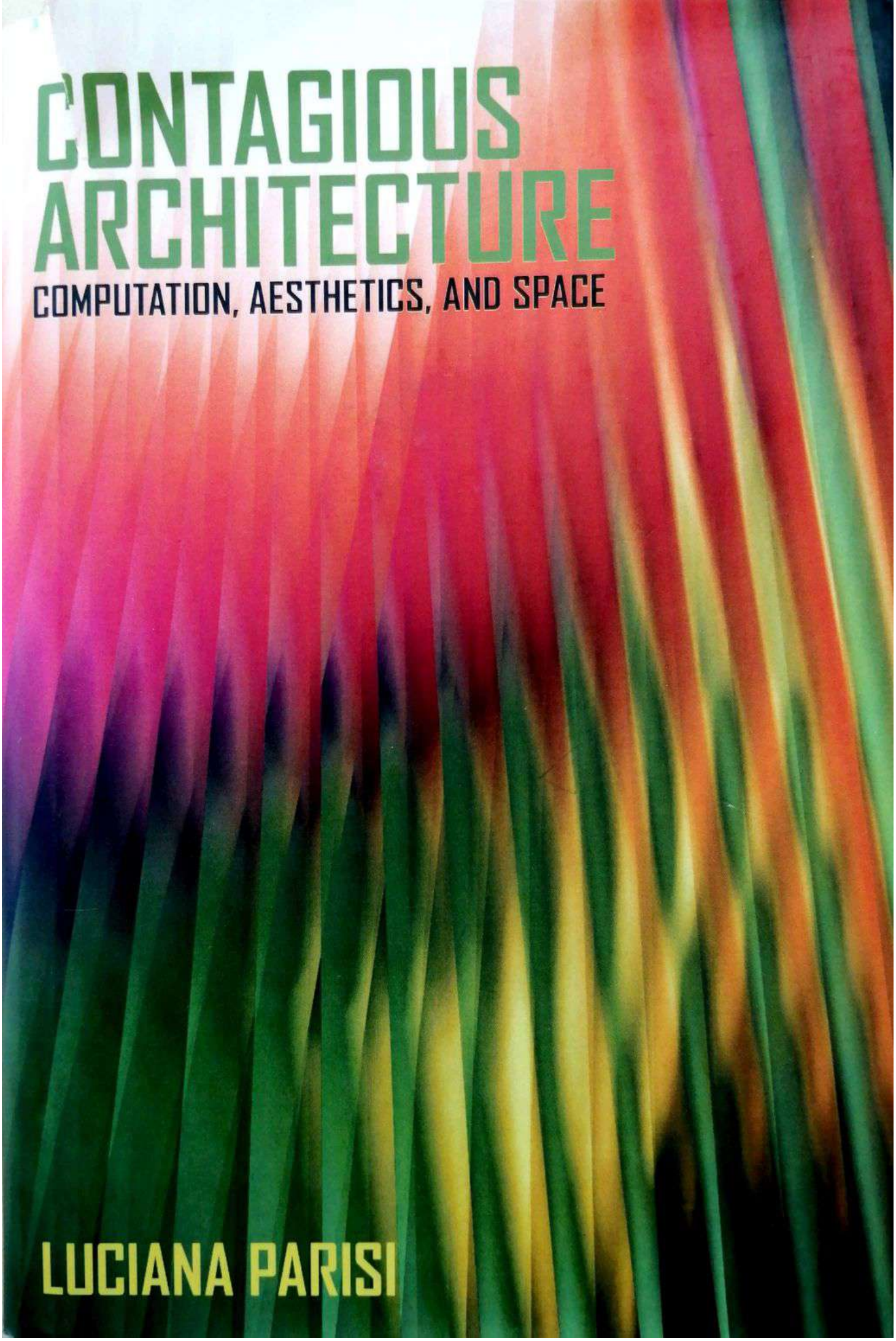

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Contagious Architecture

Computation, Aesthetics, and Space

Luciana Parisi

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Series Foreword

"What moves as a body, returns as the movement of thought."

Of subjectivity (in its nascent state)

Of the social (in its mutant state)

Of the environment (at the point it can be reinvented)

"A process set up anywhere reverberates everywhere."

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The Technologies of Lived Abstraction book series is dedicated to work of transdisciplinary reach inquiring critically but especially creatively into processes of subjective, social, and ethical-political emergence abroad in the world today. Thought and body, abstract and concrete, local and global, individual and collective: the works presented are not content to rest with the habitual divisions. They explore how these facets come formatively, reverberatively together, if only to form the movement by which they come again to differ.

Possible paradigms are many: autonomization, relation; emergence, complexity, process; individuation, (auto)poiesis; direct perception, embodied perception, perception-as-action; speculative pragmatism, speculative realism, radical empiricism; mediation, virtualization; ecology of practices, media ecology; technicity; micropolitics, biopolitics, ontopower. Yet there will be a common aim: to catch new thought and action dawning, at a creative crossing. Technologies of Lived Abstraction orients to the creativity at this crossing, in virtue of which life everywhere can be considered germinally aesthetic, and the aesthetic anywhere already political.

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"Concepts must be experienced. They are lived."

This book is about the logic of *computation*[1] and its ingression into culture. It describes a world in which *algorithms* are no longer or are not simply instructions to be performed, but have become performing entities: actualities that select, evaluate, transform, and produce data. In this world, algorithms construct the digital spatiotemporalities that program architectural forms and urban infrastructures, and are thereby modes of living. This is not to contend that algorithms are the building blocks of a physical universe in which any kind of thought can be fully computed. Instead, a closer look at algorithmic procedures shows that incompleteness in *axiomatics* is at the core of computation. These performing entities—algorithms—expose the internal inconsistencies of the rational system of governance, inconsistencies that correspond to the proliferation of increasingly random *data* within it. Instead of granting the infallible execution of automated order and control, the entropic tendency of data to increase in size, and thus to become random, drives infinite amounts of *information* to interfere with and to reprogram algorithmic procedures. These entropic bursts of data within computation add new information to the recursive functions of control, without becoming simply incorporated or used by the system (i.e., by transforming dissipative energy into information). Entropic data are operative agents of irreducible size that crack and rescript the source program of the system from within. The system of governance defined by the digital world of data can therefore no longer rely upon the smooth programming of tasks, the exact reproduction of rules, and the optimization of conducts, habits, and behaviors. *Randomness* has become the condition of *programming culture*.

This book does not imagine a world in which rationality has been replaced by the arbitrariness of information. Far from it: computational *randomness* corresponds to infinite volumes of data that are meaningful contingencies which refuse to be fully comprehended, compressed, or

sensed by totalities (i.e., by the mind, the machine, or the body). This also means that algorithms do not exclusively channel data according to preset mechanisms of binary synthesis (0s and 1s), as they also enumerate the indeterminate zone between finite states. This new function of algorithms thus involves not the reduction of data to binary digits, but the ingression of random quantities into computation: a new level of determination that has come to characterize automated modes of organization and control. Far from making the rational system of governance more efficient, this new level of determination forces governance to rely on indeterminate probabilities, and thus to become confronted with data that produce alien rules. These rules are at once discrete and infinite, united and fractalized.

From another standpoint, the emphasis on the new tendencies of algorithms to be overshadowed by infinite volumes of data explains the ingression of computational logic into culture. What is important here is not that culture has become doomed by the automated rules that transform its variety of expressions into data that can be classified, profiled, and consumed. Instead, the addition of random quantities to finite procedures turns automation into a computational adventure resulting in the determination of new cultural actualities. Instead of being exhausted by the formalism of rules or symbols that execute instructions, automated processing requires a semiopen *architecture* of axioms, whereby existing postulates are there to be superseded by others that can transform infinite quantities into contingent probabilities. Incompleteness in axiomatics thus brings to light the fact that automated processing is not predeterminate, but rather tends toward new determinations. In making this claim I do not intend to suggest that computation can now explain culture, aesthetics, and thought because it can account for change. My contention is rather that there is a concrete culture, an aesthetic and a mode of thought, specific to the computational production of new probabilities.

This is why this book argues for a new digital space that no longer or not fully coincides with Deleuze and Guattari's notions of "striated" (metric) and "smooth" (vectorial and projective or topological) space. Striated space is gridded, linear, metric, and optic.[2] It is also described as the space of logos, based on the deductive reduction of infinities to discrete unities constituting the building blocks of reason, the function of which is to find solutions to occurring problems.

In this book the striated space corresponds to the digital matrix of points that do not change over time: a prefixed, gridlike architecture derived from postulates based on discrete sets of algorithms through which optimal forms can be constructed. This is the striated space of the city, the urban

planning deduced from the exact relation between points, which establishes an infrastructural grid that predetermines movement.[3] In the last twenty years, however, the digital mapping of space has been intersected by a new tendency in digital design that has more fully embraced the power of computation to generate new architectural forms or smooth surfaces. By drawing on biological notions of morphogenesis, and thus by relying on the capacity of forms to change over time, algorithms have become generative components for form-finding and pattern-making architectures. The new centrality of generative algorithms (but also cellular automata, L-systems, and parametricism) in digital design has led to the construction of various topological geometries and curvilinear shapes that have come to be known as blob architectures. While the gridlike architecture of striated space (or digital mapping) places discrete unities at the center of a design made of points connected by lines, the topological curves of smooth space (or blob architecture) starts from the generative power of a point, the meshing and folding of which becomes the condition for the emergence of a new form.

Far from being in direct opposition, Deleuze and Guattari often refer to these two spaces as being in a relation of reciprocal presupposition, so that points can generate new curves, and curves can become frozen segments. However, this mutualism between the two kinds of spaces—or planes—may not be fully sufficient to explain the mode of extension produced by the ingression of computation into culture. To the striated (metric) and smooth (topological) spaces, this book annexes another approach to extension. This approach is defined by *mereotopology*: the study of the relation between parts, of that between parts and wholes, and of the boundaries between parts. In particular, I turn to Alfred North Whitehead's schema of mereotopological relations—a schema that is a concrete abstraction—in order to argue that neither discrete unities nor continual surfaces can account for the transformation of the digital grid, as the latter is characterized by the infiltration of randomness into finite sets of rules.

Mereotopology describes parts as being semiopen: it casts them as discrete and separable on the one hand and as undivided and continuous on the other. It postulates that there is no gap between parts, and neither are there *infinitesimal* points constituting continuous trajectories (or topological surfaces). Instead, between points there are always more points (or an infinite amount of points), which correspond not to infinitesimals, percepts, and affects but to finite segments internally defined by a unique arrangement of infinities. For Whitehead these finite segments are actualities, which are at once extended and intensive, or equipped with space

and time; they are finite durations. In contrast to blob architectures, which have given rise to a computational aesthetics expressed by the topological surface or the smooth plane of total connection, mereotopological architecture reveals that infinity is intrinsic to parts, unities, and discrete objects. From this standpoint, infinity does not coincide with the total fusion of spatiotemporal dimensions into one deforming surface, but instead can be explained by how wholes (continuities) become parts (discontinuities), and how parts can be bigger than wholes. In computational terms, infinity is equivalent to random (or incompressible) quantities of data (which are at once discrete and continuous) interfering with and reprogramming the algorithmic procedures in digital design, for instance. This also means that algorithms are not the building blocks of a topological surface whose forms continuously evolve. What connect the multiplicity of points are instead infinite quantities that ingress into the gap between points, thereby revealing the existence of yet another point (or spatiotemporal actuality) that overlaps them, but which does not originate from them. Yet how do these quantities come to determine and characterize algorithmic procedures in digital design?

This is where computation becomes entangled with Whitehead's view that it is *prehensions* that define what an entity is and how it relates to others. Prehensions point to how any actuality (from an animal body to a grain of sand, from an amoeba to an electron) grasps, includes and excludes, and transforms data. Instead of an ontological dominance of higher forms of actuality (such as human beings) over others, Whitehead argues that all entities have an equivalent status. Not only are they all real, but also they all matter. Nevertheless, this seemingly flattening ontology does not simply contend that these actualities are all the same, nor does it hold that they are all different. Whitehead proposes a radical pragmatism according to which determinate events, or what he calls occasions of experience, are defined by degrees of prehension that in turn constitute the degree of importance of some actualities compared to others.

In this book, the new function of algorithms within the programming of spatiotemporal forms and relations reveals how the degree of prehension proper to algorithms has come to characterize computational culture. Algorithms are no longer seen as tools to accomplish a task: in *digital architecture*, they are the constructive material or abstract "stuff" that enables the automated design of buildings, infrastructures, and objects. Algorithms are thus actualities, defined by an automated prehension of data in the computational processing of probabilities. From this standpoint, digital algorithms are not simply representations of data, but are

occasions of experience insofar as they prehend information in their own way, which neither strictly coincides with the binary or fuzzy logic of computation nor with the agency of external physical inputs. Instead, as actual occasions, algorithms prehend the formal system into which they are scripted, and also the external data inputs that they retrieve. Nevertheless, this activity of prehension does not simply amount to a reproduction of what is prehended. On the contrary, it can be described as a contagion. This is because to prehend data is to undergo an irreversible transformation defined by the way in which rules are immanent to the infinite varieties of quantities that they attempt to synthesize. This means that rules cannot change these infinite quantities; instead the latter can determine rules anew and thus produce new ones. From this standpoint, I do not use this notion of contagion to suggest that there is a physical connection between points (i.e., that one point of prehension is determined by the next point in a sequential order) or a potential relation between points (i.e., the fact that points are linked by infinitesimal approximations). Instead, to maintain that a prehension can be understood as a contagion is to say that infinite amounts of data irreversibly enter and determine the function of algorithmic procedures. It follows that contagion describes the immanence of randomness in programming. This irreversible invasion of incompressible data into the digital design of space has led to the production of digital spatiotemporalities that do not represent physical space, but are instead new spatiotemporal actualities. The contagious architecture of these actualities is constructing a new digital space, within which programmed architectural forms and urban infrastructures expose not only new modes of living but also new modes of thinking.

Nonetheless, by prehending (or becoming infected with) infinite quantities of data, algorithms do not simply work to generate optimal probabilities that will more closely match the architecture of the future and its urban infrastructure. The futurity of algorithmic prehensions cannot be exhausted by the image of the future. Instead, as prehensive entities, algorithms unleash the concrete futurity of the digital spatiotemporalities of the present, of which digital architecture is but one example (other examples might include the relational architecture of databases, the cultural, political and economic statements of search culture, the connectedness of social media, and the immediacy of data communication).

This book is about the ingression of computational logic into culture. It is most appropriately placed in the field of digital architecture, because the algorithmic production of digital spatiotemporalities defines: (1) that logic is becoming an aesthetic operation, and (2) that computational

aesthetics is characterized by the algorithmic prehension of *incomputable* data. In adding this aesthetic interference to computational logic I do not mean to imply that algorithms are the new synthesizer of indeterminate quantities. On the contrary, one condition of this book is that no actuality—physical or automated—could ever contain the infinite amount of infinities that are immanent to all actualities. Instead, what happens with all actualities is that these varieties of infinities are only partially and uniquely processed, so that not only is each actuality asymmetric with respect to another, but it is also asymmetric within itself. In other words, the discovery of incomputable quantities in axiomatics reveals that there can never be any totality that could subsume (external or internal) parts into one encompassing whole.

From this standpoint, the aesthetic operations of logic suggest that the prehensive activity of algorithms not only evaluates and transforms, but also enumerates and produces new computational actualities. In the field of digital architecture, this means that computational logic does not need to be used to reach aesthetic results as if it were operated by an external agent, which would select the activities of the process from an "outside." Aesthetics must instead be understood to reside at the core of computational logic, because it defines computational processing as the determining of infinities in a step-by-step fashion, and without subjecting them to complete synthesis and/or axiomatics. Aesthetics, that is, is not only complementary to logic but is immanent to it: it exposes contingency in programming, and the reality of chance in the calculation of probabilities.

It would be misleading, however, to attribute the aesthetic capacities of algorithms to a mainly qualitative synthesis of data. It is important to bear in mind when speaking of aesthetics in computation that one cannot obviate the entropic size of data, and therefore the tendencies of quantities to increase in volume, length, and density each time they are calculated. Thus, this book does not depart from one basic crux of computation: namely, the fact that computation is a method of quantification that deals with quantities. From this standpoint, *algorithmic prehensions are quantifications of infinite quantities that produce new quantities*.

This is also to say that there is a production of the new within computation that specifically concerns increasing randomness or increasing volumes of data that cannot be systematized in smaller algorithmic procedures. This book therefore contains no claims as to the necessity of cleansing culture of data pollution, because it admits that data production is an immanent process that unravels the gaps, blind spots, and incompatibilities within formal systems in their attempt to constantly invent new axioms and rules.

Similarly, this book also distances itself from the dominant cybernetic model of feedback control, which aims to include qualitative data in computational procedures by allowing the system to become co-constituted by its outside. In particular, the dominance of *second-order cybernetics* and its autopoietic model of feedback in digital architecture has led to a plethora of interactive projects whereby algorithms are designed to respond and adapt to external inputs, so as to be able to add chance to programming. Yet rather than challenge computation, this attempt to add qualitative data to programming has in my opinion served to reify the fundamental system of inference which assigns logic to rationality and aesthetics to sensation. Against this tendency, this book embraces the aesthetic function of algorithms in their quantitative concreteness, the prehension of contingency and thus the outbreak of randomness within logic. I claim that this is the computational aesthetic that governs digital culture today.

The investigation of this weird formalism points to a further level of analysis that looks for the properties of a speculative function of computation. In doing so it turns again to Whitehead's metaphysics, because the scope of his attempts to disentangle reason from the enclaves of rationality are sufficiently broad to include the possibility that automated modes of thought are modes of decision, and that decision is a mode of adding new data to and thereby rethinking what already exists, by counteracting the sequential order of patterns. In short, Whitehead's study of the function of reason has offered my investigation the opportunity to discuss a mode of thought proper to algorithms: *soft(ware) thought*. Instead of looking for ways of comparing (or conflating) computation with (or into) formal or practical notions of reason, and instead of thus associating it with conceptions of the mind that view the latter as something that executes thoughts onto the world, or as something produced by the synaptic connections of the brain's neural networks, my analysis starts from the reality of algorithms as actual modes of thought.

Seen from this standpoint, computation does not refer to a rational calculus that deduces reality from universal axioms, but rather to the algorithmic prehension of the random data that are now contaminating formal logic's attempts to continuously invent new axioms. The speculative function of algorithms corresponds to an abstract scheme of concrete data, or to enumerations of procedures through which computation is constructing our present. Thus, speculative computation is not to be confused with a new mode of prediction, which for instance forecloses the potential threat of the unknown by prompting immediate decisions that anticipate the happenings of the present. Instead, this abstract scheme includes

interference (the entropic expansion of quantities) in the procedures of the present insofar as it allows infinite volumes of data to determine spatiotemporal activities. In short, speculative computation is not a new system of probabilities that tries to turn potentialities into possibilities. It is instead an aesthetic ordering of entropic data. This is a weird ordering that involves the prehension not simply of temporal infinities but also of the infinities of extension as they become enumerated in computational procedures. This immanent partiality helps us to describe computation in terms of Whitehead's *speculative* function of *reason*, according to which algorithmic actualities select quantitative novelty from repetition, thereby allowing computation to add new data structures or spatiotemporalities to the extensive continuum of actualities.

This speculative character of computation cannot be accommodated by a cybernetic system of probabilities. As Massumi has clarified in his discussion of the efficacy of preemptive power, such a system can no longer rely on already processed data. Instead, the cybernetic mode of control based on feedback as the self-regulating property of governance—whereby the output allows the system to incorporate more complexity, and thus to become extended into or fused with its outside—now needs to account for what is not there, i.e., for the determinacy of the unknown. This is why the binary language of digital computation is no longer sufficient to anticipate the emergence of errors, or to convert unknown quanta into preset probabilities. Thus, as Massumi explains, the cybernetic apparatus of control, which is based upon and defined by the operation and the operability of procedures, employs a quasi-empirical mode of calculation, according to which the necessary emergence of the new (the uncertain) and its potential effects are precalculated and preempted before the fact. In other words, the effects of the unknown have become the causal motor by which control is unconditionally exercised and driven by immanent decisions about what has not yet happened.

The cybernetic system of feedback therefore inserts temporality or qualitative variations into its binary calculation. In particular, the calculation of infinitesimal variations between these states has challenged cybernetics to overcome its own limit, and thereby to extend its power of prediction toward qualitative variations. It is this stretch toward the inclusion of temporal variations that reveals postcybernetic control's power to act retroactively, i.e., to act by turning the potential effects of the future into operative procedures within the present. The matrix of binary digits is therefore turned into a fold of approximate calculations of the infinitesi-

mal points that join two coordinates at a tangent: the derivatives of the *x* and *y* coordinates turn parallel lines into the infinities of a potential curve. A *topological* surface thus rises above the digital matrix of sequential coding, and is ceaselessly reproduced in the digital design of facades, buildings, and urban planning. This computational aesthetic of the curve is now the dominant expression of postcybernetic control.

My investigation however does not stop at this point, as it continues to explore the stubborn reality of quantities that remains at the core of digital architecture. The reason why algorithmic and interactive architecture—or digitality in general—has been unable to grasp or produce the intensive qualities of spatiotemporal experience, of the bodily feeling of spatiotemporal variations, is that computation deals in quantities and quantifications. This book asks the reader to consider the density of computational quantities as enumerations of new actualities, or spatiotemporal entities that enter and are added to the infrastructural organization of information. The book thus embarks on a close exploration of digital architecture projects in order to account not for the generative evolution of a topological surface, but rather for the *mereotopology* of parts that are bigger than wholes. Here, once again, algorithms are foregrounded as actual occasions of data that cannot be subsumed under the totalizing framework of postcybernetic control. These parts, I suggest, do not become the fused agents in a smooth space of control: they are instead autonomous events or nexuses of actual occasions.

The mereotopological exploration of computational quantities leaves my investigation with yet another question to discuss. If digital architecture implies the production of computational space-time, does it follow that there is an architecture of thought proper to computation? The pursuit of this question leads the book's arguments toward the inevitable realization of the incomprehensible existence of soft thought: an automated mode of prehension that cannot be compressed into a totalizing system (i.e., the mind, the machine, the body, or into idealism, mechanicism, or vitalism).

Soft thought is not the new horizon for *cognition*, or for the ontological construction of a new form of rationality. Instead, soft thought stems from the immanent ingression of *incomputable* data into digital programming. Soft thought is not what replaces thinking understood as a cognitive action, or affords the mind new capacities to order and calculate, or indeed gives the body new abilities to navigate space. Simply put, soft thought pertains to the existence of modes of thought, decision making,

and mentality that do not exist in direct relation to human thinking. These modes of thought (of which soft thought is only one configuration) maintain a certain degree of autonomy from cognition demonstrated by their logical inconsistencies. This book thus ends with no surprise or final revelation, but with one remark: soft thought is not there to be understood as a new cognitive function or as a transcendent form of rationality, but to reveal that *programming culture* is infected by incomputable thoughts that are yet to be accounted for.

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"The thrill of this volume lies in its sustained pursuit of the problem of chance, randomness, and non-computability as core dynamics in digital media. Its brilliantly heterodox take on computation allows *Contagious Architecture* to develop a ground-breaking account of algorithms and software, an account that puts debates about prediction and control in computational cultures on a much more exciting footing."
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"In *Contagious Architecture*, Luciana Parisi gives us a sense of space beyond spatiality, showing us an architecture in which the fixed is fluid—an evocative and rigorous study whose scope exceeds traditional disciplinary boundaries."
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"*Contagious Architecture* is the antidote to the cyclical trend of Auguste Comte's neopositivistic 'order of discourse.' By restoring the whole spectrum of languages, the multiple whispering in computation's Tower of Babel, Luciana Parisi introduces contingencies, the 'one thousand plateaus,' as a factor of knowledge—rid of its deterministic and intrinsic nature of control—to release its consequences as well as its presuppositions."
François Roche, architect

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