Approaching Algorithmic Power

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Contemporary power manifests in the algorithmic. Emerging quite recently as an object of study within media and communications, cultural research, gender and race studies, and urban geography, the algorithm often seems ungraspable. Framed as code, it becomes proprietary property, black-boxed and inaccessible. Framed as a totality, its becomes overwhelmingly complex, incomprehensible in its operations. Framed as a procedure, it becomes a technique to be optimised, bracketing out the political. In struggling to adequately grasp the algorithmic as an object of study, to unravel its mechanisms and materialities, these framings offer limited insight into how algorithmic power is initiated and maintained.

This thesis instead argues for an alternative approach: firstly, that the algorithmic is coordinated by a coherent internal *logic*, a knowledge-structure that understands the world in particular ways; second, that the algorithmic is enacted through *control*, a material and therefore observable performance which purposively influences people and things towards a predetermined outcome; and third, that this complex totality of architectures and operations can be productively analysed as strategic sociotechnical clusters of *machines*.

This method of inquiry is developed with and tested against four contemporary examples: Uber, Airbnb, Amazon Alexa, and Palantir Gotham. Highly profitable, widely adopted and globally operational, they exemplify the algorithmic shift from whiteboard to world. But if the world is productive, it is also precarious, consisting of frictional spaces and antagonistic subjects. Force cannot be assumed as unilinear, but is incessantly negotiated—operations of parsing data and processing tasks forming broader operations that strive to establish subjectivities and shape relations. These negotiations can fail, destabilised by inadequate logics and weak control.

A more generic understanding of logic and control enables a historiography of the algorithmic. The ability to index information, to structure the flow of labor, to exert force over subjects and spaces—these did not emerge with the microchip and the mainframe, but are part of a longer lineage of calculation. Two moments from this lineage are examined: house-numbering in the Habsburg Empire and punch-card machines in the Third Reich. Rather than revolutionary, this genealogy suggests an evolutionary process, albeit uneven, linking the computation of past and present.

The thesis makes a methodological contribution to the nascent field of algorithmic studies. But more importantly, it renders algorithmic power more intelligible as a material force. Structured and implemented in particular ways, the design of logic and control construct different versions, or modalities, of algorithmic power. This power is political, it calibrates subjectivities towards certain ends, it prioritises space in specific ways, and it privileges particular practices whilst suppressing others. In apprehending operational logics, the practice of method thus foregrounds the sociopolitical dimensions of algorithmic power. As the algorithmic increasingly infiltrates into and governs the everyday, the ability to understand, critique, and intervene in this new field of power becomes more urgent.

Practice-based Strand:
Where the theoretical strand breaks down Uber, Alexa, Airbnb, and Palantir into a series of machines, the artistic strand of this project creates a series of machines in the form of browser-based artworks. These artworks are not 1:1, mirror-like recreations of the previous case-studies, nor offered as reiterations of them. While this practice draws upon discoveries from the theoretical strand, it reverse engineers them, rearranging elements in order to foreground new aspects that either critique the original or posit alternative models. A theoretical inquiry into the history of the algorithmic, for example, led to *A Machine for Reducing Risk*, a data visualisation of an 18th century maritime insurance company that underpinned slave shipping. Realised as standalone works, they have been presented in a range of contexts: online articles, digital galleries, and film festivals. Through both the making process itself and the feedback from various audiences, they offer insights into the algorithmic that can be read alongside the theoretical strand of the project.

Two basic motivations informed the creation of these artworks. The first was critique, a desire to foreground the pathologic politics of these technical regimes which are often overlooked. By transforming these darker aspects of the algorithmic into image, sound, and code, they become less abstract and more embodied—able to be seen, heard or experienced. *A Machine for Sonifying Toxic Space*, for example, generates a soundtrack from the chemical spills of the Silicon Valley technology industry. As a tool for critique, the artwork also provides a circumscribed object, a form able to intensify subtle tendencies or distill a typically complex set of conditions. *A Machine for Sorting Skin*, for example, orders photographs of bodies from lightest to darkest, explicitly foregrounding the history of racial classification inherent to technology. In crystallising aspects like bodily harm and environmental degradation, these artworks provide an alternative mode of critique to theory.

The second mode of creation was more speculative, less concerned with critiquing existing systems and more interested in exploring unrealised alternatives. Freed from the dictates of the functional or feasible, art provides a productive medium for posing the question: what if? *A Machine for Witnessing and Recounting a Crime*, for example, extrapolates from a real-world murder with a simulated desktop that recounts the evening's events via smart home notifications. Other artworks speculate on future possibilities by applying existing techniques like machine learning to domains such as terrorism. *A Machine for Dreaming Up New Anxieties*, for example, uses a character-based neural network trained on war reports to generate new 'suspicious' incidents, which are then illustrated with found footage. Rendering these alternative visions into prototypes not only presents new possibilities, but also provides a way of aesthetically registering the political stakes of algorithmic power.

All works can be viewed at http://darkmttr.xyz
Artwork descriptions can also be found in the Appendix section of this document.

Statement of Authentication:

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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Formatting:
The text adheres to the Chicago Manual of Style 17th edition (CMOS) in terms of citations and punctuation, but uses Australian spellings unless directly quoting from an American source.

Contents

Introduction

Algorithms are generally understood to comprise an effective procedure, a sequence of rules to be followed, a recipe for doing. Algorithms promise to rationalise activity, initiating and coordinating it, step-by-step, until that activity is completed. In its claim to replicate action, to make things happen consistently, repeatedly, and at scale, the algorithm is both a compelling idea and a programme for achieving it. As the cultural valence of the term ascended in recent years, appearing in promotional material and mainstream media, what drew me to the algorithmic was the doubled promise that it seemed to offer its proponents—both a model and a means to power.

To explore algorithmic power, I selected four contemporary examples. Airbnb is a "peer-to-peer online marketplace and homestay network that enables people to list or rent short-term lodging in residential properties, with the cost of such accommodation set by the property owner."[1] Uber is an online platform that connects passengers with Driver-Partners who operate as freelance workers and provide transport on demand. Alexa is Amazon's cloud-based digital assistant that listens to voice commands and speaks back—playing music, reading news, ordering products, and more. Gotham is a software platform developed by Palantir that provides customers with the ability to store, query, and visualise extremely large data sets, allowing analysts to discover patterns and relationships. All four have significant financial assets behind them, either in the form of venture capital or internal funding initiatives. All four have established user bases ranging from thousands to millions. And all four operate globally, in hundreds or thousands of cities across multiple countries.

Operational across a diverse set of sectors—travel, transport, the smart home, and security—each example exerts a significant social force, actively shaping the everyday practices of many. For a platform like Uber this entails new forms of algorithmic governance that ushers drivers to particular locations in the city at particular times of the day, and draws out a specific type of performance understood as best practice. For the "always listening" digital assistant that is Amazon Alexa, this means filling the traditionally private space of the kitchen or living room with an invisible new zone of capture. And within a system like Airbnb, the algorithmic indexing of listings exerts unseen pressures on architectures—rearranging apartments, transforming homes into hotels and subtly reconstituting the wider geographies of the city itself.

These four examples index a broader terrain of algorithmic power—platforms, services, and systems that are reformulating how life is conducted in their respective sectors: LinkedIn for careers, Deliveroo for logistics, Amazon for commerce, Google Search for knowledge, Tinder for dating, and so on. Alongside these consumer-facing examples are less visible but equally significant intrusions made at the enterprise or governmental levels. These come without focus-grouped product names, but determine teacher rankings, credit scores, loan approvals, parole sentences, and

1 Airbnb, "About Us," Airbnb, accessed May 9, 2017, https://www.airbnb.co.nz/about/about-us.

no fly lists.[2] Increasingly, the algorithmic permeates into the processes and people around us, impinging upon society and culture in highly significant ways.

Yet it is one thing to acknowledge that such power exists, it is another to make sense of it. To render algorithmic power intelligible, this thesis develops an alternative method of enquiry and tests it by examining the operations and relations of the four examples listed above. This introduction begins by briefly sketching the background, issues, and motivations of this research project. The chapter then proceeds to examine the history and contested definitions of the algorithm. Adopting a different starting point, the algorithmic is reframed in terms of logic and control, a move that proves productive for analysis. The chapter concludes with the problem of scale in algorithmic study and explains the method of the machine as a practical response.

After selecting four algorithmic examples, this project quickly came to the question of method. In the context of sociopolitical (as opposed to computer science) research, the algorithm is a relatively new and difficult object of study. A 2011 paper by Malte Ziewitz, for example, states that: "Algorithms are hard to grasp, difficult to describe and virtually impossible to observe."[3] Exacerbating this difficulty and the opacity that methods encounter is the conflation of algorithm with software programs and code. Lev Manovich, for example, explicitly defines a software medium as a combination of algorithms with a data structure.[4] Susan Schuppli, to take just one more example, more implicitly makes this connection in an article titled: Deadly Algorithms: Can Legal Codes Hold Software Accountable for Code That Kills?[5] In this view, the algorithm consists of software instructions as a special form of writing. Historian Len Shustek writes that "software is a form of literature, written by humans to be read by humans as well as machines."[6] For Katherine Hayles, software is essentially text, a literary medium. In her 2008 book, *Electronic Literature*, Hayles writes that "critics and scholars of digital art and literature should therefore properly consider the source code to be part of the work, a position underscored by authors who embed in the code information or interpretive comments crucial to understanding the work."[7] While Hayles acknowledges the social and cultural forces surrounding this new form of text, she ultimately

2 Cathy. O'Neil, *Weapons of Math Destruction : How Big Data Increases Inequality and Threatens Democracy* ([London]: Penguin Books, 2018).

3 Malte Ziewitz, "How to Think about an Algorithm: Notes from a Not Quite Random Walk (Draft)" (Knowledge Machines between Freedom and Control, Kulturfabrik Hainburg, Austria, 2011), 12.

4 This is done early on in *Software Takes Command*: "We have arrived at a definition of a software 'medium,' which can be written in this way: Medium = algorithms + a data structure". Manovich here is drawing upon Niklaus Wirth's book from 1975 titled *Algorithms Plus Data Structure Equals Programs*. Lev Manovich, *Software Takes Command: Extending the Language of New Media*, International Texts in Critical Media Aesthetics 5 (New York: Bloomsbury Academic, 2013), 7.

5 Susan Schuppli, "Deadly Algorithms: Can Legal Codes Hold Software Accountable for Code That Kills?," *Radical Philosophy*, no. 187 (October 2014), https://www.radicalphilosophy.com/commentary/deadly-algorithms.

6 Len Shustek, "What Should We Collect to Preserve the History of Software?," *IEEE Annals of the History of Computing* 28, no. 4 (2006): 110.

privileges the roles of the writer and reader so dear to literary studies. In this view, the code is the *ur*-text, the originary document. If only one could examine this writing, the argument goes, one would be in a position to understand software as a cultural and literary object, in the same way one might read Plato or Paine. In fact this is the fundamental assumption of critical code studies. Mark Marino defines the discipline as one "that uses critical theory to explore the extra-functional significance of computer code, exploring not merely what the code does, but what it means."[8] In another article, Marino states that "we can read and explicate code the way we might explicate a work of literature."[9] For Alexander Galloway, code is also text, albeit a special kind of writing that does what it says. "Code," he declares, "is the only language that is executable."[10] While rightly highlighting the uniquely performative nature of software, he still fundamentally regards it as a textual document. As such, he attempts "to read the never-ending stream of computer code *as one reads any text*."[11] Of course, this text is typically a proprietary piece of intellectual property. As such, it is blocked from public scrutiny and made available only to employees and selected stakeholders. Access to the holy text of the source code is never granted. The moment of enlightenment, so anticipated, simply never arrives.

It was clear that I would never gain access to the source code of Uber or Airbnb, Palantir or Alexa. Instead, to gain a baseline understanding of each object, I adopt an interdisciplinary mix of four methods. *Archival analysis* collects articles, blog posts, press releases, and other texts from the last three years related to each object. These begin to explode the singular object (e.g. 'Uber') into the personnel involved, the techniques employed, the materials utilised, the development over time, and so on. *Design analysis* collects visual material: screenshots, logos, marketing, media packs and user journeys. These interfaces and imagery lay out the vision for each object—claims, promises, ideals—but also indicate some of the operations underpinning this imaginary. *Data analysis* collects supplementary data available on each object: adoption rates, venture capital, data centre locations, and public user information. This non-proprietary information sketches out the economy of each algorithmic ecology—from the small scale 'currency' of the user or object to the broader financial forces directing it. *Fieldwork* is a set of small, purposefully subjective activities related to each object —taking notes on the experiential qualities elicited when taking rides, staying in homes, or speaking with a digital assistant. If the researcher remains 'outside' the object of study with the other methods, this one is designed to embody him firmly inside the algorithmic ecology as one more

7 N. Katherine Hayles, *Electronic Literature: New Horizons for the Literary* (Notre Dame, IN: University of Notre Dame Press, 2008), 35.

8 Marc Marino, "Critical Code and Software Studies" (Digital Humanities 09, University of Maryland, 2009), https://games.soe.ucsc.edu/sites/default/files/nwf-CS11-dh09-expressiveProcessing.pdf.

9 Marc Marino, "Critical Code Studies," Electronic Book Review, December 4, 2006, http://www.electronicbookreview.com/thread/electropoetics/codology.

10 Alexander R Galloway, *Protocol: How Control Exists after Decentralization* (Cambridge, MA: MIT Press, 2004), 165.

11 Galloway, *Protocol*, 20.

material with particular agencies and abilities. The 'field' here is not any particular geography, but rather explores how the infrastructural field of the cloud permeates the phenomenological and social field of lived experience.

These initial explorations supported my sense that the algorithmic could be understood as performative rather than textual—layers of activity rather than lines of code. In contemporary usage, the algorithmic has rapidly expanded beyond computer science and symbolic logic—it has moved off the whiteboard and into the world. Yet if the world is a promising place, it is also a hazardous one. Here, clean code is replaced with messy reality; abstract integers are replaced with contentious subjects, ideal scenarios are replaced with uneven performativities. Objectives cannot be assumed, but must be fought for, carried out incessantly. New bodies, spaces, and roles are made available, but these come with new expectations. The low-level operations enacted within the algorithmic—distributing data, moving matter, forming connections—must accumulate into successful meta-operations: producing subjectivities, directing experiences, and shaping relations.

In shaping subjectivities and structuring relations in particular ways, these operations are political. The political here refers not to politicians and parties, but simply to the ability to determine the arena of possibilities—to make some things doable, sayable, and thinkable and others not.[12] Antoinette Rouvroy observes that algorithmic power is "effected through the reconfiguration of informational and physical architectures and/or environments within which certain things become impossible or unthinkable."[13] Far from being 'merely' functional, algorithmic operations are embedded with assumptions about the behaviours to be allowed, the users to be acknowledged, the communities to be supported, the forms of capital to be facilitated, and so on. As Wendy Chun stresses, these assumptions exert constant force over time and in doing so "ground and foster habits of using."[14] Algorithmic decisions privilege particular races, classes, and genders while disadvantaging others. They normalise certain behaviours while disabling other practices. And they can be used to underpin remote forms of extraction and capitalisation. Enmeshed at a deep level within a platform or service, these values are tirelessly reinforced with every execution. For Liam Magee and Ned Rossiter, this is the politics of parameters, a "politics that remains for the most part implicit as it is pervasive."[15] Such a politics has already arrived unannounced—indeed, is already operational, quietly redefining the possibilities available to subjects and spaces.

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12 While wishing to keep the discussion high level in this introduction, my understanding of politics is derived from Jacques Ranciere's *Politics of Aesthetics*, in which he notes that the political is based on a 'distribution of the sensible': "a delimitation of spaces and times, of the visible and the invisible, of speech and noise" or in other words, a set of forces that determine who may speak and who must remain silent, what gets to be visible and what must remain hidden. See Jacques Ranciere, *The Politics of Aesthetics: The Distribution of the Sensible*, trans. Gabriel Rockhill (London: Continuum, 2013), 41.

13 Rouvroy, "The End(s) of Critique," 155.

14 Wendy Hui Kyong Chun, *Updating to Remain the Same: Habitual New Media* (Cambridge, MA: MIT Press, 2017).

Taken together, these early forays into objects and methods began to reveal the aims of the research project. Introducing a new approach to the study of the algorithmic (outlined below in *Method*) would provide three benefits. Firstly, it would offer a methodological contribution to the field of algorithmic study, a nascent field still grappling with ways to unravel this difficult object of study. Secondly and more substantively, this approach would render algorithmic power more intelligible. Algorithmic power does not just happen, but must be incessantly negotiated, emerging from its encounters with people and things. Understanding these operations, including their contingencies and failures, provides a foundation—not just for 'countercultural' interventions and activism—but for the more modest goal of living with them or despite them. And thirdly, by unraveling specific algorithmic operations, this approach also provides insights into its politics, as sketched above. By foregrounding the (often pathologic) political determinations of the algorithmic, we gain a better understanding of what we're subscribing to when using them, how we might critique them, and how we might construct more emancipatory alternatives. These are the motivations of the project. In the next section, I introduce an alternate approach to algorithmic investigation that goes beyond source code and software.

Method

Origins and Redefinition

What is an algorithm? For such an epitome of rationality, the term is strangely ambiguous. Nevertheless one way to understand its evolution is through its history, a genesis that can be briefly sketched. The word algorithm is merely an updated form of 'algorism', an older term originating from the Latin translation of the ninth century Arabic mathematician, Al-Khwarizmi. As historian Robert Steele demonstrates, algorism "owes its name to the accident that the first arithmetical treatise translated from the Arabic happened to be one written by Al-Khwarizmi in the early ninth century, 'de numeris Indorum,' beginning in its Latin form 'Dixit Algorismi,'" a translation made about 1120 by Adelard of Bath.[16] The arrival of this text in Europe established a split between two differing schools of calculation: the older Abacists and the new Algorists. The Abacists used a horizontal tablet with tokens moved around sand or paper, rather than the vertical Eastern version with rods that typically springs to mind. Over a two hundred year period, they had formalised a number of processes for working with numbers. And yet, as Steele explains, the "great difficulty of the early Abacists, owing to the absence of a figure representing zero, was to place their results and operations in the proper columns of the abacus, especially when doing a division sum."[17]

15 Liam Magee and Ned Rossiter, "Service Orientations: Data, Institutions, Labor," in *There Is No Software, There Are Just Services*, ed. Irina Kaldrack and Martina Leeker (Leuphana, Germany: meson press, 2015), 73–89.

16 Robert Steele, *The Earliest Arithmetics in English* (Oxford: Oxford University Press, 1922), xiv.

17 Steele, *The Earliest Arithmetics in English*, x.

Khwarizmi's text introduced new tools for calculation and the processes for their effective operation. The first change was the number system itself. Roman numerals quickly became unwieldy when writing large quantities (e.g. lxxxviiij), so in their place, Khwarizmi introduced a sleek new set of 'Hindu-Indian' numbers. The alienness of these integers comes across particularly in one 13th century French translation, which carefully steps the reader through these "nine letters, which are called figures, written as follows: 9, 8, 7, 6, 5, 4, 3, 2, i."[18] The second introduction was a set of seven operations. The same French text, written in verse form, lists them: "Addition, subtration / Doubloison, mediation / go Mouteploie et division / Et de radix eustration."[19] Addition, subtraction, multiplication, and division are all well-known. Alongside these four operations, 'duplation' was the doubling of a number, 'mediation' was halving, and 'radix eustration' was the extraction of a root number. Integers and operations were formalised into a system for carrying out consistent calculation. In doing so, this 800 year text old hints at contemporary connotations of the algorithmic as not just a static set of integers, but a carefully specified series of operations.

The final concept from Khwarizmi was the introduction of zero, or—derived from the Arabic *sifr*—cipher. In explaining this strange new device, the same 13th century author resorts to the physical world. "These figures," he writes, "are not sufficient for reckoning without this one: o, called naught, which is worth nothing, creates nothing but shadow, to such an extent does it encumber the ground, yet no article will ever be written in any work without it; of itself it can bear no fruit, but it gives significance to others."[20] Taken for granted today, zero was wholly novel to Europe. Indeed the most well-known early treatise, the *Carmen de Algorismo* written by Alexandre de Ville around 1240, lists zero on line three before all the other numbers.[21] Before zero, place—tens, hundreds, thousands—was maintained by a rigid set of grids. The introduction of zero, as Steele asserts, enabled the "computer to dispense with the columns of the Abacus."[22] A new mode of computation emerged that was both more concise and more easily checked. And yet, as Gillian Evans cautions, the ascendancy of the algorist style over the abacus school was largely a "technical improvement."[23] The mathematical fundamentals were not made redundant, but instead repackaged into a streamlined set of figures and operations. "The algorism," Evans suggests, "is not

18 Unknown author, quoted in Louis C Karpinski and EGR Waters, "A Thirteenth Century Algorism in French Verse," *Isis* 11, no. 1 (1928): 59.

19 Unknown author, lines 88-91, quoted in Karpinski and Waters, "A Thirteenth Century Algorism in French Verse."

20 Unknown author, quoted in Karpinski and Waters, "A Thirteenth Century Algorism in French Verse," 65.

21 For a transcription of the Carmen, see *Robert Steele, The Earliest Arithmetics in English* (Oxford: Oxford University Press, 1922), 72.

22 Steele, *The Earliest Arithmetics in English*, xv.

23 Gillian R Evans, "From Abacus to Algorism: Theory and Practice in Medieval Arithmetic," *The British Journal for the History of Science* 10, no. 2 (1977): 122.

an entirely separate method of calculation… but a technique in which influences have become interfused."[24]

From there the typical genealogy of the algorithmic moves forward to Babbage's Analytical Engine in 1834, Ada Lovelace's programme for calculating Bernoulli numbers in 1843, Alonzo Church's work in symbolic logic throughout the 1930s, Alan Turing's seminal paper on computation published in 1936, and von Neumann's architecture underpinning the ENIAC and merge-sort algorithm in 1945.[25] A general understanding of the algorithm thus emerges from this lineage. As mathematical historians Crossley and Henry argue, "in the 12th century and for a long time thereafter the spelling 'algorism,' with an 's,' meant the rules and procedures for using the nine Hindu-Arabic numerals 1, 2, 3, 4, 5, 6, 7, 8, 9 and the cypher."[26] Even today, some computer-science papers continue to use algorism over algorithm, and the general notion of rules and procedures is threaded through the diverse definitions.

One of the more well-known definitions, for instance comes from mathematician Stephen Kleene in the 1940s, who defined the algorithm as a performable procedure.[27] While seemingly simple, Kleene is leaning heavily here on a specific understanding of the algorithmic as that which is performable or computable in a Turing sense. In 1967, cognitive scientist Marvin Minsky defined the algorithm as "an effective procedure"[28] and asserted that such a procedure requires two elements:

> (1) a language in which sets of behavioural rules are to be expressed, and
> (2) a single machine which can interpret statements in the language and thus carry out the steps of each specified process.[29]

Minsky thus established two components—a coordinating set of instructions and a performance that executes them. Such a formulation shares much in common with the definition of logic and control that will be taken up and expanded shortly in this thesis. In 1973 influential computer scientist Donald Knuth provided five key aspects of an algorithm: an algorithm produces *outputs* from *inputs*, it must be *finite*, terminating after a specific number of steps; it must be *definite*, with each step precisely defined, and it must be *effective*, with simple operations that in principle any

24 Evans, "From Abacus to Algorism," 122.

25 Sabrina Schönhart et al., "History of Algorithms," Virtual Exhibitions in Informatics, 2003, http://cs-exhibitions.uni-klu.ac.at/index.php?id=193.

26 John N Crossley and Alan S Henry, "Thus Spake Al-Khwārizmī: A Translation of the Text of Cambridge University Library Ms. Ii. Vi. 5," *Historia Mathematica* 17, no. 2 (1990): 103–131.

27 Stephen Cole Kleene, "Recursive Predicates and Quantifiers," *Transactions of the American Mathematical Society* 53, no. 1 (1943): 59.

28 Marvin Minsky, *Computation: Finite and Infinite Machines* (Upper Saddle River, NJ: Prentice-Hall, 1967), 106.

29 Minsky, *Computation: Finite and Infinite Machines*, 106.

person could carry out.[30] And in 2000, David Berlinski defined the term for a more mainstream audience, penning these lines:

> *an algorithm is*
> *a finite procedure,*
> *written in a fixed symbolic vocabulary,*
> *governed by precise instructions,*
> *moving in discrete steps, 1, 2, 3, . . .,*
> *whose execution requires no insight, cleverness,*
> *intuition, intelligence, or perspicuity,*
> *and that sooner or later comes to an end*[31]

While these framings clearly share some similarities, the proliferation of definitions throughout the decades, each with their own subtle distinctions, suggest that the notion of the algorithm is both open-ended and constantly shifting. Indeed, for some theorists, the term has always been frustratingly ambiguous. Barbin et al., for instance, have added properties of finiteness and iteration, "distinguishing it from vaguer notions such as process, method or technique."[32] But despite these qualifiers, the term remains relatively open. Blass and Gurevich, for example, are emphatic:

> we disagree with Kleene that the notion of algorithm is that well understood. In fact the notion of algorithm is richer these days than it was in Turing's days. And there are algorithms, of modern and classical varieties, not covered directly by Turing's analysis, for example, algorithms that interact with their environments, algorithms whose inputs are abstract structures, and geometric or, more generally, non-discrete algorithms.[33]

Gurevich would stress this idea in a later paper, arguing moreover that "the notion of an algorithm cannot be rigorously defined in full generality" because such a notion is constantly expanding.[34] This expansion for Gurevich largely seems to consist of new problem-solving entities still firmly

30 Donald Knuth, *The Art of Computer Programming: Fundamental Algorithms*, 3rd ed., vol. 1 (Reading, MA: Addison-Wesley, 1973), 5-6.

31 David Berlinski, *The Advent of the Algorithm: The Idea That Rules the World* (New York: Harcourt, 2001), xviii.

32 Barbin, Evelyne, Jacques Borowczyk, J-L Chabert, Michel Guillemot, Anne Michel-Pajus, Ahmed Djebbar, J-C Martzloff, C Weeks, and Jean-Luc Chabert. *A History of Algorithms: From the Pebble to the Microchip*. Springer Science & Business Media, 2012. 2.

33 Andreas Blass and Yuri Gurevich, "Algorithms: A Quest for Absolute Definitions," *Bulletin of the EATCS* 81 (2003): 203.

34 Yuri Gurevich, "What Is an Algorithm?," in *SOFSEM 2012: Theory and Practice of Computer Science: 38th Conference on Current Trends in Theory and Practice of Computer Science*, ed. Mária Bieliková et al. (Berlin: Springer, 2012), 31–42.

inside the bounds of computer science. Yet the term has been picked up outside these narrow disciplinary constraints. Philosopher Daniel Dennett, for example, has stated that "according to Darwin, evolution is an algorithmic process"[35] and more recently media theorist Jonathan Beller has observed that history quite clearly reveals the "algorithmic character" of capital.[36] These broader adoptions demonstrate that the concept of the algorithm has been interpreted and applied in various ways, an ambiguity that can be productive rather than problematic, opening up research into tangential issues and interdisciplinary spaces: cities and surveillance, power and political economy, race and cultural studies.

But in terms of definitions, this thesis begins from a different starting point. In 1979 programmer Robert Kowalski published a paper titled 'Algorithm = Logic + Control.'[37] For Kowalski, an algorithm consists of "a logic component, which specifies the knowledge to be used in solving problems, and a control component, which determines the problem-solving strategies by means of which that knowledge is used."[38] From sorting lists to proving ancestry, Kowalski's numerous examples are all meant to demonstrate how the approach to a problem is conditioned by the understanding of it (logic) and the performative operations enacted to address it (control). For example, take a pathfinding algorithm. Logic here includes the goal of finding a path as well as theoretical knowledge regarding movement through space, whereas the control component consists of a particular routine that moves from one area to the next in order to find an optimal route. Given this distinction, "Different control strategies determine different pathfinding algorithms. Forward search from the initial node... is bottom up reasoning," while "backward search is top-down reasoning."[39]

While the goal was always the same, some processes were clearly more efficient than others, better exploiting the particularities of computation. "Sequential search," for example, "is suitable for data stored sequentially in arrays or linked lists. Other search strategies are more appropriate for other data structures, such as hash tables, binary trees, or semantic networks."[40] Thus, despite the paper's title, Kowalski was less concerned with defining the algorithm than perfecting it, arguing that the "efficiency of an algorithm can often be improved by improving the control component without changing the logic of the algorithm."[41] In other words, the separation of logic and control was meant to facilitate cleaner role division and smoother optimisation, allowing programmers to retain

35 Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995), 60.

36 Jonathan Beller, *The Message Is Murder: Substrates of Computational Capital* (London: Pluto Press, 2018), 12.

37 Robert Kowalski, "Algorithm = Logic + Control," *Communications of the ACM* 22, no. 7 (1979): 424–436.

38 Kowalski, "Algorithm = Logic + Control,"424.

39 Kowalski, "Algorithm = Logic + Control," 432.

40 Kowalski, "Algorithm = Logic + Control," 432.

41 Kowalski, "Algorithm = Logic + Control," 424.

a logical understanding of a problem while tweaking the control procedures used to attack it. Whether or not this separation was effective in terms of optimisation is not particularly relevant. Instead, I want to misuse Kowalski's computer science oriented paper, thickening its pragmatic definitions into a theoretical framing.

Control

Kowalski's notion of control can be extrapolated and expanded. In the former framing of algorithm as software, it is the source code that matters above all. Commands are carried out without question or friction. Instructions translate effortlessly into work done in the world. For Kowalski too, control could be performed in different ways, but its success was assumed—passive integers sorted, shifted, and transformed. But when news feeds (Facebook), transport (Uber), living space (Airbnb), and labor (Amazon) are now considered algorithmic, then the notion of control must also move beyond the abstracted realm of computer science and out into the world. Control operations are never simply dealing with different data structures, but with the particularities of circuits and chips, homes and networks, bodies and cities.

To successfully operate, the algorithm must enlist material actors, make compromises and negotiate for its successes. As Chun reminds us, execution is not simply a "perfunctory affair."[42] Algorithms are not just immaterial instructions that exert effortless control. As the following chapters will demonstrate, they must contend with the frictions of heat and distance, they must obtain labor via coercion or seduction, and they must be embodied within geographies of networks and data. In his 1986 book *The Control Revolution*, James Beniger also considered control as a form of "material processing," a way of instrumentalising matter towards a particular end.[43] Beniger argued that the industrial revolution had given rise to an explosion of energy and a resulting crisis of control, and that the recent rise of the information society was simply the latest phase of a longer period of technological development attempting to come to grips with such a crisis.[44] Far from being random, new inventions in this lineage afforded more control—novel mechanisms of manipulation that better directed inputs towards specific objectives. Thus control for Beniger, and the definition used here, is simply "purposive influence towards a predetermined goal."[45] Control, as one component of the algorithmic, reminds us that they are not simply an idealised and abstracted formula that exist in a vacuum, but rather a sociotechnical entity embedded in the world.

42 Wendy Hui Kyong Chun, "On 'Sourcery,' or Code as Fetish," Configurations 16, no. 3 (2008): 304.

43 James Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, MA: Harvard University Press, 1986), vii.

44 Beniger, *The Control Revolution*, vii.

45 Beniger, *The Control Revolution*, 8.

Taken seriously, this notion of control moves quickly beyond source-code and software, radically expanding the algorithmic as an object of study. Indeed, even from a conservative engineering standpoint, their production no longer conforms to this framing anyway. The model of the monolithic application—the downloadable desktop executable—even one with externalised libraries and dependencies, has been largely abandoned. There were simply too many complexities: multiple teams working on the same codebase, competing functionality that required integration, tracking of overlapping changes. Developers have ways to deal with all these things, but the complexity became fragility—forcing errors, code forking, and reverting to previous versions. In a conference presentation, Airbnb engineer Melanie Cebula explains that as the scale of the company increased, so did its customer-base and daily transactions, and the existing monolithic model could not handle the performance and security requirements—the result was a crisis of control, or in Cebula's terms, a situation which foregrounded issues of "enforcement" and "compliance."[46]

Rather than the single code-base of the 'monolith', Airbnb, like many technologically driven corporations, has shifted to the use of microservices, "a suite of independently deployable, small, modular services in which each service runs a unique process and communicates through a well-defined, lightweight mechanism to serve a business goal."[47] From converting currency to tracking a vehicle, these are small, highly targeted services that focus on doing one thing well. The resulting shift in architecture was gradual, but already at the time of Cebula's presentation, Airbnb consisted of 300 microservices supported by 900 engineers.[48] Uber, to take just one more example, consisted of over 1000 microservices as of mid 2016.[49] Each development team focuses on a single microservice, and this distributed model means updates and their resulting ripple effects are highly constrained. What this means for code studies, in effect, is that *there is no source code*. There is no distinct textual document that can be examined, but rather a dispersed array of services operating quasi-independently within a shared environment.

Of course, from an engineering perspective, such an approach offers flexibility and focus, allowing services to be developed and refined independently, with minimal disturbance to functionality as a whole. But the point here is not merely to endorse the innovation narrative of any particular startup. Instead, the shift from monolith to microservices—and going further, to the bodies, matter, and moments they must enlist to operate—exemplifies the methodological limitations of

46 Melanie Cebula, "Airbnb, From Monolith to Microservices: How to Scale Your Architecture" (FutureStack Conference New York, September 25, 2017), https://www.youtube.com/watch?v=N1BWMW9NEQc.

47 Tom Huston, "What Is Microservices Architecture?," SmartBear, 2018, https://smartbear.com/learn/api-design/what-are-microservices/.

48 Cebula, "Airbnb, From Monolith to Microservices."

49 Matt Ranney, "What I Wish I Had Known Before Scaling Uber to 1000 Services" (GOTO Conference, Chicago, September 28, 2016), https://www.youtube.com/watch?v=kb-m2fasdDY.

understanding the 'algorithm' as a single, self-contained object, and instead suggests that the algorithmic comprises a broader *ecology of control* that purposively influences subjects and spaces.[50]

For one, this emphasises their *distributed* nature. Processes are not carried out line-by-line, in a linear fashion, but rather diffused throughout the ecology's diverse array of heterogeneous actors and agents and executed asynchronously. Services respond to other services. Jobs are handed on. Packets of data are ingested. Quantities of capital are re-circulated. Processes adapt to fluctuations in the wider environment. As Erich Hörl suggests, this is a "culture of control that is radically distributed and distributive, manifest in computers migrating into the environment, in algorithmic and sensorial environments."[51] Such an ecology of control is a rich sphere of activity in which incessantly negotiated processes emerge from the complex interplay of many elements working with and against each other.

Secondly, an ecology of control foregrounds its *heterogeneity*. Various activities impinge upon each other, collaborating but also conflicting. Human and non-human matter is taken up in particular ways, enacting a performance which contributes towards a broader algorithmic objective. Algorithms are not monolithic objects with tidy edges. Nor can they be neatly defined as purely technical and textual. Instead we must ask, with Matthew Fuller, what makes up these ecologies with their "shared rhythms, codes, politics, capacities, predispositions and drives, and how can these be said to mix, to interrelate and to produce patterns, dangers and potentials?"[52] The algorithmic glues together these disparate elements and divergent objectives into an effective procedure, but their latent differences remain.

Finally, such an ecology is *multi-scalar*. In his book the *Three Ecologies* Felix Guattari anticipated how environmental crises would begin to blur boundaries. To consider effects only at the level of 'the nation' would no longer make sense. Climate change is both cosmic and cellular. Thinking ecologically means attending to the "visible relations of force on a grand scale, but will also take into account molecular domains of sensibility, intelligence and desire."[53] Algorithmic ecologies of control are also full of lively interactions and critical operations at many different scales. Take, for instance, the everyday act of a user locating herself using a phone. Even this apparently simple

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50 Ecology is used here in Erich Hörl's sense, a term decoupled from its usual associations with the organic, the authentic, and the healthy. Instead, as he argues, in the traditional nature / technics divide, 'ecology' and the 'environmental' have now moved closer to the technical. Ecology and the environmental are thus perhaps better understood as an all encompassing field of technical control created via "the collaboration of a multiplicity of human and nonhuman agents."

51 Erich Hörl, "Introduction to General Ecology: The Ecologization of Thinking," in *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl and James Burton (London: Bloomsbury Academic, 2017), 4.

52 Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (Cambridge, MA: MIT Press, 2005), 2.

53 Félix Guattari, *The Three Ecologies*, trans. Paul Sutton (London: The Athlone Press, 2000) 28.

operation encompasses a gesture of the hand, a collection of smartphone circuitry, a network of data centres, a stretch of submarine cabling, a series of geospatial satellites, and so on. Ecologies provide a way of "understanding the various scales and layers through which media are articulated together with politics, capitalism and nature, in which processes of media and technology cannot be detached from subjectivation."[54]

Control provides an intervention that moves away from the opaqueness of the secret 'black boxes' that mysteriously "control money and information"[55] and towards the algorithmic as a performance carried out in the world and articulated through matter. The closed code of software is replaced by the purposive influence of material towards a predetermined goal, material processing that can be observed, analysed, and critiqued.

Logic

In the same way, Kowalski's notion of logic can be amplified and extended. For Kowalski, if control determined *how* something is done, logic defined *what* was to be done.[56] Admittedly, the definition of logic and phrases associated with it shift throughout the paper, from "the knowledge to be used in solving problems", to "definitions" (425), to "predicate logic" (426) to "reasoning" (428) to the "representation of a problem domain" (428) to something that comprises the "definitions of data structures" (430). Again, Kowalski is interested in efficiency, not etymology, and thus logic is gestured to rather than defined. But two statements in particular can be extrapolated.

First, "the logic component defines the problem domain-specific part of an algorithm."[57] This is taken to mean the information necessary to understand the problem *as* a specific type of problem, with specific rules and tools for solving it. In one section of the paper, for example, logic is associated with the "definition of a factorial", or the "logical connector *if*"; another section specifies the logic of ancestry—based on a genealogy of relations, Zeus is or is not the grandparent of Harmonia.[58] For Kowalski, these understandings are axiomatic. But the awareness of a problem domain is not simply given, nor can it be merely conflated with 'common sense'. Instead this logic is built atop an epistemological foundation comprising knowledge of numbers, paths, and propositions, "the techniques and procedures accorded value in the acquisition of truth."[59] Such knowledge does not emerge *ex-nihilo*, but instead arises from an epistemic history, a sedimentation

54 Jussi Parikka and Michael Goddard, "Unnatural Ecologies," *The Fibreculture Journal*, no. 17 (2011): 1.

55 Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (Cambridge, MA: Harvard University Press, 2015).

56 Kowalski, "Algorithm = Logic + Control," 435.

57 Kowalski, 429

58 Kowalski, 426

59 Foucault, "Truth and Power," 131.

of concepts, contested and contributed to over time by a series of philosophers, mathematicians, and scientists. Because of this, such knowledge is embedded with a particular set of assumptions and ideals. These values privilege particular ways of thinking, establishing the "ensemble of rules according to which the true and the false are separated and specific effects of power attached to the true."[60]

Secondly, Kowalski suggests that the form of logic "also influences the way the algorithm behaves."[61] Again the paper focuses on the practical possibilities, tweaking behaviour for optimisation and efficiency. But the algorithmic, as discussed in control, is not something hermetically walled off the world, but actively impinges upon its subjectivities and relations. It touches, for example, not just integers but individuals. The implication is that logic does not simply change the way the algorithmic behaves, but the way we behave. The logical configuration of the algorithm distributes its forces in particular ways, intensifying some pressures and relaxing others. In this sense, logic acts as the control of control—providing, in Foucauldian terms, the programme for power, one which "assures the elaboration of the act itself; it controls its development and its stages from the inside."[62]

Logic, then, is about epistemologies—formations of knowledge containing certain understandings of objects, properties, and relations, and thus infused with particular values. But logic is also about strategies—defining an approach and a set of procedures to be deployed in order to best arrive at specific imperatives. 'Strategy' here simply implies that logic's data is not random and logic's procedures are not trial-and-error attempts—a blind flailing at the problem. Instead logic, like the 'good strategy' defined by Richard Rumelt, starts "with a diagnosis that defined or explained the nature of the challenge... identifying the most critical aspects of the current situation."[63] After this diagnosis, logic as the 'control of control', must coordinate deployment. Logic then, like good strategy, defines "a guiding policy for dealing with the challenge and a set of coherent actions" to carry it out.[64] Far from being arbitrary, logic is carefully considered: it comprises the strategically relevant knowledge, a strategic formulation of the problem, and a strategic programme of action designed to resolve it.

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60 Michel Foucault, "Truth and Power," in *Power/Knowledge: Selected Interviews and Other Writings*, 1972-1977, ed. Colin Gordon (New York: Pantheon, 1980), 132.

61 Kowalski, 429

62 Foucault, *Discipline and Punish*, 152.

63 This is war and strategy theorist Lawrence Freedman's gloss of Rumelt's book. See Richard Rumelt, *Good Strategy Bad Strategy: The Difference and Why It Matters* (New York: Currency, 2011). Quoted in Lawrence Freedman, *Strategy: A History* (Oxford: Oxford University Press, 2013), 789.

64 The second half of the quote. Freedman, *Strategy*, 789.

Airbnb, again, provides a concrete example. Via data from the Inside Airbnb website, we can examine the information associated with an example Airbnb listing.[65] It's important to note that this data is attained from web-scraping—an automated script that regularly collects the publicly accessible information available on Airbnb's website. As such, this list might only represent a portion of the internal data that Airbnb possesses on each listing. Nevertheless, such a variable list begins to sketch out the knowledge-structure that Airbnb is predicated on (see table below). One can, for example, see how location is covered off by including a variety of supplementary and overlapping spatial schemas: the governmental logic of street name and zip code (Roosevelt Avenue, Austin, TX 78756), the Ptolemaic logic of a geographical coordinate system (latitude 30.3266088, longitude -97.73167385), and even a market-based logic which slots the city into a particular niche (market: Austin).

Yet also emerging here is the strategic dimension of logic. Certain information is privileged—registered, indexed, and made comparable with others—whilst other information is ignored. And this foregrounding of certain fields works to normalise particular behaviours. Host_response_time, for example, calculates how long, on average, a Host takes to respond to a booking enquiry or other communication from a Guest. Similarly, Host_response_rate stores the percentage of all received messages that the Host has responded to. In the same way, Host ratings are registered via an array of variables, such as the total number of reviews, the average rating, and also sub-ratings on particular aspects: Cleanliness, Accuracy, Location, and so on.

id	4235416
name	Cool studio in groovy central Austin
space	Cool and charming studio apartment in a duplex ...
description	Cool, charming studio apartment in Central Austin ...
neighborhood_overview	The Brentwood/North Loop neighborhood still has the feel ...
notes	I keep the place stocked with all manner of current guides ...
transit	Two blocks to the #5 Cap Metro bus which takes you ...
access	The apartment has its own private driveway with ...
interaction	I'm happy to greet you on arrival and answer any...
house_rules	No pets. No smoking inside. Two person maximum ...
host_name	[censored]
host_since	2013-01-20
host_location	Austin, Texas, United States
host_about	I am professional cultural journalist and writer who is a ...
host_response_time	within an hour
host_response_rate	100%

65 Murray Cox, "Inside Airbnb," Inside Airbnb, accessed September 25, 2017, http://insideairbnb.com.

host_verifications	['email', 'phone', 'reviews', 'jumio', 'kba']
host_identity_verified	t
street	Roosevelt Avenue, Austin, TX 78756, United States
market	Austin
latitude	30.3266088
longitude	-97.73167385
property_type	Apartment
room_type	Entire home/apt
accommodates	2
bathrooms	1
bedrooms	0
beds	1
bed_type	Pull-out Sofa
amenities	{Internet,"Wireless Internet","Air conditioning",Kitchen, ...
price	$85.00
calendar_updated	yesterday
availability_30	4
number_of_reviews	62
review_scores_rating	96
review_scores_value	10

Subselection of variables from single Airbnb listing in Austin, Source: http://insideairbnb.com/get-the-data.html

These are relatively simple pieces of information, but they gesture to the ways in which the knowledge embedded in algorithmic logic can become a hinge for exerting force over spaces and subjects. Embedded in a table like the one above, they initially appear rigid and linear, an antiquated statistical logic harking back to the 18th century. And yet by being stored inside new architectures, they can be circulated and cross-indexed, spun up into fluid new formations to again become, as Foucault noted, "both a technique of power and a procedure of knowledge."[66] As stated explicitly in the Airbnb Terms of Service:

> Ratings and Reviews are part of a Member's public profile and may also be surfaced elsewhere on the Airbnb Platform (such as the Listing page) together with other relevant information such as number of bookings, number of cancellations, average response time and other information.[67]

66 Foucault, *Discipline and Punish*, 148.

67 Airbnb Legal, "Terms of Service," accessed August 17, 2018, https://www.airbnb.co.nz/terms.

Most will be familiar with such 'surfacing' and its feedback effects: high Ratings and Reviews have the ability to propel listings upwards in search rankings, while even a slight slip in these metrics can cut into the popularity and profitability of a space.[68] These mechanisms can exert significant power, compelling Hosts into a particular performance of hospitality, for example, or overhauling the architecture and amenities within a space. Fields like response times and Ratings thus demonstrate the potent links that can be made between logic and control—between the indexing of activity as knowledge, and the operationalising of that knowledge in order to steer practices towards a particular objective.

So Reviews, as just one small example, are both a data field and a force exerted on Hosts, suggesting that the duality between logic and control is by no means clear cut. As Kowalski admitted, the "distinction between logic and control is not wholly unambiguous," and alternative categorisations might shift logical aspects into control, or vice versa.[69] Such blurriness was seen as problematic from a programming perspective, undermining the objective of cleanly separated components which might be independently optimised. But for Foucault, the adaptation and intensification of control and logic—or transposed, power and knowledge—always depended on their mutual interplay. As he stated, the "control and transformation of behaviour were accompanied - both as a condition and as a consequence - by the development of a knowledge of the individuals."[70]

On the one hand, power is infused through and through with knowledge. The purposive influence over subjects, spaces, and temporalities is directly underpinned by epistemological operations that index, frame, and filter. As Foucault argued, "the delicate mechanisms of power cannot function unless knowledge, or rather knowledge apparatuses, are formed, organised, and put into circulation."[71] The knowledge-structures of logic create a hinge for force, underpinning techniques able to coerce subjects, to cajole them into best-practice behaviours, to steer them towards end-points—or more subtly, to incentivise them, to draw upon their motivations, to elicit their participation.

On the other hand, knowledge is animated through mechanisms of power. Knowledge is not fixed and fossilised, nor is logic hermetic and hard coded. Rather, to be effective, knowledge must actively engage with the world, interfacing with objects, updating itself and retaining its relevance. In other

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68 For more on these mechanisms of ranking and reviews, see Airbnb Blog, "How Search Works on Airbnb," The Airbnb Blog - Belong Anywhere (blog), April 14, 2014, https://blog.atairbnb.com/how-search-works-on-airbnb/. Airbnb Help Centre, "What Factors Determine How My Listing Appears in Search Results? | Airbnb Help Centre," accessed April 29, 2018, https://www.airbnb.co.nz/help/article/39/what-factors-determine-how-my-listing-appears-in-search-results.

69 Robert Kowalski, "Algorithm = Logic + Control," *Communications of the ACM* 22, no. 7 (1979): 425.

70 Foucault, *Discipline and Punish*, 125.

71 Michel Foucault, "Society Must Be Defended": *Lectures at the Collège de France, 1975-1976*, trans. François Ewald (New York: Picador, 2003), 33.

words, logic, contrary to Kowalski's glossing of it, is never given but rather performed through "the actual instruments that form and accumulate knowledge, the observational methods, the recording techniques, the investigative research procedures, the verification mechanisms."[72] For the algorithmic, this dynamic adaptation of logic relies on an ongoing ability to apprehend subjects, ingest information, and parse environments—operations of control performed in space and time on materials. It is through "mechanisms of inscription, recording, and calculation," Lucas Introna asserts, that "algorithmic actors emerge as producers of particular domains of knowledge."[73]

Working together, these dual components amplify and extend one another, establishing a circuit of reinforcement. As Joseph Rouse argues, "a more extensive and finer-grained knowledge enables a more continuous and pervasive control of what people do, which in turn offers further possibilities for more intrusive inquiry and disclosure."[74] In algorithmic operations, this feedback appears most obviously in the way information capture and cross-indexing pave the way for more invasive prediction and steering. One theorist put this interrelation succinctly: "in knowing we control and in controlling we know."[75]

Thus logic and control, knowledge and power interpenetrate, forming "the machinery by which the power relations give rise to a possible corpus of knowledge, and knowledge extends and reinforces the effects of this power."[76] Despite their constant interpenetration, however, the maintenance—rather than conflation and collapse—of logic and control as two distinct components of the algorithmic seems productive, providing a dialectic concerned with how the production of epistemologies amplifies (or undermines) the intensity of force able to be exerted, and conversely, how control mechanisms feed back into the adaptation of logics which are more articulated, more invasive, and more effective.

Logic and control thus help us understand the *specificity* of algorithmic power—the way in which particular modalities of force are initiated and consistently executed. As later chapters will show, the logic and control that Uber asserts over a driver differs from that used by Alexa on a domestic user. The design of logic and control engenders each instance of algorithmic power with a distinctive shape. At the same time, logic and control provide a *generic* access point into understanding algorithmic power across disparate instances—one that can equally be employed to Palantir, or

72 Foucault, "Society Must Be Defended", 33.

73 Lucas D Introna, "The Algorithmic Choreography of the Impressionable Subject," in *Algorithmic Cultures* (Routledge, 2016), 27.

74 Joseph Rouse, "Power/Knowledge," in *The Cambridge Companion to Foucault*, ed. Gary Gutting (Cambridge: Cambridge University Press, 2005), 96.

75 Gary Gutting, "Michel Foucault," in The Stanford Encyclopedia of Philosophy, ed. Edward N. Zalta, Winter 2014 (Stanford University, 2014), https://plato.stanford.edu/archives/win2014/entries/foucault/.

76 Foucault, *Discipline and Punish*, 29.

Airbnb, or the many examples that undoubtedly lie outside the scope of this research project. Indeed the historical 'precursor' text at the end of this thesis was inspired by this commonality or continuity of logic and control—the fact that logic and control are not exclusive to contemporary technical systems, but part of a much longer lineage.

Of course, this is not the first exploration into these objects. From *Algorithmic Life*[77] to *Algorithmic Cultures*[78] and *What Algorithms Want*,[79] a nascent field of algorithmic studies has emerged over the last few years, building on top of previous fields such as software studies, code studies, and science and technology studies. Undoubtedly then, there is a wealth of erudite and insightful scholarship to draw from. But there are also issues. For one, some of it is based on a textual model of the algorithm already discussed, the source-code as *ur*-text that is written by a programmer and read back by the user. Another issue is that, while 'algorithmic studies' proper is new, some of its more substantive predecessor texts are now dated. Adrian Mackenzie's *Cutting Code*, for example, is now a decade old and focuses on a model of computation centred on the desktop: standalone applications, kernels, and command lines.[80] This age means that the mobility and ubiquity of contemporary computation, exemplified in the smartphone, is unaccounted for. Similarly Matthew Fuller's *Media Ecologies*, while particularly instructive as methodology, was released back in 2005. The landscape of media has significantly shifted since its case studies on pirate radio and web pages were written.[81] A third problem is the universalisation of technologies. Kitchen and Dodge's *Code/Space*, for example, explores systems like airport security as idealised models that fail to fully account for the particularities of place and their uneven performativities. In a similar vein we have scholarship which tends towards a generic understanding of the 'algorithmic.' The work of Louise Amoore, for example, on the role of algorithmic regimes in risk, security, and war is excellent.[82] Likewise the investigations of Tiziana Terranova into algorithmic capitalism are both incisive and insightful.[83] And there is no doubt that their more inductive approach to formulating general theories of power, control, and finance is needed. But empiric analyses of specific algorithmic instances are also necessary—not least because they deflate some of the totalising rhetoric which abounds in these spheres. The algorithmic, as suggested, is an ecology of heterogeneous agencies and conflicting

77 Louise Amoore and Volha Piotukh, *Algorithmic Life: Calculative Devices in the Age of Big Data* (New York: Routledge, 2016).

78 Robert Seyfert and Jonathan Roberge, *Algorithmic Cultures: Essays on Meaning, Performance and New Technologies* (New York: Routledge, 2017).

79 Ed Finn, *What Algorithms Want: Imagination in the Age of Computing* (Cambridge, MA: MIT Press, 2017).

80 Adrian Mackenzie, *Cutting Code: Software and Sociality* (New York: Peter Lang, 2006).

81 Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (Cambridge, MA: MIT Press, 2005).

82 Louise Amoore, *The Politics of Possibility: Risk and Security Beyond Probability* (Durham: Duke University Press, 2013).

83 Tiziana Terranova, "Red Stack Attack," in *#Accelerate: The Accelerationist Reader*, ed. Robin Mackay and Armin Avanessian (Falmouth, UK: Urbanomic Media Ltd, 2008), 379–400.

logics held in tension and performed in time. These forces are significant and important, but specific stories 'on the ground' reveal that they can also be myopic and fallible. A final problem is the restriction of scholarship to a single object in a single journal article. Alex Rosenblat's excellent ethnographic work, for example, is mostly confined to Uber and Lyft and distributed piecemeal across dozens of publications.[84] So, as with any research field, there are gaps and oversights within algorithmic studies. This thesis offers a modest contribution to addressing some of these—a single text that examines four specific and contemporary algorithmic regimes using a more performative methodology, but which also seeks inductive insights into the conditions and operations common across them.

Machines

The final aspect to this approach of algorithmic study is the notion of the machine. In attempting to understand my case-studies, to analyse their myriad processes and parts, I quickly came up against the issue of scale. As Terranova reminds us, these are highly complex systems composed of architectures and organisations, labor and logistics, not to mention "hardware, data, data structures (such as lists, databases, memory, etc.), and the behaviours and actions of bodies."[85] Unraveling the entire system appeared to be either daunting, resulting in tomes of endless description, or superficial, tending towards broad generalisations without empirical specifics. Confronted with a limited project timeframe and the overwhelming complexity of a system like Uber, a researcher must not just ask what is feasible, but what would be valuable. What is worth focusing on?

Existing approaches tend towards two poles, problematic not least because they are typically assumed as given. Too small and the researcher, like the computer scientist, zooms in on a particular technical procedure—facial recognition, for example. This hyperfocus allows for the fine-tuning of a specific routine, typically foregrounding issues of efficiency and accuracy. But this blinkered approach also works to frame the algorithmic as abstracted and apolitical, divorced from the messy

84 I draw from Rosenblat's work and her collaborations with Tim Hwang in the sections on Uber. See
Alex Rosenblat, "Uber's Phantom Cabs," Motherboard, July 27, 2015,
https://motherboard.vice.com/en_us/article/ubers-phantom-cabs.
Alex Rosenblat and Tim Hwang, "Regional Diversity in Autonomy and Work: A Case Study from Uber and Lyft Drivers," 2016, https://datasociety.net/pubs/ia/Rosenblat-Hwang_Regional_Diversity-10-13.pdf.

85 Tiziana Terranova, "Red Stack Attack," in #Accelerate: The Accelerationist Reader, ed. Robin Mackay and Armin Avanessian (Falmouth, UK: Urbanomic Media Ltd, 2008), 384.

realities of gender and culture, class, and capital.[86] The result is all too clean—a technical but apolitical detail.

But swinging the other way also encounters problems. Too large, and the researcher, like the journalist or the social scientist, is presented with a convoluted singularity. The algorithmic is understood as something that undoubtedly shapes society and contours political agency. But due perhaps to disciplinary background, the researcher is unable to break this ecology down into components and unravel its technical underpinnings.[87] The result is that a powerful social force seems to be mysteriously or nefariously exerted by a bewildering system. The result is all too overwhelming—a sociopolitical but atechnical totality.

How does the researcher delimit the investigation in a productive but realisable way? As Adrian Lahoud makes clear, "the question of scale is paramount"—it must be neither overdetermined, carrying too much redundant information, nor undetermined and too coarse, but rather specified to "capture the relevant parts of the problem in question much like a sieve that must be calibrated."[88] What is needed is a lens or filter. This lens would cluster the research material around vital operational points within the ecology, allowing low-level technical performativities to mix productively with higher-level social, political, and cultural forces.

The lens used here is that of the machine, theorised by Levi Bryant. A machine for Bryant does not denote the usual metal bodies and complex circuitry. Rather a machine is simply "a system of operations that perform transformations on inputs thereby producing outputs."[89] This basic definition means that, rather than cogs and computers, all forms of life and non-life can be productively theorised as different types of machines. As Bryant explains, "a tree is no less a machine

86 One example of this broader utilitarian tendency within computer science is Kowalski's paper, already discussed. In software engineering, this tendency can be seen particularly on the Airbnb and Uber Engineering blogs. Dozens of blog posts delve into the technical difficulties of scaling up, migrating informational architectures, and deploying flexible solutions while always maintaining an (ostensibly apolitical) focus on optimization, accuracy, and efficiency. The point here is not to critique computer science, but to simply suggest that their framing of the algorithmic is not adequate for critical media studies.

87 Here again I'm distilling a tendency from a number of articles. The articles referenced below, for example, all acknowledge Airbnb's force in reshaping cities, but consistently refer to it as the 'Airbnb effect' or the 'Airbnb phenomenon'. Renate van der Zee, "The 'Airbnb Effect': Is It Real, and What Is It Doing to a City like Amsterdam?," *The Guardian*, October 6, 2016, sec. Cities, https://www.theguardian.com/cities/2016/oct/06/the-airbnb-effect-amsterdam-fairbnb-property-prices-communities.
Jacqui Alexander, "How Airbnb Is Reshaping Our Cities," The Conversation, September 16, 2016, http://theconversation.com/how-airbnb-is-reshaping-our-cities-63932.

88 Adrian Lahoud, "Floating Bodies," in *Forensis: The Architecture of Public Truth*, ed. Forensic Architecture, Goldsmiths, University of London (Berlin: Sternberg Press, 2014), 495–518.

89 Levi R. Bryant, *Onto-Cartography: An Ontology of Machines and Media* (Edinburgh: Edinburgh University Press, 2014). 38.

than an airplane, and a constitution is no less a machine than a VCR."[90] Machines can be corporeal or incorporeal, with most being an amalgamation of both types. Rather than searching for some eternally fixed essence, the aim here is on investigating processes and routines that are always shifting. For Bryant, when "confronted with a machine, our first thought is not of its properties or qualities, so much as its operations."[91] To speak of the machine is simply to foreground how objects *work* rather than what they *are*.

Machines can be joined to other machines, a process that Bryant calls structural coupling.[92] Coupling machines together changes not just their appearances, but their abilities—forming new things with new capacities. For example, Bryant explains that adding the stirrup to the horse and rider to form a Stirrup-Horse-Rider machine was not just a simple addition, but rather fundamentally changed the form of warfare, providing a firm platform which riders could exert pressure against and thereby dramatically increasing the force behind their lances.[93] The coupling of machines together is not merely superficial or syntactical, but consequential, producing new powers. Indeed, Bryant's assertion is that, in themselves, machines are pluripotent. The particular way in which one machine is instrumentalised by another does not exhaust all it can do. Machines always content latent capacities or abilities that are not being drawn upon. This is why, for Bryant, single machines do not have a purpose, but only "take on a purpose or use when structurally coupled to other machines."[94] The 'use' of a predator/prey machine could be understood as producing a better species: sharper teeth, tougher coats, faster movement.

Of course, the notion of the machine has a legacy, one in which many of these concepts reappear. Bryant draws upon Deleuze and Guattari's notion of desiring-machines. For the duo, the machinic is also significantly expanded to encompass all things. "Everything is a machine. Celestial machines, the stars or rainbows in the sky, alpine machines."[95] The notion of conjoined or connected machines appears here too. "The breast is a machine that produces milk, and the mouth a machine coupled to it."[96] Deleuze and Guattari, in turn, are indebted to Lewis Mumford's concept of the megamachine. For Mumford, colossal monuments such as the pyramids of Egypt represent a triumph, but also an immense logistical and labour challenge for ancient societies without industrial processes or modern machinery. The problem was formidable: "mobilizing a large body

90 Bryant, *Onto-Cartography*, 16.

91 Bryant, *Onto-Cartography*, 38.

92 Bryant, *Onto-Cartography*, 24.

93 Levi Bryant, "Two Types of Assemblages," Larval Subjects, February 20, 2011, https://larvalsubjects.wordpress.com/2011/02/20/two-types-of-assemblages/.

94 Bryant, *Onto-Cartography: An Ontology of Machines and Media*. 24.

95 Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*, trans. Robert Hurley, Mark Seem, and Helen Lane (Minneapolis: University of Minnesota Press, 1983). 2.

96 Deleuze and Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*. 1.

of men and rigorously coordinating their activities in both time and space for a predetermined, clearly envisaged and calculated purpose."[97] What was needed was a coordinated operation, directed from above, in which man power could be distributed and delegated into particular roles. The solution for Mumford was the megamachine, an "invisible structure composed of living, but rigid, human parts, each assigned to his special office, role, and task, to make possible the immense work output and grand designs of this great collective organisation."[98] Like Bryant, Mumford treats social and technical machines equally. Indeed, for Mumford, the social precedes the technical, the "social megamachine comes before the modern 'non-human' machine, for the mechanical agents had first to be 'socialized' before the machine itself could be fully mechanized."[99] The organisation and coordination of people towards a large-scale project paves the way for processes that seek to automate particular aspects of it.

Finally, one might revisit Gottfried Leibniz and his notion of natural machines. For the 17th century philosopher, man-made machines are characterised by parts that become meaningless and useless when separated from their core apparatus. For example, "the tooth of a brass wheel has parts or fragments which, for us, are no longer artificial things, and no longer have any marks to indicate the machine for whose use the wheel was intended."[100] These mechanical constructions are crude imitations of natural machines, infinitely complex living bodies designed by an intelligent creator. The natural machine displays a type of recursion, carrying out operations not only in its totality but in its smallest components. As Leibniz asserts, natural machines "are still machines in their least parts, to infinity."[101] Like Bryant's machine, Leibniz's natural machines insist on the operability and necessary agency of sub-elements within the system.

Applying this philosophical idea to technological objects, we get sub-selections of the material totality which feel strategic and significant—intersections where software and hardware, labor and nature come together to produce key algorithmic operations. Take, for example, the Microphone-Alexa-LivingRoom machine which appears in the chapter on Alexa. This starts with a simple premise—what happens when a microphone is placed in the centre of a home and connected to the technical affordances of the cloud? Somehow that space is changed, and in doing so new social interactions are captured and new subjects are formed. Do domestic behaviours or speech patterns change now that every word is being listened to? By themselves each of these elements possess particular capabilities, and when coupled together they carry out new operations, operations autonomous yet also integral to the ecology as a whole.

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97 Lewis Mumford, *The Myth of the Machine [Vol. 1], Technics and Human Development* (New York, NY: Harcourt, Brace & World, 1967). 191.

98 Mumford, *The Myth of the Machine*. 189.

99 Mumford, *The Myth of the Machine*. 194.

100 Gottfried Leibniz, *Leibniz: Philosophical Essays* (Indianapolis, IN: Hackett Publishing, 2015). 432.

101 Leibniz, *Philosophical Essays*. 432.

Bryant's machinic theory is much more articulated. But the concepts outlined above are the ones taken from this broader programme and applied quite practically, the understanding that: 1) objects can be framed as machines that operate, that 2) these machines can be coupled together in strategic ways, and that 3) these coupled machines have new abilities. The machine provides a productive flattening, allowing for operations which encompass the social and political alongside the technical. The machine alleviates the overly large-overly small scale problem while acknowledging complexity (machines are always composed of smaller machines). And machines as couplings take the novel affordances of relational intersections seriously.

The machine thus contributed in a pragmatic way to the method of enquiry. In focusing analysis, the machine provided a lens or filter, usefully delimiting the scope of investigation. But more than just a tool to establish the boundaries of research, the machine also provided a gateway into the algorithmic as a research object in the first place. After struggling with analytical scales that seemed either daunting or inconsequential, early writing tests using this approach proved highly productive. The machine allowed analysis to not just slide between the technical and the social, but to consider them together in their mutual shaping, their reciprocal interplay. Their hyphenated connections (e.g. Microphone-Alexa-LivingRoom) constantly stressed the relations formed between things. New conditions emerge from these dynamic relations. Thus, rather than 'just' code or 'just' informational infrastructure, machines messily imbricated such systems with subjects and spaces, constantly drawing in their everyday relations with bodies and cities. In this sense, the machinic was a method that acknowledged from the beginning that the technical shaped—and was shaped by—the experiential and political. Moreover, as a scalar intervention, the machine provided empirical detail and specificity while also indicating some of the higher-level, more universal conditions established by the whole. Like logic and control, the machine provided a way to access and understand algorithmic operations, a method of inquiry that could be applied across the disparate instantiations. The structure of the thesis is a direct result of this machine-centred strategy.

To summarise, the algorithmic can be understood as a coupling of logic and control, in which a knowledge-structure strategically coordinates the purposive influence of materials towards a predetermined goal. To analyse these complex operations, strategic intersections of sociotechnical agency are clustered together as machines. The next four chapters use this approach to analyse Palantir Gotham, Uber, Amazon Alexa and Airbnb. This work provides a kind of acid-test for this reframing of the algorithmic, investigating how it might generate new insights into the algorithmic as operations of sociotechnical structuring. These operations carry force. They actively shape our agency and activity and thereby become politically potent. However, as the next few chapters will show, the smooth efficacy of these procedures can never be guaranteed, but rather must be incessantly negotiated. By analysing operations, we see not only how things work, but where they

start to break down—differentiating points of intensity from more sparsely regulated zones, moments of control from those of unexpected contingency. In doing so, it is hoped to set out a model of algorithmic power highlighting those areas where analysis and intervention might be most effective.

1.
Legitimate Power: Palantir

Delineating Life

On January 30, 2016 Arthur Ureche, a forty year old union dues administrator, was driving his white Chevy compact through Los Angeles when he noticed 4 police cruisers following him. Ureche's last traffic violation was when he was nineteen, for driving too slow. But as he pulled over to let them pass, they stopped at a safe distance, exited their vehicles and trained their firearms on him. An officer barked out instructions using a megaphone, ordering Ureche to unlock his doors. The lock jammed. Ureche silently panicked, trying to comply without using any sudden movements. A helicopter whirred overhead. The officers waited. Ureche's car had been identified as belonging to a wanted drug felon in California. But the car had Colorado plates. An automatic license plate reader had misidentified the vehicle. As journalist Chris Francescani later noted, "same numbers; different states."[1]

This number was provided by Gotham, a data analysis platform used by the Los Angeles Police Department. That the police were then mobilised in order to 'capture' Ureche gestures to Gotham's *legitimacy*. As the chapter will argue, Gotham's technical capabilities drive its political credibility, generating a legitimate power. Gotham's logic capably encapsulates a massive silo of big data that believably matches the world 'out there' and then integrates it into an internal knowledge-structure that appears to coincide with reality. At the same time, its tools provide a powerful suite of capabilities that seem to allow patterns, insights, and connections to emerge organically. Based on this legitimate logic, the control enacted on bodies in spaces is also deemed to be appropriate—these decisions make sense because Gotham has credibly 'made sense' of the world through information.

The chapter thus tracks how legitimate power emerges from technical conditions. Following the method discussed in the introduction, Gotham is broken down into machines. Each machine is analysed in turn, providing insights in itself while contributing to a broader understanding of this algorithmic system as a whole. The chapter thus begins with the Stack-Tools-Analyst machine, showing how Gotham's big data abilities and toolsets provide analysts with a believable window on the world. Next, the Life-DynamicOntology machine demonstrates how this credible world view is nevertheless a carefully constructed one, defined by a particular structuring of information. The Analyst-Thunderbird-LosAngeles machine explores Gotham's use by the LAPD to examine how this credible logic becomes exerted as control over those in LA, influencing their action (or inaction).

Of course, if any institution is associated with legitimate power, it is the state. The second half of the chapter thus discusses how Gotham reconfigures conventional legitimacies in the sphere of

1 Chris Francescani, "License to Spy," *Backchannel*, December 1, 2014, https://backchannel.com/the-drive-to-spy-80c4f85b4335#.wc45mo7uo.

immigration. The final section of Deportation machine argues that in handing immigration decisions to automated procedures, the state gains flexibility but allows the algorithmic to encroach on a form of legitimacy that was once its exclusive domain—sovereignty.

But first, what exactly is Gotham? Gotham is a big data analytics platform developed by Palantir. In the backend, it integrates a client's disparate datasets into a coherent single knowledge base. In the front-end, it offers a suite of integrated tools to interpret and draw insights from this data. As Palantir recognised, while institutions may have gathered massive repositories of information, their ability to integrate that data, to handle its hefty processing requirements, and to make sense of it can be lacking. Gotham offers computational tools to assist a human analyst in discovering the key signals amongst all the big data noise: whether a link between terror cells, a transaction from a rogue trader, or the location of a stolen vehicle. Founded in 2003 by Peter Thiel, Palantir was based on an insight learned at Thiel's former company Paypal: human and computational agents working together proved better at combating the "adaptive adversary" of financial fraudsters than hard-coded algorithms alone.[2] Gotham thus provides both automated operations and manual tool sets: filters which can be setup to flag anomalies, graphs which visualise the relationships between entities, and the geospatial mapping of resources and agents. Through its front-end tools and backend power, Gotham provides clients with the ability to store, query, and visualise extremely large data sets, allowing analysts to discover patterns and relationships.

Gotham began life as a tool specifically developed for the needs of government institutions. Funded in part by In-Q-Tel, the CIA's venture capital branch, some of its first clients included the Department of Defense, the Marine Corps, the NSA, and others.[3] But Palantir was never a Washington insider—in fact at one point the company was even forced to sue the US Army in order to open up the contract bidding process.[4] Instead, the startup is a decidedly Silicon Valley affair. Company culture is one component of this—development teams comprised of engineers partially paid in company stock who enjoy free lunches and other perks. Location is the other—the company has quietly gobbled up much of the commercial space in Palo Alto with its long leases.[5] Indeed, with its $20 billion dollar valuation, Palantir is the fourth most highly valued tech startup, placing it directly alongside more public companies like Uber and Airbnb.[6]

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2 Palantir, "About," *Palantir*, June 6, 2016, https://palantir.com/about/index.html.

3 Cromwell Schubarth, "Palantir, Backed by CIA, Raised $50 Million in a Funding Round That Now Totals $444 Million," Silicon Valley Business Journal, September 15, 2014, https://www.bizjournals.com/sanjose/news/2014/09/15/cia-backed-palantir-adds-50m-to-its-war-chest.html.

4 Court of Federal Claims, *Palantir Technologies Inc. v. US*, No. 16-784C (Court of Federal Claims, 2016).

5 Marisa Kendall, "Palantir Technologies Scoops up Palo Alto Office Space," *Santa Cruz Sentinel*, April 30, 2016, http://www.santacruzsentinel.com/article/NE/20160430/NEWS/160439988.

6 Sarah Buhr, "Palantir Has Raised $880 Million At A $20 Billion Valuation," *TechCrunch*, December 23, 2015, http://social.techcrunch.com/2015/12/23/palantir-has-raised-880-million-at-a-20-billion-valuation/.

Thus, both Palantir as a company and Gotham as a product were never beholden to a single sovereign. Their promise of big data to provide answers was also alluring for other actors holding massive silos of information, leading to adoption by dozens of law enforcement agencies and major corporations: BP, Coca-Cola, Walmart, Credit Suisse, NASDAQ, GlaxoSmithKline, and Airbus.[7] In-house solutions of clients, often cobbled together over years with clunky interfaces, are typically swept aside by Gotham—an integrated infrastructure developed by an outsider with technical expertise. Regardless of sector or product, governmentality is made available to all, a set of techniques "exercising towards its inhabitants, and the wealth and behaviour of each and all, a form of surveillance and control as attentive as that of the head of a family over his household and his goods."[8] It is, in short, one platform to rule them all. So despite its government origins, Palantir is not a tale of shadowy intrigue and backroom deals. These operations are not constrained to the spheres of spycraft or the battlefield, but instead spill out into mechanisms which impinge on the practices of ordinary citizens and everyday sectors: health and transport, food and finance.

Stack-Tools-Analyst machine

Gotham claims to make sense of life, to "visualise relationships, explore divergent hypotheses, discover unknown connections, bring hidden patterns to the surface."[9] This first machine, Stack—Tools—Analyst, comprises the 'stack' of back-end technologies, a suite of front-end tools, and the human analyst. Here, mechanisms of control taking place in data centres and on screens construct a logical internal world that looks and feels like the world, supporting an imaginary of encapsulating and analysing reality. In order to accomplish this, it must carry out two divergent operations which appear almost contradictory.

On the one hand, Gotham must 'have' life. In other words, the data available and addressable within the platform must approach the richness, variety, and speed of the reality 'out there.' Messiness, ambiguity, and overwhelming amounts of information are not only tolerated, but welcomed as indicators of authenticity. To this end, the layers of backend technologies comprising the Palantir 'stack' enable the capture and storage of massive volumes of data which can be queried at high velocity. This is a highly technical performance—a negotiation with scalability and servers,

7 Other clients include American Express, Bank of England, Comcast, JPMorganChase, Kimberley-Clark and News Corp. Some of these clients have since left, while some of them, such as Airbus, are new acquisitions with major projects and funding behind them. William Alden, "Inside Palantir, Silicon Valley's Most Secretive Company," *BuzzFeed*, May 7, 2016, https://www.buzzfeed.com/williamalden/inside-palantir-silicon-valleys-most-secretive-company.

8 Michel Foucault, "Governmentality," in *The Foucault Effect: Studies in Governmentality* (Chicago: University of Chicago Press, 1991), 92.

9 Palantir, "Palantir Gotham," Palantir, accessed May 21, 2018, https://palantir.com/palantir-gotham/index.html.

nodes and tables, computation and latency. Simultaneously, however, it is also an ideological performance, supporting the volume, variety, and velocity of data required to convince a user or organisation that that this data represents reality.[10] What are the requirements to make this vision rational and believable, and how are these supported by Gotham's backend technologies?

First, data must approach petabyte scale. At these magnitudes, big data begins to hold out the promise of a total picture, a set of information which can be incessantly parsed, filtered, sorted, and searched through in order to find the next breakthrough or anticipate the latent risk. As STS scholar Max Liboiron asserts, "the promise of Big Data is premised on this belief; through larger and ever more detailed data sets of mundane, everyday interactions, otherwise invisible patterns can become apparent and predictable."[11] That this promise is asymptotic—an incessant programme of information capture which never arrives at the horizon of the totality—does nothing to diminish its power. How is data made big? One way is through the integration of additional datasets. But disparate databases are often irreconcilable, based on multiple standards, specifications, and formats. Another is through the integration of unconventional data. But such information can be incomplete or imperfectly structured. As Palantir engineer Andrew Ask outlines in a presentation, Apache Cassandra, a core component of the Gotham backend, addresses some of these issues.[12] While the traditional relational database model is comprised of rows and columns, much like Excel, Cassandra is a so-called NoSQL approach, a non-relational database with a much more minimal key-value model (e.g. occupation: doctor, age: 35). Rather than matching rows and columns perfectly between databases, this nominal 'schema-less' structure provides more flexibility when merging datasets. This structure also helps with incomplete data. Rather than wasting labor hours and storage by 'cleaning up' data (e.g. filling in empty cells with zeroes), the NoSQL model means that data can be messier. In fact, in her writings on data, Claudia Aradau points out that big data = messy data has become a new motto of sorts, characterised as "data which comes from multiple sources and in heterogeneous formats."[13]

Secondly, data must approach the present moment. In an elaborate presentation titled "Leveraging Palantir Gotham as a Command and Control Platform," a group of Palantir engineers demonstrate

10 The '3Vs' of big data are well known: volume, variety, and velocity. But here I want to show how these technical characteristics also impart a subjective shift that legitimates the resulting decisions and actions.

11 Max Liboiron, "Disaster Data, Data Activism: Grassroots Responses to Representing Superstorm Sandy," in *Extreme Weather and Global Media*, ed. Julia Leyda and Diane Negra (New York: Routledge, 2015), 145–62.

12 Andrew Ash, "Palantir at Scale: Harnessing, Processing, and Analyzing Petabyte Scale Data" (Govcon 8, Tysons Corner, October 23, 2012), https://www.youtube.com/watch?v=Z5wb5If0f54&t=1069s.

13 Aradau, Claudia. "The Signature of Security: Big Data, Anticipation, Surveillance." *Radical Philosophy*, no. 191 (2015): 21–28.

the capabilities of 'Railgun' to an audience of government agencies.[14] Railgun, they explain, is a layer built on top of the Gotham platform which provides it with "the present tense."[15] They visualise and manage the logistics of a (notional) humanitarian aid project undertaken by a Marine Corp division as it unfolds. Using real-time tracking data, they follow the progress of naval units off the coast of Somalia, offloading their supplies, transitioning to vehicles, getting stuck at a flood crossing, and ultimately arriving at a Red Cross encampment.[16] Here the traditional pace of information refresh is foregrounded. Data updated or 'ingested' quarterly, weekly or even nightly comes far too late to assist such in-the-moment decision-making. Rather than stable but irrelevant data, the engineers champion "volatile and ephemeral data."[17] The focus is on data as close to the current moment as possible. So while an archive of this real-time data might be useful to have, it would be populated by "setting a rolling time horizon, beyond which data can be flushed out."[18] A dynamism arises from approaching the 'now', and this constantly fluctuating data initiates a *subjective* shift which pushes away from the connotations of the dusty archive. The experience of the analyst morphs from information to animation, from dead symbols to lively avatars. It's this quality which allows the Palantir engineers to claim that "more and more, we are sampling reality."[19]

Thirdly, data must approach real-time responsiveness. It is not enough simply to have data which can be captured in the present and stored at scale. Data must *feel* responsive, a quality achieved by ensuring minimal latencies between query and response, even when operating on large datasets. Palantir addresses this by using MapReduce, a core component of the Apache Hadoop system. Rather than a single, powerful supercomputer, Hadoop was explicitly designed to distribute processing across hundreds or thousands of consumer grade computers, commodity hardware *en masse.* The basic grouping that Hadoop establishes is the cluster, defined by several key nodes. MapReduce thus serves two essential functions: "it parcels out work to various nodes within the cluster or map, and it organises and reduces the results from each node into a cohesive answer to a query."[20] The Map method allows a basic job, such as word counting a million documents, to be split into batches of 100 and 'mapped' to various nodes. These batches are processed simultaneously, leveraging the efficiencies obtained from parallel computation. The figures from

14 Palantir. *Railgun: Leveraging Palantir Gotham as a Command and Control Platform*, 2013. https://www.youtube.com/watch?v=ZSB0wOMINhg.

15 Palantir, *Railgun*.

16 Palantir, *Railgun*.

17 Palantir, *Railgun*.

18 Palantir, *Railgun*.

19 Palantir, *Railgun*.

20 Stephen Bigelow and Mark Chu-Carroll, "What Is MapReduce? - Definition from WhatIs.com," *SearchCloudComputing*, accessed April 13, 2017, http://searchcloudcomputing.techtarget.com/definition/MapReduce.

these batch jobs are then summed by the Reduce method which returns the total word count.[21] While highly technical and somewhat arcane, it's this low-level architecture of hardware and software which transforms the experience of interacting with data. Rather than the 'definitive' SQL query which might take minutes to run on a large dataset, the low latencies afforded by MapReduce create a more conversational experience, in which feedback, iteration, and articulation become vital activities, a type of *feeling out* of the data. As one engineer states, clients "want to get a feel for it, they want to look through it, and if those responses come back in a matter of seconds, it's possible for them to do this." Taken together, these three backend technologies accomplish a subjective shift in which it appears that life itself can be exhaustively captured and incessantly interrogated.

So on one hand, Gotham must expand and encompass in order to legitimise its claim of sampling reality. But on the other, it must make sense of it all. By itself, this sheer deluge of data tells us nothing. Information must be worked on, either through automated processes built into the platform or through manual operations by the human analyst: finding threads, constructing sequences, and matching activities in such a way that a pattern emerges. By removing the irrelevant and extraneous, sorting and sifting, the user hopes to converge on the weak signal in the midst of overwhelming noise. In this operation too, a kind of tipping point is reached, an accumulation of tiny indicators which slowly edge towards a result. The next few pages dive into three specific tools, examining how they work to lift a pattern out of the morass of messy data. (Images of these tools and interfaces can be found in the Appendix section of the *Dark Matter* website).

The first tool is Search Around, a core feature evidenced by its extensive use in the firm's online demonstrations. As its name suggests, Search Around can be run on any item, searching for other items which share links and visualising them as nodes attached in a spiderweb-like fashion.[22] How are items linked together as similar? In Palantir's demonstrations using notional data, this took many forms: a flight on the same plane, a shared former residence, a telephone call made to the same third party, a small enough variation in IP addresses.[23]

Two brief points stand out here. First, informational proximity is not geographical proximity—persons separated by great distances are often designated as having close-knit connections. Searching 'around' an informational space operates differently than searching around physical space. Data, as Claudia Aradau reminds us, "can draw together even the most distant things."[24] Moreover, the power of the visual diagram to perform as evidence should not be overlooked in this regard. The

21 Apache, "MapReduce Tutorial," accessed April 13, 2017, https://hadoop.apache.org/docs/r1.2.1/mapred_tutorial.html.

22 Palantir, *Search Around*, 2013, https://www.youtube.com/watch?v=-iIaUvn4kc.

23 Palantir, *Prepare, Detect, Respond, And Harden: Palantir Cyber In Action*, 2013, https://www.youtube.com/watch?v=6mIQmL2Lapw.

interface instantly collapses thousands of kilometres into a handful of pixels separating two icons. Suddenly two people in two different countries become proximate on the analyst's monitor. Their once disparate life-worlds now sit alongside each other; their seemingly independent networks are clustered together; a thick black line connects their avatars on screen, demonstrating their 'obvious' affiliation.

Secondly, these linkages are metonymic not taxonomic—associations are built up by linking small tokens of information from one individual to another, rather than any kind of obvious Linnean clustering. Undoubtedly traditional groupings like race and religion inform analysis, but they no longer maintain their former currency. Instead, as Aradau points out, resemblances in big-data mining are primarily based on "analogy, correspondence and similitude."[25] Motive here is irrelevant. The inferral of some inner ideology that drives a person towards particular goals or strategies carries little weight within analysis. As *WIRED* editor Chris Anderson once quipped, "Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity. With enough data, the numbers speak for themselves."[26] Instead, the logic is grounded on empirical activity rather than professed principles—what you do rather than who you are or what you believe. As Andrew Goffey and Matthew Fuller argue, in employing data mining "the aim here is not so much to find causes as to make correlations, statistical correspondences."[27] These linkages are gradually formed through the accumulation of minor activities that are both documented and verifiable. The data don't lie.

This hard empiricism also works to undermine claims of analyst impartiality—the data 'merely' presents what you did rather than what a single person *believes* you did. Traced, time-stamped and screen-shotted by multiple analysts, the information passes through many layers, gradually becoming divorced from the single individual and any alleged stereotyping. Instead, as Mike Ananny has argued, these algorithmic categorizations "signal certainty, discourage alternative explorations, and create coherence among disparate objects."[28] The result is an ostensibly unbiased set of evidence, devoid of conjecture and guesswork. As one client stated in its rationale for adopting the tool, Palantir "helps reduce human error and analytic uncertainty by presenting

24 Claudia Aradau, "The Signature of Security: Big Data, Anticipation, Surveillance," *Radical Philosophy*, no. 191 (2015): 24.

25 Aradau, "The Signature of Security," 23.

26 Chris Anderson, "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete," *WIRED*, June 23, 2008, https://www.wired.com/2008/06/pb-theory/.

27 Matthew Fuller and Andrew Goffey, *Evil Media* (Cambridge, MA: MIT Press, 2012), 145.

28 Mike Ananny, "Toward an Ethics of Algorithms: Convening, Observation, Probability, and Timeliness," *Science, Technology, & Human Values* 41, no. 1 (January 2016): 103.

information already available to the user in a common sense fashion."[29] The imaginary operating here is one of objective pattern, not subjective prejudice.

The second tool is Flows, a plugin for Gotham which enables the visualisation of material flows.[30] Phone calls, emails, money, or any other material flows understood by the system are visualised as bright dots which move from one object to another over time. This tool produces an array of effects, each tied closely to its formal properties. Flows *crystallises*, solidifying connections between entities. Though a line already indicates an association, the bright dot moving from one point to another 'thickens' this linkage, visually demonstrating the exchange of matter between one person and another. Flows *formalises*, providing a high-level understanding of often very complex networks of objects. The dots of currency or calls often originate from a common 'hub' and are received by 'spokes,' or travel between clusters before jumping to other clusters. This visualisation thus provides an impression of structure in the chaotic jumble of network lines—an insight into the arrangement, groupings, and hierarchies of actors. Finally Flows *prioritises*, providing the analyst with the most important agents in a network. By scaling the size of the dot to the magnitude of matter (number of calls, amount of money, etc), significant transactions and interactions stand out easily in the visualisation and can be flagged for further investigation.

The third tool is the Timeline, taking the form of date and time indicators in a module along the bottom of the screen. Timeline allows the analyst to specify a time window of a few seconds, hours or days. This isolates the action, only visualising the events or activity which occurred during that period. This window can be dragged incrementally along the Timeline, providing the analyst with a play-by-play of events as they unfolded. The key intent here, like the other tools, is to uncover a discernible pattern, a particular signature of activity. The human analyst stands in for the algorithmic, operating according to the same logic of analogy, correspondence, and similitude. Do events seem coordinated, occurring at roughly the same times? Is there a particular sequence of behaviour which is constantly repeated? Do the seemingly random activities of a network become cyclical or consequential over time? Conversely, is there a rupture or break in these habitual routines which appears significant? To answer these questions, Timeline is often coupled with Flows to uncover a pattern of action. In one of Palantir's notional demonstrations, the analyst 'discovered' that three operatives were receiving phone calls, then two days later were transferring finances to a particular account, a sequence which was repeated weekly. One month later, these operatives all

29 Department of Homeland Security, "Privacy Impact Assessment Update for the FALCON Search & Analysis System" (October 11, 2016), https://www.dhs.gov/sites/default/files/publications/privacy-pia-ice-032-falcons-b-october2016.pdf.

30 Flows has been demonstrated both in person at conferences and through online demos, see Palantir, *GovCon7: Introduction to Palantir*, 2011, https://www.youtube.com/watch?v=f86VKjFSMJE.
Palantir, *Palantir in the Anti-Money Laundering Space*, 2014, https://www.youtube.com/watch?v=dVsx4I8gkKk.

boarded a plane on the same day, bound for the same city of Chicago.[31] While the insights brought to light during these demonstrations are inherently staged, they provide a compelling vision which is taken up by a range of public and private actors.

This vision of order from chaos, of insights from information, thus consists of two divergent operations. The information available, like the life it ultimately references, must be immense, up to the minute, and yet responsive. Operations need to allow for the ingestion of data that is unstructured, turbulent, and messy—in other words, patternless. In this difficult terrain, the analyst goes to work, painstakingly arranging objects and linking activities. 'Reality' is carefully dissected using a suite of tools that pry out the considered plans lurking within this ostensible disarray. In this powerful fantasy, a clear pattern emerges from the sea of data noise, an uncovering of the looming financial risk, the imminent threat, or even just the next consumer trend.

Life-DynamicOntology machine

While Gotham's mechanisms of control carried out through database engines and data stores work to encapsulate large datasets, their integration requires a common logic. Gotham's clients are often attempting to combine datasets from disparate sources, each with their own data collection practices and proprietary formats, rendering them conflicting and incompatible. Gotham's promise is not just to group information into a federated portal, but to make it fundamentally interoperable.

To do this requires a shared knowledge-structure, a universal schema. In this sense, Gotham is like any other algorithm—to do work in the world, the world must be internalised and structured. In computer science, the schema or framework that designates objects, properties, and relationships is known as the information ontology, a "formal, explicit specification of a shared conceptualisation."[32] As its name suggests, it defines what it means to *be* in the code world, naming the entities which can exist and specifying their properties, relationships, and capacities. In order for the 'outer' world to be understood, it must be mapped in a particular way.

Information systems have long had to grapple with the optimal way to abstract the properties of the 'real world.' Peter Chen's 1976 paper is typically seen as seminal in formalising a response to this problem in the form of informational ontologies. In it Chen, a computer scientist, establishes his Entity-Relationship model, which "adopts the more natural view that the real world consists of

31 Palantir, *GovCon7: Introduction to Palantir*, 2011, https://www.youtube.com/watch?v=f86VKjFSMJE.

32 Rudi Studer, V Richard Benjamins, and Dieter Fensel, "Knowledge Engineering: Principles and Methods," *Data & Knowledge Engineering* 25, no. 1–2 (1998): 184.

entities and relationships."[33] Any information ontology thus establishes an understanding of the contents and structure of the world, a literal world view. The word 'natural' is an indicator that we are dealing explicitly with an ideology—a system of beliefs about how the world is constructed and a set of ideals about how it should operate. On page two, Chen's model establishes a 'male-person' as a subset of Person; on page three, he exemplifies the concept of a Role by using husband and wife; and on page four, he links an employee's work time to a project Entity in order to measure productivity.[34] This 40 year old paper thus foreshadowed some of the political implications of the ostensibly 'logical' systems which work to codify gender, sexual, and labour norms.

This conceptualisation is not just abstract computer science, nor infosystems playing at philosophy, but provides the logical underpinnings of the algorithmic, determining its abilities to both understand and intervene within the everyday. Certainly this logic is highly productive, establishing a standard by which things can be compared and cross-indexed, a hard-edged abstraction that allows both human and machinic agencies to find relationships and establish patterns. For Gotham, details from multiple sources can be integrated into a cohesive, meaningful whole, and this interoperability sets up a combinatory drive in which new datasets become additive, complementing records and contributing to a fuller picture. Simultaneously, however, this ontology works to sanitise the messiness of life, inherently abstracting away some of its infinite complexity as extrinsic and unwanted. This formalisation of a logic is thus always already a delineation, a boundary separating the internalised and acknowledged from the externalised and ignored. This decision becomes highly significant, apprehending and internalising subjects and spaces in a particular way, a decision that, as will be explored in later chapters, determines the efficacy of control mechanisms and the intensity of force.

Information ontologies often swing between two unproductive poles, a tension that Palantir engineer Asher Sinensky explains in a promotional video for the company's software.[35] On one end is the highly specific ontology, composed of very particular names, relationships, and knowledge structures. This links it tightly to one domain or company in which those terms are understood, but severely inhibits any broader applicability. This specificity also limits the ability to integrate new sources of data which have alternate ontological structures.[36] It might even exclude new information

33 Peter Pin-Shan Chen, "The Entity-Relationship Model—Toward a Unified View of Data," *ACM Transactions on Database Systems (TODS)* 1, no. 1 (1976): 9.

34 Chen, "The Entity-Relationship Model," 10, 11, 12.

35 Palantir, *Dynamic Ontology*, 2012, https://www.youtube.com/watch?v=ts0JV4B36Xw.

36 The highly specific ontology can be considered a proprietary way of structuring information, individualised to a particular company. To take Chen's example above, one company might tie work hours to a Project, while another linked them to a Person. To achieve compatibility between these ways of understanding the world, translation or remapping is required from one to the other. This is the friction alluded to here in terms of integration and interoperability.

in the 'correct' data structure—entities or relationships which simply weren't foreseen when the system was being developed. Hard coded with a rigid notion of the world, the specific ontology lacks the flexibility and openness required to integrate new arrangements of information.

On the other end is the highly generalised ontology composed of generic identifiers and broad connections. This ostensibly universal understanding of the world paints in broad strokes, often covering over the cultural, social, and geographical specificities useful in discovering insights. Even when discovered, these insights can be difficult to communicate to external parties in such vague terms. What does it mean when a link is established between Object A and Object B because of Object C? These problematic poles are not new. Nicolas Guarino's widely cited paper on information ontologies contrasts fine-grained ontologies which get "closer to specifying the intended meaning of a vocabulary... but it may be hard to develop and to reason on" with coarse ontologies, "a minimal set of axioms written in a language of minimal expressivity... intended to be shared among users *which already agree* on the underlying conceptualisation."[37]

Palantir Gotham, by contrast, uses a dynamic ontology. Only a nominal structure is hardcoded: Objects, Properties, and Relationships. Objects, in turn, are further divided into Documents, Entities, and Events. Gotham was always envisioned as a broadly applicable platform. The Solutions page on the Palantir website lists a broad array of use-cases: cyber security, pharmaceutical research and development, defence, disaster preparedness, health care delivery, disease response and law enforcement. The ontology can be personalised for each client, allowing them to find what Palantir calls the "sweet spot" between specificity and universality.[38] Ontological labels can be customised for specific use-cases. In Gotham, the generic 'person' can be modified to become a soldier, doctor, or NGO worker and an item transferred between entities might be articulated variously as a phone call, a cash payment, or an infection.

Similarly, ontological structures can also be tailored. Sinensky explains that 'career', for example, could be understood alternatively as an Object, Property or Relationship.[39] A doctor might be an Object, alongside other objects such as nurse and paramedic. This means, however, that a doctor cannot have multiple jobs or other occupations—she cannot be two Objects at the same time. Alternatively, a doctor might be considered a Property, the value of a characteristic labeled 'occupation' which is then attached to an object. This allows multiple values for occupation to exist: doctor, teacher, activist. However, this structure means that such an object doesn't automatically inherit the the properties of 'doctor', potentially limiting insights and pattern finding. Finally, as

37 Nicola Guarino, "Formal Ontology and Information Systems," in *Proceedings of FOIS*, vol. 98, 1998, 87.

38 Palantir, *Dynamic Ontology*.

39 Palantir, *Dynamic Ontology*.

Sinensky notes, a doctor might be considered a Relationship. In this scenario, any generic 'person' Object which treated a 'patient' Object might be given the status of doctor. This version of the ontology is based on actions rather than labels, a structure which could provide a more open-ended notion of occupation, but also might result in confusion and ambiguity. Each of these three understandings of career come with their own strengths and weaknesses, a particular set of assumptions and oversights. The structuring of information directly influences the kind of connections, relationships, and insights that organically 'emerge' from it.

Data structures, in this way, don't just inform our understanding of what something like career means— they literally codify it, specifying and setting it in place during the logical instantiation of the code world. One of Palantir's primary goals is to establish relationships between Objects—whether links between customers or crime syndicates. Another key use is pattern matching to find outlier Properties—as in a fraudulent payment or an unauthorised address. Ontologies thus become hugely important, touching every facet of the platform: Data Import, Search and Discovery, Graph Interaction, Property Visualisation, Timeline, and the Histogram. As Sinensky stresses, the ontology "is very deeply enmeshed into everything the user does. The Ontology permeates almost every function in the Palantir Workspace."[40]

The ontology thus critically underpins functionality, supporting but also shaping it. For Palantir, this interior logic defines the code-world, providing "the means by which data from multiple sources are transformed and integrated from their raw storage formats into data objects and associated properties that represent real objects in the world—people, places, things, events, and the connections between them."[41] In doing so, a series of decisions must be made: a particular set of Objects are acknowledged, a particular set of Properties are established, a particular set of Relationships are mapped. These parameters are coded as the assumed norm. Fernand Braudel reminds us that "all structures are simultaneously pillars and obstacles."[42] Whether the historical norms and mental frameworks tracked by Braudel or the ontologies listed here, understandings of the world provide an established framework that fosters productivity but also place limitations on what can be thought and actioned. In defining this specification, a host of other properties and possibilities are simultaneously excluded, prevented from being registered or realised. The construction thus performs a double-move, delineating the internal and acknowledged from the externalised and ignored. To construct, then, is inherently to constrain.

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40 Palantir, *Dynamic Ontology*.

41 Palantir, "Palantir Gotham Technologies," Palantir, accessed August 24, 2018, https://palantir.com/palantir-gotham/technologies/index.html.

42 Fernand Braudel, "History and the Social Sciences: The Longue Durée," in *The Longue Durée and World-Systems Analysis*, ed. Richard E. Lee, trans. Immanuel Wallerstein (New York: SUNY Press, 2012), 249.

In determining the internal schema, the ontology exerts a silent force. When the objects are purely internal and abstract, such as a Rectangle, ontologies are rather benign—an object specified by four sides, with properties of height and width, and relationships with other entities such as lines. But what happens when the algorithmic attempts to understand and abstract life itself? We might consider the ontological instantiation of an Activist or an Immigrant, a translation with much higher stakes socially and politically. As Seb Franklin stresses, "the question of what is central (and thus captured and modelled) and what is peripheral (and thus discarded) within computationalist modes of social representation takes on a distinctive historical and political significance."[43] The constructed information ontology establishes the boundaries of the world—the knowledge to be known, the actions possible to take, the relationships which can be made. In this way the ontology exerts a largely imperceptible but ineluctable power, a silent and incessantly reinforced set of rules which are applied globally across the code-world. Once instantiated, these 'natural' rules, to use Chen's description, become embedded and ingrained, making it difficult to imagine alternatives.

What slippages occur as the algorithm attempts to map the outer material world onto an inner ontology? Casting to a particular ontology defines what is in, but also what is out. It is a process of delineation that produces a border. And in this mapping process, something is always left over. The result is an excess, an overflow, a remainder. As Matthew Fuller attests, "systems grappling with their outside" inevitably produce a likeness, but also a "collapse and spillage."[44] An ontology is always an approximation, an abstracted being-in-code which can never grasp the variability and totality of a being-in-the-world. This slippage creates liminalities that can be exploited, gaps which increase as the algorithmic attempts to understand new subjects and spaces.

One attempt to resolve this disparity of data is through the integration of more data, the quest to "collect it all."[45] Indeed, one of the primary drivers behind the increasing deluge of information which is captured, stored, and integrated into systems like Palantir is the framing of the extrinsic as vulnerability. The extrinsic is the missing variable, the factor which was overlooked, the information unaccounted for. If, the argument goes, we could only combine databases, multiply metadata and integrate new forms of information (affective, cultural, social), a total picture could be obtained. In urban theorist Keller Easterling's words, there would be no more "elements that fall between the rubrics and between the indices," no more "pathologies and eccentricities" which arise unexpectedly.[46] The extrinsic would finally become intrinsic. But an information ontology, even a dynamic one as used by Palantir, demonstrates that algorithmic systems always already begin from a

43 Seb Franklin, *Control: Digitality as Cultural Logic* (Cambridge, MA: MIT Press, 2015), 47.

44 Fuller, *Media Ecologies*, 83.

45 A phrase and concept rising to prominence and more mainstream usage in the wake of Snowden. See Glenn Greenwald, "The Crux of the NSA Story in One Phrase: 'Collect It All,'" *The Guardian*, July 15, 2013, sec. Opinion, https://www.theguardian.com/commentisfree/2013/jul/15/crux-nsa-collect-it-all.

code-world which has been consciously filtered and framed. This decision involves simplification and reduction, inclusion and exclusion. As Guarino asserts, an ontology is a *commitment*, a commitment which constrains the intended models of a logical language.[47] To abstract is always also to ignore.

Analyst-Thunderbird-LosAngeles machine

The two previous sections have explored how Palantir responds to the crisis of control presented by big data. Palantir's systems retain the 'messiness' of these massive repositories from disparate sources, whilst simultaneously rendering them queryable through back-end systems and intelligible through front-end software tools. The 'glue' that ties all this information together is Gotham's ontology, a logical knowledge-structure that allows analysts to draw believable links betweens disparate objects, to develop credible profiles, and to 'uncover' persuasive patterns. The result is a simulation of reality that is both convincingly rich and machine-readable—a Legitimate Power.

The Analyst-Thunderbird-LosAngeles machine continues from this point, exploring how the insights revealed through Gotham's logic are enacted on a particular populace in a particular place. Thunderbird is simply Palantir's name for the automated license plate reader system integrated into the version of Gotham used by the Los Angeles Police Department (LAPD). Thunderbird can be thought of as a custom add-on or plug-in for this particular client that provides specific functionality. In Los Angeles, the algorithmic logic of Gotham is spun out into an expansive and highly material performance— a complex juridico-political network of human and non-human elements: inspectors and lawyers, sensors and governors, license-plate readers and police.

The LAPD was one of the first law enforcement agencies to adopt the Palantir platform. Indeed, a 2013 video produced by Palantir uses the agency as an exemplary case study, and includes a series of complementary testimonials in which the Police Chief credits the platform with helping them "make sense of all the noise that's out there."[48] In 2014, the department doubled down, spending another $2.9 million for a contract for Palantir "to furnish, configure, and install a new upgraded module to LAPD's existing platform and to incorporate new data."[49] The contract details the addition of new data modules comprising license plate data which is routinely collected, mugshots

46 Keller Easterling, *Enduring Innocence: Global Architecture and Its Political Masquerades* (Cambridge, MA: MIT Press, 2005). 134.

47 Nicola Guarino, "Formal Ontology and Information Systems," in *Proceedings of FOIS*, vol. 98, 1998, 97.

48 Palantir, *Palantir at the Los Angeles Police Department*, 2013, https://www.youtube.com/watch?v=aJ-u7yDwC6g.

49 The Mayor's Office of Homeland Security and Public Safety, "Fiscal Year 2014 Urban Areas Security Initiative Grant," May 18, 2015, http://clkrep.lacity.org/onlinedocs/2014/14-0820_misc_5-18-15.pdf.

from the local county, as well as an array of information available from the Department of Motor Vehicles: home address, home telephone number, physical/mental information, social security number, and a photograph.[50]

This expansion of accessible data and the integration of it into the unified Palantir platform sought to create a more comprehensive informational environment. In this way, Thunderbird exemplifies the two contrasting operations sketched out previously—it voraciously expands the scope of data capture and simultaneously provides tools and functionality to converge towards a particular target. As human geographer Ian Shaw sums up, "the entire 'normal' population must first be coded and modelled to geolocate the abnormal. In order to individualise, the security state must first totalise, effecting an intensive policing of the lifeworld. The two spatial optics of urban manhunting are thus population (expansion) and person (contraction)."[51] A key goal here is the need to 'capture it all,' the quest towards the totalisation of information which is supported on a technical level by the Palantir stack. To be able to locate *any* individual, it is first necessary to know *every* individual, entailing the representation of a mass population through data.

How does this information come together in the regulation of life? License plate data is automatically captured by dedicated reader equipment manufactured by a third party, most commonly Vigilant Technologies.[52] A fixed license plate reader is commonly attached to a light pole, capturing plates of cars passing beneath it and transmitting them directly back to law enforcement headquarters. A mobile version, used heavily by the LAPD, takes the form of two cameras mounted on top of the police cruiser. The mobile readers operate continuously, detecting plate imagery from within their visual feed, isolating and converting it to a sequence of alphanumeric characters, and adding this to a scrolling list of plate data on a monitor inside the car. These plates are checked against state and federal databases to match against particular activity. The Federal Bureau of Investigation, for example, maintains a special machine-readable file for plate reader systems which is refreshed twice daily.[53] The vehicle might have been reported stolen, it might be registered to a sex offender who is violating his parole, or it might belong to a so-called scofflaw who has routinely ignored parking fines. Once flagged, the corresponding series of operations plays out on the owner of the vehicle—an arrest, a fine, a warning, and so on. In this way, every plate hides a potential

50 Department of Motor Vehicles, "DMV and Your Information," March 13, 2017, https://www.dmv.ca.gov/portal/dmv/detail/dl/authority#info.

51 Ian GR Shaw, "The Urbanization of Drone Warfare: Policing Surplus Populations in the Dronepolis," *Geographica Helvetica* 71, no. 1 (2016): 25.

52 Patrick Hoge, "Vigilant Tracks License Plates for Cops," *San Francisco Business Times*, August 2, 2013, https://www.bizjournals.com/sanfrancisco/blog/2013/08/vigilant-tracks-license-plates-for-cops.html.

53 Keith Gierlack et al., *License Plate Readers for Law Enforcement: Opportunities and Obstacles* (Rand Corporation, 2014), 49.

crime. In fact, the LAPD recently denied a Freedom of Information Act request based on the grounds that the plate data is investigatory.[54] In other words, all cars in Los Angeles are under ongoing investigation.

Critics of technology and surveillance often conjure up the nightmare scenario in order to build public support for their stance: the global glitch, the rogue employee, the fatal error.[55] Of course, these unforeseen situations can occur and do matter. Their consequences often fall heaviest on those groups already marginalised or vulnerable. For example, Denise Green, an African-American woman, was pulled over in 2009 when automatic license plate reader technology mistook a 3 for a 7, flagging her car as stolen.[56] Officers ordered her out of the vehicle at gunpoint, forced her to her knees and handcuffed her while they searched her car. Green, a 50-year-old bus driver, described the experience as a "nightmare" and had to take two weeks off for counselling.[57]

But such cases are anomalies. While devastating to the individual, in the cold logic of power they are both too contained and too spectacular—a force unleashed on a single body that draws attention to possible abuse. A more subtle and systemic effect occurs in those proximate to the subject and in the wider population as a whole. "A nightmare scenario of an Office of Special Enforcement inspector going rogue, stalking a colleague or creditor or lover with Palantir's mobile technology, is certainly conceivable," concedes journalist Brendan O'Connor: "But the potential for that kind of outright abuse is less disturbing than the ways in which Palantir's tech is already being used. The city's embrace of Palantir, outside of law enforcement, has quietly ushered in an era of civil surveillance so ubiquitous as to be invisible."[58] This silent regime runs as a low-level hum in the background, an undercurrent informing (and more precisely, discouraging) a range of political practices.

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54 Al Jazeera America, "LAPD: All Cars Are under Investigation," March 25, 2014, http://america.aljazeera.com/watch/shows/the-stream/the-stream-officialblog/2014/3/25/lapd-all-cars-areunderinvestigation.html.

55 The *Denver Post* ran an investigation into the use of law enforcement databases for stalking and surveilling ex-partners, see Sadie Gurman and Eric Tucker, "AP: Across US, Police Officers Abuse Confidential Databases," *Denver Post*, September 28, 2016, https://apnews.com/699236946e3140659fff8a2362e16f43.
One specific example is the case of Anne Marie Rasmusson, a former police-officer whose database profile was accessed 425 times by 18 different agencies. "Is Anne Marie Rasmusson Too Hot to Have a Driver's License?," City Pages, February 22, 2012, http://www.citypages.com/news/is-anne-marie-rasmusson-too-hot-to-have-a-drivers-license-6755567.

56 Ali Winston, "Privacy, Accuracy Concerns as License-Plate Readers Expand," *SFGate*, June 17, 2014, http://www.sfgate.com/crime/article/Privacy-accuracy-concerns-as-license-plate-5557429.php.

57 Winston, "Privacy, Accuracy Concerns as License-Plate Readers Expand."

58 Brendan O'Connor, "How Palantir Is Taking Over New York City," September 26, 2016, https://www.gizmodo.com.au/2016/09/how-palantir-is-taking-over-new-york-city/.

A 'chilling effect' is the term used to describe this subtle discouragement, a subliminal process in which the subject self-regulates activities that might be deemed political or controversial. In 2009, the Association of Police Chiefs commissioned a report investigating the potential ethical implications caused by the automated capture of license plate data on a mass scale. Though unsurprisingly glowing in its overall outlook, the authors did caution organisations about this potential chilling, warning that populations exposed to the technology might become "more cautious in the exercise of their protected rights of expression, protest, association, and political participation."[59]

But is this chilling effect merely anecdotal or imaginary, assumed by those concerned with surveillance and privacy? In 2016 legal researcher Jon Penney conducted one of the first empirical inquiries into these effects. Penney focused on Edward Snowden's reveal of the NSA PRISM programme of June 2013, honing in on that moment when the world learned that the US government was conducting mass surveillance of their phone calls, web searches, and other everyday activities increasingly conducted online. One of the key problems in measuring the effect of surveillance, of course, is that subjects are typically unaware it is even occurring. In contrast, the Snowden revelations were a highly publicised bombshell which alerted a broad public that their activities were actively being monitored. In short, the disclosures set up a clear before and after: pre- and post-Snowden.

Penney analysed the traffic of 48 'controversial' Wikipedia articles—pages like 'dirty bomb' and 'suicide attack' related to terrorism and other topics likely to raise surveillance flags.[60] Penney discovered that after the revelations in June 2013, visitors to these pages dropped by 20 percent. What's more, this was not a temporary drop-off, but part of a longer lasting effect. Penney notes, for example, that viewership of the wiki article on Hamas was previously trending up, gaining 60,000 views per month; post-Snowden, however, this trend reversed, with 20,000 fewer people visiting the page month after month.[61] The study demonstrated that, contrary to the mantra of 'nothing to hide, nothing to fear,' subjects under surveillance do regulate their own behaviour, even if this is done unconsciously.

Of course, Palantir is not the NSA and Gotham is not the PRISM programme. We must be careful not to overburden this object, ascribing a whole range of overwhelming and nebulous effects to its operations. Indeed, one of the key experiential qualities of Palantir's processes is just how incredibly

59 William Nagel, Meghann Tracy, and Heather Cotter, "Privacy Impact Assessment Report For The Utilization Of License Plate Readers" (Alexandria, Virginia: International Association of Chiefs of Police, September 2009), 7.

60 Jon Penney, "Chilling Effects: Online Surveillance and Wikipedia Use," *Berkeley Technology Law Journal* 31, no. 1 (2016): 140.

61 Penney, "Chilling Effects," 151.

banal they become. The key functionality can be learned in a day of workshops.[62] The interface is designed to be highly intuitive. Point and Click. Drag and Drop. There's nothing particularly awe-inspiring here, no technology which points to its own spectacle. Rather, the whole activity becomes depoliticised precisely to the extent to which it is deemed ordinary and procedural.

At the same time, we must acknowledge those capacities, sketched out in the previous section, which Gotham provides: the assimilation of unstructured data, the conversational query and retrieval of information, the cross-referencing of properties and a progressive accumulation of associations leading to the formation of an ostensibly organic pattern. Integrating license-plate data into this platform via Thunderbird adds new capabilities: the tracking of behaviours over time and the ability to locate a subject in space. This is a radical amplification of surveillance capabilities—facilitating the targeting and interrogation of subjects on massive scales. Gotham thus provides both a significant expansion in the scope of data analysis while simultaneously facilitating an effortlessness in their use—an economisation of regulation.

If power wants anything, Michel Foucault might say, it is increased economy. To be effective, power must be flexible rather than fossilised, adapting to new conditions and challenges. This constant reconfiguration proceeds not randomly but strategically. Power evolves in certain ways over time and tends towards a particular set of priorities, a concept of *intensification* which Jeffrey Nealon finds within Foucault's work and extends.[63] The movement from the costly to the economic forms a guiding logic, constituting both an overall objective and defining the transformations necessary to achieve it. For Nealon, this plays out historically as a series of selective adaptations, as "the formulaic movement of power's intensification: abstraction, lightening, extension, mobility, and increased efficiency."[64] Of course, Foucault's *Discipline and Punish* highlighted a moment in this lineage, an evolution from the violent punishments enacted directly on the body and the brick-and-mortar incarceration of the flesh towards a much lighter and efficient regime, embodied at that time in Bentham's designs for the panoptic prison. New embodiments within this trajectory move incrementally towards a more effective performance which can be attained more 'economically' in every sense: materially, financially, temporally, and so on.

This is a shift from the *somatic* to the *systemic*. Disciplinary power is often understood as a more traditional form of control exerted on the body through prisons, barracks, hospitals, and so on. But

62 Spencer Woodman, "Documents Suggest Palantir Could Help Power Trump's 'extreme Vetting' of Immigrants," *The Verge*, December 21, 2016, http://www.theverge.com/2016/12/21/14012534/palantir-peter-thiel-trump-immigrant-extreme-vetting.

63 Jeffrey Nealon, *Foucault Beyond Foucault: Power and Its Intensifications Since 1984* (Stanford: Stanford University Press, 2008).

64 Nealon, *Foucault Beyond Foucault*, 32.

the panoptic prison anticipated, even if weakly, the trajectory of power away from physical presence. "Power," Foucault insisted, "has its principle not so much in a person as in a certain concerted distribution of bodies, surfaces, lights, gazes; in an arrangement whose internal mechanisms produce the relation in which individuals are caught up."[65] Somatic power relying on bodily intervention is both expensive to maintain and constrained inherently by the corporeal—a particular body with a limited line of sight, a finite span of attention, a fixed number of work hours, and so on. This is why Nealon suggests that intensity strives incessantly towards a more efficient "smearing or saturation of effects over a wide field."[66] The body is bypassed in favour of suffused forces exerted by a systemic solution. In Bentham's panopticon, the arrangement of prison cells at particular angles, the centrality of the tower and the masked windows together formed a system which amplified the disciplinary potential of vision, distributing its effects ubiquitously throughout space and persistently throughout time. For the inmates, the gaze was decoupled from the warden and embedded into the very walls themselves.

Given a trajectory of intensity, this disciplinary gaze might be updated to an *algorithmic gaze*—a gaze which operates not on the body directly, but on its data shadow—indexing the swirl of information produced by the subject and associated with him or her: credit scores and criminal records, phone calls and chat logs, Skype calls and social media. In doing so, informational technologies maintain a diffused and largely imperceptible field—-a steady pressure which obliges the subject to adopt particular practices of self-regulation. Gotham, for its part, acts as both interface and integrator for these systems—a glue to bind together disparate data and a graphical interface to inspect it. While the ability of physical visibility to produce self-governing inmates might have been overstated in Foucault's time, the tendency of the subject towards self-governance in the hard light of algorithmic visibility seems decidedly less so. Governing shifts from external coercion to internal conformity, an incessant performance which is both self-initiated and self-managed. As Foucault reminded us, once these forces are instantiated on the subject, "he makes them play spontaneously upon himself; he inscribes in himself the power relation in which he simultaneously plays both roles; he becomes the principle of his own subjection."[67]

Despite these tendencies, power is never totalising. There are always errors and inconsistencies present in the algorithmic. But the particular modalities of this power indicate that traditional framings and responses may prove relatively ineffective. Take, for example, the notion of resistance. Algorithmic power is not a corporeal body which oppresses and can thus be pressed against. Rather, as a Foucauldian reading suggests, this power is highly diffuse, infused into the mechanisms

65 Foucault, *Discipline and Punish*, 255.

66 Nealon, *Foucault Beyond Foucault*, 34.

67 Foucault, *Discipline and Punish*, 256.

of informational systems. In this sense, Gotham is more akin to a saturated field laid over a topography of subjects. Humanity and technology are bound up intimately within this environment, interdependent and inextricable. Indeed, some of Gotham's core database fields are also considered the core elements of citizenry and identity: a social security number, a bank account, an address, and so on. As Peter-Paul Verbeek asserts, "conceptualising this relation in terms of struggle and oppression is like seeking resistance against gravity, or language."[68] This is not to collapse into fatalism, but simply to recognise that the traditional language of 'oppression' and 'resistance' needs to be updated or even supplanted.

A second notion which may require updating is that of refusal, consciously opting out of particular platforms or informational systems. The extent to which a significantly unconnected life is even possible for those in the Global North is debatable, though some partial non-participation is indeed achievable. Of course, refusal itself is often only feasible for those who already possess a certain degree of privilege: an established reputation, offline social support structures, a stable career, and so on. This leads to one of the core reasons why refusal may be ineffective—it often seems to disenfranchise more than it empowers, excluding the subject from life-enhancing realms of cultural, social, and financial exchange. In Seb Franklin's words, "disconnection from channels of communication appear aberrant or pathological and thus leads to expulsion from circuits of representation and inclusion."[69] The subject becomes cut off from vital networks, a move which costs them greatly while effecting the system very little.

In contrast to resistance or refusal, the Analyst—Thunderbird—LosAngeles machine suggests some alternative and deeply immanent strategies. Several tangible examples are mentioned in a 2014 Rand report by Gierlack et al.[70] For instance, the report notes that license plate reader cameras are configured to function in both day and night settings, necessitating the capture of both infrared and visible photos of the car plate in high definition. The volume of this 'doubled' data is often entirely unexpected. Aging digital storage systems of law enforcement agencies are quickly overwhelmed, forcing organisations to erase old data to free up space for new data. The result is that "these limits, rather than privacy concerns, ended up shortening their data retention period."[71] Rather than any overt intervention from outside—government regulation or citizen activism, for example—the processes within the system itself work to undermine its own efficacy. In another example, the complexity of the natural and built environment creates unexpected frictions which

68 Peter-Paul Verbeek, "Resistance Is Futile: Toward a Non-Modern Democratization of Technology," *Techne: Research in Philosophy and Technology* 17, no. 1 (2013): 77.

69 Franklin, *Control: Digitality as Cultural Logic*, 136.

70 Keith Gierlack et al., *License Plate Readers for Law Enforcement: Opportunities and Obstacles* (Rand Corporation, 2014).

71 Gierlack et al., *License Plate Readers for Law Enforcement*, 68.

the algorithmic attempts to resolve. As the report elaborates, "the cameras also can false-read structures as license plates, as one department found when its system kept seeing wrought-iron fences around some homes as '111-1111' plates."[72] The disparity between the messiness of the outer world and the internal schema of the code world creates an 'incorrect' result from the department's perspective. In these instances, informational flows still run but are shifted tangentially, producing outputs considered incoherent and unusable.

Putting these two inconsistencies together, we arrive at a final example. The report discloses that "drivers have beaten the system by using black electrical tape to alter their license plates."[73] Automated license-plate reader systems all contain particular assumptions about the visual schema to be expected—darker pixels situated on the white background of the plate itself which should resolve into a sequence of alphanumeric characters. By injecting unexpected matter into the ecology —tape stuck between plate characters—the expected algorithmic flow runs but is diverted or interrupted. The resulting output is deemed valid by the machine but useless to humans. This practice doesn't 'resist' the system (shut down the servers?), nor 'refuse' it (stop driving altogether?). Rather, this practice works *with* the system rather than against it, understanding the operational logics at work, playing with these processes and exposing them to unexpected inputs. This feels like a more strategic practice—one which recognises how entangled we are with technological systems while at the same time instrumentalising particular operations in order to counterbalance their often asymmetric power structures.

If the previous machines have explored Gotham's credible internal logic, the Analyst—Thunderbird—LosAngeles machine has pointed to the stakes of such credibility. Data, structured in meaningful ways, becomes convincing, shaping the everyday actions (and inactions) of those residing in LA by purposively influencing them towards a particular outcome. Logic is linked to control. However this interconnection also opens up unexpected results, as detailed in the problems encountered by automated license plate readers. Rather than resistance or refusal, then, Thunderbird suggests immanent interventions that employ discrepancies between inner logic and outer world.

72 Gierlack et al., *License Plate Readers for Law Enforcement*, 80.

73 Gierlack et al., *License Plate Readers for Law Enforcement*, 100.

Deporting Life

Algorithmic Sovereignty?

If the first half of this chapter explored how technical affordances produce a legitimate power, then the second half examines how this algorithmic legitimacy challenges conventional legitimacies. Sovereignty, as the right to wield legitimate force, has long been the exclusive purview of the state. Yet with Palantir, governance seems to become free-floating—a set of functionalities bundled into a product-offering and available to all. What would it mean then, to speak of an algorithmic sovereignty? This section will argue that state power has not been erased, but neither has it persisted unchecked and unchanged. Palantir's role in immigration demonstrates novel ways to combine disparate databases, to slice into the population, and to flexibly delineate citizen from alien. In deploying these capacities, the state claws back technical power while sacrificing sovereign power. Yet the logic of big data differs from the state; the use of automation in particular points to a future where citizenship is redefined.

Sovereignty has a long history. Any genealogy of sovereignty must begin with Jean Bodin, the figure most responsible for developing and formalising the concept in his 1576 series *Six Books of the Commonwealth*. Bodin's initial formulation was that "sovereignty is that absolute and perpetual power vested in a commonwealth."[74] By *absolute*, Bodin insisted that the power of the prince to establish law, to impose these laws on subjects, and to uphold these laws by whatever means necessary—in short, to rule—was not accountable to any other individual or institution. By *perpetual*, Bodin argued that sovereignty was indefinitely wielded—those who possessed it might delegate it temporarily to agents or emissaries, but this transient authority didn't constitute absolute sovereignty. To this core definition Bodin added the property of *indivisibility*; to more effectively manage sovereign power, a state might contain distinct administrative and juridical arms, for instance—but these were bureaucratic conveniences ultimately directed by a cohesive and supreme sovereign.

In his 1651 book *Leviathan* Thomas Hobbes takes up a number of the core attributes of sovereignty introduced by Bodin. This power is indivisible, for as Hobbes notes, "A kingdome divided in it selfe cannot stand."[75] This power is perpetual, and can "by no grant passe away without direct renouncing of the soveraign power."[76] And this power is absolute, indeed "the power and

74 Jean Bodin, *Six Books of the Commonwealth*, trans. M.J. Tooley (Oxford: Basil Blackwood Oxford, 1576), Book 1, Chapter 8.

75 Thomas Hobbes, *Leviathan* (Salt Lake City: Project Gutenberg, 2015), 168.

76 Hobbes, *Leviathan*, 168.

honour of subjects vanisheth in the presence of the power soveraign."[77] Written in the context of the English Civil wars, Hobbes saw firsthand the violence, misery, and death that disorder could bring. In a world such as this, according to his famous formulation, life could only ever be "nasty, brutish, and short."[78] This state of nature must be subdued and a political realm imposed. Law was needed in place of lawlessness, order in place of anarchy.

Thus while sovereignty can be framed as a legal concept, it is constantly intertwined with power and and the question of which individuals or institutions wield that power. For Bodin and Hobbes, it was always the state, whether structured as a monarchy, republic, or (if necessary) a democracy, that should possess this power to be the final arbiter, the ultimate authority. But for many theorists, this power has been gradually usurped, overtaken or incorporated into other forces. For Antonio Negri, modern capitalism is now the "power that absorbs and configures all other power, state power first of all."[79] For Giorgio Agamben, "the great state structures have entered into a process of dissolution and the emergency has... become the rule."[80] If the power of the state lingers, it is fainter and filtered through other forces and relations. Indeed for Michel Foucault, what is most frustrating is the inability of others to see this shift. Conditions have changed; the analysis of power has not. The result is that "the representation of power has remained under the spell of monarchy. In political thought and analysis, we still have not cut off the head of the king."[81] Instead of being monolithic, power is multiple and distributed; instead of being assumed, power must be performed; and instead of being exclusive to the state, power circulates amongst diverse actors and institutions. Sovereignty, such as it is, has shifted into other forms.

In business and technological domains, the impotence of state sovereignty has long been an 'obvious' reality, driven by digital disruption. In Silicon Valley in particular, this dominant view can be traced through a lineage of key figures and institutions such as Stewart Brand, the Whole Earth Catalogue, *WIRED* magazine, and not least, John Perry Barlow, whose "Declaration of the Independence of Cyberspace" asserted that the network was an autonomous space with its own laws, customs, and codes. "Governments of the world," Barlow proclaimed, "you have no sovereignty where we gather."[82] To take a more recent example, Taylor Owen's book *Disruptive*

77 Hobbes, *Leviathan*, 169.

78 Hobbes, *Leviathan*, 353.

79 Antonio Negri, *Insurgencies: Constituent Power and the Modern state* (Minneapolis: University of Minnesota Press, 2009), 250.

80 Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life*, trans. Daniel Heller-Roazen (Stanford: Stanford University Press, 2016), 22.

81 Foucault, *The History of Sexuality*, 85.

82 John Perry Barlow, "A Declaration of the Independence of Cyberspace," Electronic Frontier Foundation, February 8, 1996, https://www.eff.org/cyberspace-independence.

Power: The Crisis of the State in the Digital Age argues that digital decentralisation empowers smaller players to challenge sovereignty. Taylor argues that, from Anonymous to the Arab Spring, Snowden to the Syrian Electronic Army, "digitally enabled actors are changing the way the world works and disrupting the institutions that once held a monopoly on power."[83] Thus, whether coming from tech pundit Tim O'Reilly or alt-right figurehead Moldbug, there seems to be no end to figures proclaiming the end of state sovereignty in the face of new technologies.

Nothing better exemplifies this challenge to state sovereignty than the tech titans of Silicon Valley: Uber, Facebook, Amazon, Google, Airbnb, and so on. In a simple sense, these entities are companies, registered as such, with employees and offices. In another sense, as will be discussed at length in the chapter on Uber, they represent a new kind of entity that is not just data-driven, but algorithmic in its existence, in its ability to scale rapidly and relentlessly without the transactional costs borne by traditional companies. The result is that these algorithmic regimes do appear to rival nation-states when seen through some of the conventional indicators of power: population, wealth, and scale.

Considering population, we might consider the technology industry metric of monthly active users (MAUs) as analogous to a country's inhabitants. If this is the case, then Facebook's 1.79 billion MAUs have recently overtaken the 1.3 billion constituents of China. Even a relatively struggling social media platform such as Twitter just falls behind the population of the United states (313 million MAUs vs 323 million residents). Mapping some of the largest technology platforms against the largest countries, the ability of a single algorithmically-infused company to modulate the lives of vast populations becomes significant (Figure 1).

83 Taylor Owen, *Disruptive power: the crisis of the state in the digital age* (New York: Oxford University Press, 2016).

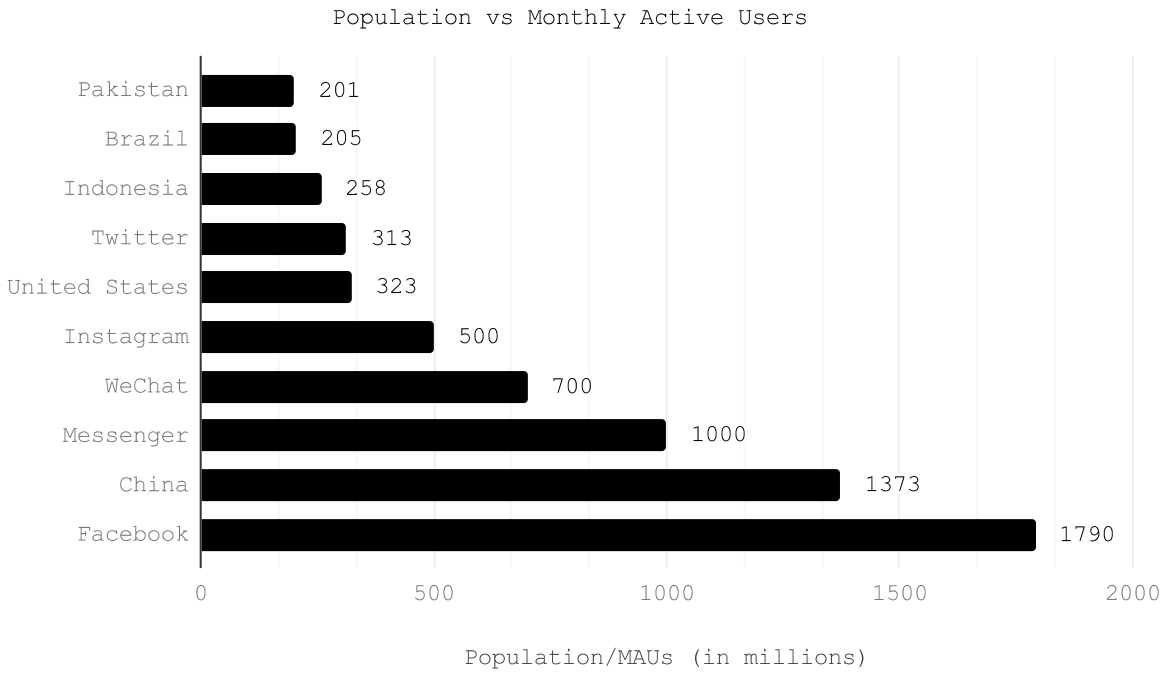

Figure 1: country population vs monthly-active users

Wealth is another key indicator. In January of 2015, Apple Inc announced the biggest net income earned in a single quarter by any publicly traded company, ever. While some publications compared these corporate figures with countries erroneously, even the more modest results obtained when done correctly are astonishing. According to the *Financial Times*, "we estimate that Apple's economic output in 2014 was worth about $87 billion," placing the Cupertino titan alongside the economies of countries such as Ecuador and Slovakia, with around $100 billion.[84] Apple also holds a substantial $178 billion of liquid assets, a figure similar to the amount held by the sovereign wealth fund of Norway.[85]

In terms of scale, these contemporary algorithmic examples appear highly dispersed across the globe. Uber, for example, is available in 527 cities across 77 countries; Similarly Airbnb is distributed across 34,000 cities in 141 countries.[86] Even a small selection of these cities as a constellation of dots illustrates how these ecologies expand far beyond the borders of traditional nation-states (Figure 2). An alternative map might sketch out the informational edges linking these nodes—the backbones, fibre optic and submarine cables which criss-cross borders. Informational

84 Matthew Klein, "If Apple Were a Country," *Financial Times*, January 29, 2015, sec. Alphaville, https://ftalphaville.ft.com/2015/01/28/2103622/if-apple-were-a-country/.

85 Klein, "If Apple Were a Country."

86 These figures were taken from their respective websites, but are constantly growing, so will be outdated by the completion of this research project. In any event, the point is not the exact figures, but that geographic dispersal exceeds nation-state boundaries and unsettles traditional governance.

infrastructures allow a centrally coordinated set of algorithmic operations to be performed worldwide. To be sure, the conditions created by these operations are undoubtedly inflected and modulated by local forces. Yet equally, we must acknowledge the universal set of conditions able to be asserted across these specificities. From a legal perspective, this dispersion presents a problem of juridical control. Highly globalised systems transverse nation-state jurisdictions, frustrating or complicating efforts to regulate them. As Benjamin Bratton asserts, these ecologies "overflow the normal legal geography," not just drawing a new territory, but occupying it.[87]

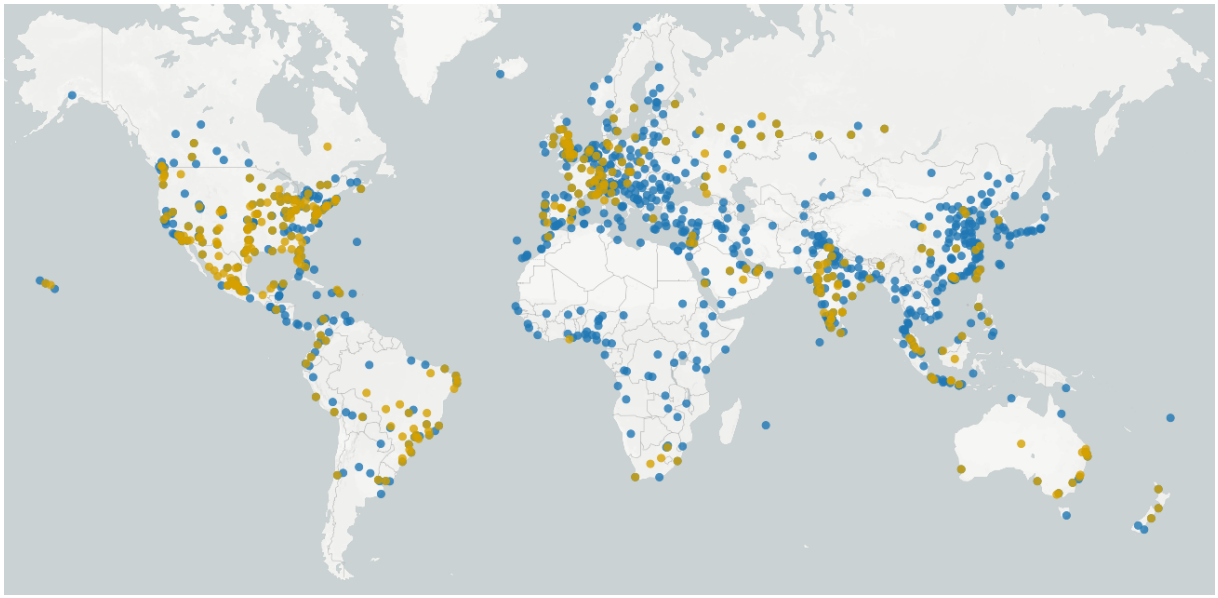

Figure 2: a subselection of cities where Uber (yellow) and Airbnb (blue) are active

Indeed, for some, these regimes constitute their own distinct realm. In a statement reminiscent of Barlow's cyberspace declaration, Eric Schmidt and Jared Cohen predict that "the vast majority of us will increasingly find ourselves living, working, and being governed in two worlds at once."[88] Of course, this claim to an entirely separate jurisdiction could be dismissed as rhetoric or fantasy. Google itself, along with Microsoft, Apple, and other tech titans, certainly recognise nation-state jurisdictions when it comes to tax avoidance strategies such as the Double Irish Sandwich.[89] But what the duo seem to identify is a subjective shift in governance. When your income comes from Uber, your accommodation from Airbnb, and your news from Facebook, it is not as if your citizenship of a certain nation-state is relinquished. But the theoretical status of being a citizen

87 Benjamin H. Bratton, *The Stack: On Software and Sovereignty*(Cambridge, MA: MIT Press, 2015), 35.

88 Eric Schmidt and Jared Cohen, *The New Digital Age: Reshaping the Future of People, Nations and Business*, 2014, 3.

89 Danielle Thorne, "The Double Irish and Dutch Sandwich Tax Strategies: Could a General Anti-Avoidance Rule Counteract the Problems Caused by Utilisation of These Structures?" (Wellington, New Zealand: Victoria University School of Law, 2013), https://researcharchive.vuw.ac.nz/xmlui/bitstream/handle/10063/3252/thesis.pdf?sequence=2.

seems more abstract than the everyday practices of being a user—the vague 'rights' of a state subject are replaced by the 'realities' of the algorithmic subject. A search update buries your business; a blocked account halts your ability to connect with family and friends. If this governance is not more important, it at least feels more immediate than an ancient bill of rights or a policy discussion in parliament. The power-relations shaping this subjectivity are constantly performed rather than legally assumed. As Foucault argued, to understand this power, one needs to replace "the privilege of sovereignty with the analysis of a multiple and mobile field of force relations."[90]

Undoubtedly, then, there is a degree to which power becomes decoupled from the state and taken up in new ways by new actors: operations become 'stateless', regulatory regimes partially evaded, and the national denationalised. But the state doesn't disappear. "It is not enough" insists Saskia Sassen, simply to posit that these transformations have brought about "declining significance for the national state."[91] Immigration is one sphere where state significance clearly persists. If global technological processes engender a denationalisation, then for Sassen, "immigration is renationalising politics."[92] From Trump's vision of a Mexico/US wall to the recent landmark results achieved by anti-immigration parties in Germany and Austria, the ability of this controversial issue to rehabilitate a potent form of populism has not gone unnoticed.[93] If the migration of capital offshore or internationally has been invisible and unchecked, the migration of people has been highly attended to and fiercely opposed. And if economic and technological trends signalled the frailty of the state, then immigration signals its return with ferocity. Given these conditions, one way to examine the transformation of sovereignty would be through immigration and one of its primary figures—the citizen. How does the algorithmic reconfigure the citizen?

Deportation Machine

To explore the transformation of sovereign power as it relates to the algorithmic, this section examines the way in which Palantir is employed by two agencies within US Immigration and Custom Enforcement (ICE): Homeland Security Investigations and the Enforcement and Removal

90 Foucault, *The History of Sexuality*, 99.

91 Saskia Sassen, *Losing Control: Sovereignty in an Age of Globalization*, 2015, 17.

92 Sassen, *Losing Control*, 105.

93 "The radical right party profited from the fact immigration was the number one election issue."
Cas Mudde, "What the Stunning Success of AfD Means for Germany and Europe," *The Guardian*, September 24, 2017, http://www.theguardian.com/commentisfree/2017/sep/24/germany-elections-afd-europe-immigration-merkel-radical-right.
"By turning the People's Party into a vocal anti-immigrant force, Sebastian Kurz remade it in his own image."
Emily Schultheis, "A New Right-Wing Movement Rises in Austria," *The Atlantic*, October 16, 2017, https://www.theatlantic.com/international/archive/2017/10/austria-immigration-sebastian-kurz/542964/.

Office. The infusion of the algorithmic into the bureaucratic mechanisms of immigration provides substantial new affordances. For investigative journalist Spencer Woodman too, this engine of elements, fused together to efficiently achieve a particular purpose, can only be described as one thing—a Deportation Machine.[94] How might a Deportation Machine operate? Given the sensitivity of this subject, and the secrecy of these particular agencies, details are scant. Any analysis will inevitably be partial and somewhat speculative. Yet some insights can be gleaned from public documents, governmental presentations, and leaked slides.

While Palantir has a long history with governmental agencies, the genesis of this Deportation Machine might be located in May of 2014. Through its online portal, U.S. Immigrations and Custom Enforcement (ICE) issued a request for proposals from interested contractors. The chosen contractor would deliver a "web-enabled Investigative Case Management (ICM) system."[95] As part of this process, ICE delivered a two hour Powerpoint presentation detailing the project's technical requirements, timelines, and acquisition strategies. The slide deck features some startling statistics on the department: 61,000 cases opened a year, 55 million Person Subject records, and 4 million Vehicle Subject records. But it also contains a notional 'Day in the Life Of' scenario sketching out the vision the agency has for the future system.

In the scenario, 'SA Jones' receives information on a subject from an officer at a port of entry. As a result of several "consolidated, interfaced" searches, he finds matching records and more information.[96] Jones interviews the subject, and learns the car colour and airplane license plate of his mysterious employer, Caliber. Jones searches again using these parameters, and locates Caliber in an old case file, identifying his real name and his alias due to a tattoo of a gun on his arm.[97] Jones links all these objects and properties, creating a new case file. This file contains "metadata about the investigation" as well as housing media like the suspects "Miranda waiver and photos."[98] In the story, these documents lead to arrest, and Jones must update his dispositions as the subject is indicted and convicted. The flow here becomes legal and penal, moving from charging documents

94 Spencer Woodman, "Palantir Provides the Engine for Donald Trump's Deportation Machine," *The Intercept* (blog), March 2, 2017, https://theintercept.com/2017/03/02/palantir-provides-the-engine-for-donald-trumps-deportation-machine/.

95 Federal Business Opportunities, "ICE Investigate Case Management System - HSCETC-14-R-00002 (Archived)," October 11, 2014, https://www.fbo.gov/index?s=opportunity&mode=form&id=36fb3b697a2ccb4ec7084b4e0ec6cdb9&tab=core&_cview=1.

96 ICE, "TECS Investigative Case Management (ICM) statement of Objectives," May 1, 2014, https://assets.documentcloud.org/documents/3478481/ICE-ICM-statement-of-Objectives.pdf, 15.

97 ICE, "TECS Investigative Case Management," 18.

98 ICE, "TECS Investigative Case Management," 19.

to the U.S. Attorney's Office and onto a court ruling before terminating in the icon of an individual behind bars with the byline: "Justice is Served."[99]

Though notional (and aspirational), the 'Day in the Life Of' diagrams foreground the critical collaborative role that technical and medial operations play at every stage of the investigation—legalities and functionalities tightly codetermined. In the sphere of immigration, data is not some dead archive, accumulated merely to hoard. Instead, it adapts in order to actively hound its subjects: capturing a facial photograph or an airplane plate, translating between corporeal tattoo and 'immaterial' file, shapeshifting from analytical pixels to judicial printout. And in the sphere of immigration, the 'success' of this informational pursuit cancels jobs, separates families, and evicts bodies. To update Kittler, data determines their situations.

In September 2014 the contract to integrate this data was awarded to Palantir Technologies at a total cost of $41,629,069.08.[100] The adoption of Palantir went with an internal renaming. As one document outlined, "Palantir Gotham has been modified for ICE's specific requirements and has been internally renamed FALCON."[101] Integrating the agency's existing datasets created a centralised silo that was both invasive and extensive. Public privacy documents state that these records may include: "identifying and biographic data, citizenship and immigration data, customs import-export history, criminal history, contact information, criminal associations, family relationships, employment, military service, education and other background information."[102]

But almost immediately, the machine needed to grow. A follow-up project awarded Palantir a further 4 year contract to integrate additional datasets. The desire for more information is typically insatiable and Palantir's primary imperative is one of constant expansion—connecting to wider databases, ingesting less formalised, more ad hoc material, and integrating all of this into a cohesive and queryable world. The agency's budget request follows this promise, rationalising the cost by stating the integrations would "significantly enlarge the universe of data available to analysts and agents."[103] In Year 1 the objective was to integrate DARTTS, an enormous trove of financial records and activity. Expanding from the platform's existing 300 million data records to DARTTS 3 billion records was an order of magnitude difference; the resulting data deluge would overwhelm the "56

99 ICE, "TECS Investigative Case Management," 20.

100 Federal Business Opportunities, "ICE Investigate Case Management System."

101 ICE, "FALCON Operations," August 23, 2013, https://www.documentcloud.org/documents/3517285-FALCON-Operations.html, 6.

102 Department of Homeland Security, "Privacy Impact Assessment Update for the FALCON Search & Analysis System" (ICE, October 11, 2016), https://www.dhs.gov/sites/default/files/publications/privacy-pia-ice-032-falcons-b-october2016.pdf.

103 ICE, "FALCON Operations," 1.

server cores/Gotham perpetual licenses currently deployed" and thus an additional 176 server cores were purchased and configured.[104] In Years 3 and 4, the goal was to integrate an array of smaller datasets from other agencies and providers. 17 databases in total were brought within the Palantir/FALCON platform, including the National Security Entry and Exit Regulation System (NSEERs), the Arrival and Departure Information System (ADIS), the Border Crossings from Treasury Enforcement Computer System (TECS), the United States Visitor and Immigrant Status Indicator Technology (US-VISIT), and I-94 data.[105] The incorporation of these datasets and the rollout of additional server cores would mean a significant expansion of the system's capabilities. By the end of year 4, according to the project timeline, the system would support 4.2 billion records and 6,000 concurrent users across both desktop and mobile.[106]

These expansions are not simply trivia. To be sure, they underline the appetite for expansion that big data brings about. But they also foreground the diverse branches of the state as an enormous capture device. Despite the stereotype of the state as a fumbling dinosaur that misunderstands technology and struggles to legislate it, the power of its extensive information on populations is not to be overlooked. As sociologist Evelyn Ruppert reminds us, historically the state "maintained an effective monopoly on data regimes concerning whole populations."[107] Palantir Gotham, as stated early in this chapter, essentially offers the same toolsets to all its clients. But it is also true that the power of these tools can be amplified through the richness and volume of information at their disposal. This insight does not escape the government agencies employing Palantir, who argue that "the utility of the system and the value it adds to law enforcement investigations increases exponentially as more data sets are added."[108]

But if big data is productive, it also creates new problems. As previously argued, Palantir addresses a crisis of control in Beniger's sense: the logistical issues of integrating massive datasets are resolved through back-end technologies, the overload of information is managed through a cohesive user interface and a suite of filtering tools such as Search Around, Flows, and the Timeline. Yet if the technical issues of big data are resolved, the epistemological issues remain—the production of meaning, the emergence of false positives, the generation of spurious correlations. Simply put, what constitutes valid knowledge? Indeed an early evaluation of Palantir by GCHQ listed this as a possible risk, giving "the analyst greater potential for going down too many analytical paths which

104 ICE, "FALCON Operations," 2.

105 ICE, "FALCON New Requirements Outline," accessed December 10, 2017, https://assets.documentcloud.org/documents/3517286/FALCON-New-Requirements-Outline.pdf, 2.

106 ICE, "FALCON New Requirements," 7.

107 Evelyn Ruppert, Engin Isin, and Didier Bigo, "Data Politics," *Big Data & Society* 4, no. 2 (December 2017): 4.

108 ICE, "FALCON Operations," 6.

could distract from the intelligence requirement."[109] Is an association truly significant, a needle emerging from the chaotic haystack? Or is it simply wish fulfilment, conjured up to match the insights that this immense world of information is meant to provide? As researchers Kate Crawford and danah boyd observe, all too often big data simply "enables the practice of apophenia: seeing patterns where none actually exist, simply because enormous quantities of data can offer connections that radiate in all directions."[110] As explored earlier in this chapter, Palantir's logic is constructed through both expansion and contraction. To substantiate a claim of encapsulating 'reality,' it embraces unstructured information with a suitable degree of messiness and disorder. But this expansion is only a prelude to the contraction of pattern-finding. In the end a signal must be extracted from this noise, and big data—for all its productivities—leaves this core question unanswered. Which signal will it be?

Palantir's creation concept was the belief that human agents and computational agents, working together, could use analysis to defeat an "adaptive adversary."[111] Analysis here, though aided by scripted rulesets, flags, and filters, is a decidedly human task. This task is slow. Even with thousands of analysts operating concurrently, wading through the deluge of data in order to isolate individuals, track activities and uncover associations is a prolonged procedure, "time-consuming and manually labor-intensive due to complexities in the current U.S immigration system."[112] But, perhaps more importantly, this task is undeniably human. Palantir and its clients focus on its empiricism—the analytical disassociated from bias and subjectivity. To this end, the platform allows analysts to abstract themselves out, as it were—to generate paper trails of evidence, to create visualisations of linkages that 'speak for themselves,' to produce collaborative analysis with colleagues. Yet, despite these mechanisms, the decision-making ultimately comes down to the sense-making agency of the individual. One of Palantir's clients stated that it "assists the human evaluation and decision-making process and helps reduce human error and analytic uncertainty by presenting information already available to the user in a common sense fashion."[113] Of course, to *sense* takes time. And to use that sense to develop a *common* consensus takes more time still. It's easy to imagine that in the pressurised sphere of immigration, this time-commitment quickly creates a

109 SIGINT Development Steering Group, "SDSG Integrated Analytics Workshop" (Cheltenham, UK: GCHQ, October 14, 2011), https://ass ets.documentcloud.org/documents/3469343/SDSG-Integrated-Analytics-Workshop-WriteUp.pdf.

110 danah boyd and Kate Crawford, "Critical Questions for Big Data: Provocations for a Cultural, Technological, and Scholarly Phenomenon," *Information, Communication & Society* 15, no. 5 (2012): 668.

111 Palantir, "About."

112 ICE, "HSI Extreme Vetting Program Background," The Intercept, July 18, 2017, https://theintercept.com/document/2017/08/07/hsi-extreme-vetting-program-background/.

113 Department of Homeland Security, "Privacy Impact Assessment Update for the FALCON Search & Analysis System" (ICE, October 11, 2016), https://www.dhs.gov/sites/default/files/publications/privacy-pia-ice-032-falcons-b-october2016.pdf.

backlog of cases. But the real issue is that common sense is inevitably difficult and messy. It involves sense-making—weighing evidence, accounting for opposing claims and taking responsibility. And always threatening in the background is the claim that 'human error and analytic uncertainty' have impinged too heavily on the 'human evaluation and decision-making process.' We have little faith in our own abilities. Instead of human-centred analysis, a new paradigm of decision-making was desired—automation.

In July of 2017 U.S. Immigrations and Custom Enforcement (ICE) hosted an industry day, outlining a new project they wanted technology firms to bid for. Sign-in sheets for the two-day event obtained by investigative journalists Woodman and Biddle show the usual suspects: Booz Allen Hamilton, IBM, SAS, SAIC, Deloitte; but notably Palantir and its analysis-based systems were nowhere to be seen.[114] The event introduced the Extreme Vetting Initiative, a project based directly on Trump's phrase from a 2016 speech and linked to a supposedly similar "ideological screening test" from the Cold War era.[115] The presentation essentially sought to convert this ideology to operations, laying out the technical objectives for such a system.

The key objective, according to ICE, was a system that "automates, centralises, and streamlines the current manual vetting process;" if "actionable" data was retrieved, then it should make "determinations via automation."[116] What exactly constitutes actionable data is unknown. And perhaps that is an unspoken benefit. If the all-too-human analysis of Palantir signalled a chronic anxiety about our ability to make decisions, then automation promises to remove doubt by offloading responsibility. As Tarleton Gillespie argues, our faith in the algorithmic is strong—we want it to be right.[117] And here determination and automation dovetail perfectly together—the decisions must be right because they are made so swiftly and effortlessly. Andrew Goffey and Matthew Fuller note that environments and objects left to the "discretion of machines" are managed with operations characterised by both incredible speed and unwavering certitude.[118] Again, automation undoubtedly offers a form of acceleration, an urgent requirement when

114 See the sign-in sheets from the 2 day workshop: ICE, "July 18, 2017 Sign in Sheets," July 18, 2017, https://www.documentcloud.org/documents/3914251-July-18-2017-Sign-in-Sheets-1.html
ICE, "July 19, 2017 Sign in Sheets," July 19, 2017, https://www.documentcloud.org/documents/3914252-July-19-2017-Sign-in-Sheets.html.

115 Donald Trump, "Transcript" (Youngstown, Ohio, August 15, 2016), https://factba.se/transcript/donald-trump-speech-youngstown-oh-august-15-2016.

116 ICE, "HSI Extreme Vetting Industry Day Presentation" (Arlington, Virginia, July 18, 2017), https://assets.documentcloud.org/documents/3914250/Industry-Day-Presentation-1.pdf.

117 Tarleton Gillespie, "Can an Algorithm Be Wrong? Twitter Trends, the Specter of Censorship, and Our Faith in the Algorithms around Us," Culture Digitally, October 19, 2011, http://culturedigitally.org/2011/10/can-an-algorithm-be-wrong/.

118 Fuller and Goffey, *Evil Media*. 140.

screening thousands of applicants daily. But this is also an epistemological compression, moving instantly from information-given to knowledge-production while fast-forwarding through the time of deliberation, hesitation, and uncertainty. Of course, this instant, perfectly made evaluation is an illusion. As scholars like Crawford, Introna, Nissenbaum, and Pariser have demonstrated, assumptions and biases are 'baked-in' to these automated choices at a deep level.[119] But through the many layers of technical abstraction, the conflictual nature of decision-making becomes conveniently obscured. Algorithmic reason, writes Antoinette Rouvroy, "exempts from the burden of creating any type of community, of organising interpretation or evaluation processes."[120] The problem is ostensibly solved with surety and efficiency.

Intelligence refers to a capacity to 'pick out' or 'collect' the differences 'between' items.[121] If this is the case, then the ingestion, parsing, modelling, and prediction performed by this technology indeed constitutes a form of intelligence, but one without the inevitable delay and moral ambiguity resulting from deep deliberation. Bernard Stiegler writes that "algorithms, which are quicker than reason and which therefore amount to automated understanding, short-circuit" the slow work of discourse and deliberation.[122] In fact intelligence here is not really about the consideration of truth at all, but about the acceleration of activity. In this sense, the operational requirements envisioned for the government's new immigration platform are not so far removed from the techno-singularity panegyrics of philosopher and alt-right poster boy Nick Land. "What intelligence wants, in the end, is itself—where 'itself' is understood as an extrapolation beyond what it has yet been, doing what it is better."[123] In other words, the goal of such a project is intelligence without thought. The incredible productivity of automation is a direct result of what Stiegler calls "functional stupidity"[124] and Fuller terms the "economy of ignorance."[125] The ICE presentation describes a

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119 Kate Crawford, "Algorithmic Illusions: Hidden Biases of Big Data" (Strata Conference, Santa Clara, California, February 26, 2013), https://www.youtube.com/watch?v=irP5RCdpilc.
Helen Nissenbaum, "How Computer Systems Embody Values," *Computer* 34, no. 3 (2001): 120–119.
Lucas D Introna and Helen Nissenbaum, "Shaping the Web: Why the Politics of Search Engines Matters," *The Information Society* 16, no. 3 (2000): 169–185.
Eli Pariser, *The Filter Bubble: How the New Personalized Web Is Changing What We Read and How We Think* (London: Penguin Books, 2012).

120 Antoinette Rouvroy, "The End(s) of Critique: Data Behaviourism versus Due Process," in *Privacy, Due Process and the Computational Turn. London: Routledge*, ed. Mireille Hildebrandt and Katja De Vries (New York: Routledge, 2013), 149.

121 Douglas Harper, "Intelligence," Online Etymology Dictionary, accessed April 5, 2018, https://www.etymonline.com/word/intelligence.

122 Bernard Stiegler, *Automatic Society* (Cambridge: Polity Press, 2016).

123 Nick Land, "Against Orthogonality," *Outside in* (blog), October 25, 2013, http://www.xenosystems.net/against-orthogonality/.

124 Stiegler, *Automatic Society*, 102.

125 Matthew Fuller, "Black Sites and Transparency Layers," in *How to Be a Geek: Essays on the Culture of Software* (Cambridge, UK: Polity Press, 2017), 220.

situation in which immigration agents input a name and rapidly receive either a green light or a red light.[126] What could be clearer or more unquestionable?

Naming the alien becomes automated, a delineation without arbitration. And it is here that the sovereignty of the algorithmic begins to emerge. Political historian Richard Bourke defined sovereignty as the "final decision-making mechanism within a political community."[127] Using this formula, the political community is the state, the mechanism is algorithmic, and the final decision determines who gets to be a citizen—obtaining access to welfare, health care, infrastructure, and so on. This power, like Bodin's famous formulation, is not accountable to any other individual or institution (absolute), is held indefinitely (perpetual), and cannot be shared or split (indivisible). In dividing and deciding, the algorithmic performs a liminal power.

On the one hand, such a boundary is final, exerting a decisive force. The word 'decision' in Latin is literally to cut (*caedere*) off (*de).* To decide is to slice into the field of possibility, selecting some and discarding others. In doing so, a continuous domain is interrupted, fractured by a break. Indeed for Foucault, the racial division of white from black, for example, was underpinned by a form of sovereign power that introduced a "biological-type caesura within a population that appears to be a biological domain."[128] The decision (*de-caedere*) creates a break (*caesura*) in the smooth space of citizenry. Updating this language for the algorithmic, to cut off is to establish a boundary-condition, a logic gate. Ambiguity is zeroed out. As Amoore observes, the "algorithmic turn in security has no tolerance for the emergent or half-seen figure."[129] Hard distinctions are established: the valid passes through into the recognised interior; the invalid is repelled, ignored, and exteriorised. The algorithmic strives to decisively delineate true from false, white from black, alien from citizen, green light from red.

Yet on the other hand, this border is highly flexible. Rather than static criteria, a morphable membrane is produced, underpinned by the capacity of technologies to assemble, index, and average a constellation of disparate signals. Many of Palantir's notional demonstrations, for example, focus on its ability to combine travel activity, phone conversations, and financial transactions from a myriad of data sources into a cohesive profile.[130] The makeup of such signals can

126 ICE, "HSI Extreme Vetting Industry Day Presentation."

127 Richard Bourke, Concept of Sovereignty, interview by Serious Science, August 10, 2017, https://www.youtube.com/watch?v=kuobgLICp1w.

128 Michel Foucault, *"Society Must Be Defended": Lectures at the Collège de France, 1975-1976*, trans. François Ewald (New York: Picador, 2003), 255.

129 Louise Amoore, "Security and the Claim to Privacy," *International Political Sociology* 8, no. 1 (March 1, 2014): 108–12, https://doi.org/10.1111/ips.12044.

130 This engineering challenge that visualized and structured data around a fictional arms dealing network is just one of many that could be chosen. Palantir, "VAST 2010 Challenge," July 3, 2014, https://www.youtube.com/watch?

be adjusted, with new metrics added or removed. Similarly, the weighting of signals might be modified, with some parameters being privileged as heavier factors whilst others only figuring nominally. As John Cheney-Lippold observes, "new information can come to light within this algorithmic system and an algorithm can subsequently move to change both a category's meaning and the once-essential ideals ascribed to that category."[131] Rather than being static or set in stone, the categorization resulting from such an aggregation becomes a pliable structure. As Deleuze foresaw, rigid moulds would give way to more fluid forms, modulations able to "continuously change from one moment to the other."[132] By adjusting its classifiers, this power obtains an elasticity, allowing it to adapt to additional insights and information over time.

The algorithmic thus offers adaptability to the state—power becomes final *and* flexible. One of ICE's key system objectives is the ability to "perform regular, periodic and/or continuous review and vetting of nonimmigrants for changes in their risk profile after they enter the United States."[133] Immigration here is reconfigured. It is no longer the single event of a body crossing a border or a plane arriving at a port of entry. The power of the state at these moments was concentrated but transient, a temporary ability to stamp a visa or deport an applicant. Instead, by reformulating immigration as the interiorisation of the User into the algorithmic, this event becomes indefinitely extended and opened up to moment-by-moment recalculation. The liminal power of the algorithmic is employed, a decision-making mechanism that can instantly invert the interior and the exterior, transforming an interim acceptance into an ultimate rejection. Instead of fixed, it is "malleable, dynamic, and impermanent," preventing "any possible claim to inviolate protection."[134] Rather than a resolution for all time, decisions are made just-in-time.

This is the decisionism of the algorithmic, one that constitutes a "new field of the political."[135] Such power is not simply theoretical. It provides a new flexibility to deportation criteria in which the

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v=ANjE_78m8U4.

131 John Cheney-Lippold, "A New Algorithmic Identity: Soft Biopolitics and the Modulation of Control," *Theory, Culture & Society* 28, no. 6 (2011): 171.

132 Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (1992): 4.

133 ICE, "HSI Extreme Vetting Industry Day Presentation."

134 John Cheney-Lippold's concept of algorithmic citizenship (*jus algoritmi*) is based on the criteria of 51% foreignness designated by the National Security Agency (NSA). Operating through metadata and dynamically assigned without the subject's knowledge, it is rather different from the shift seen here from citizen to User. But the flexibility of its logic and the incessancy of its calculation is still highly relevant. John Cheney-Lippold, "Jus Algoritmi: How the National Security Agency Remade Citizenship," *International Journal of Communication* 10 (2016): 22, 1736.

135 Ned Rossiter and Geert Lovink, "FCJ-029 Dawn of the Organised Networks," *Fibreculture*, no. 5 (2005), http://five.fibreculturejournal.org/fcj-029-dawn-of-the-organised-networks/. See also: Ned Rossiter and Soenke Zehle, "Mediations of Labor: Algorithmic Architectures, Logistical Media, and the Rise of Black Box Politics," in *The Routledge Companion to Labor and Media*, ed. Richard Maxwell (London: Routledge, 2015), 62–72.

threshold separating the productive from the problematic migrant has suddenly been adjusted. Immigration raids carried out by ICE in the US, for example, have traditionally targeted migrants with major felonies. But in a recent series of raids carried out by the Trump administration, half those targeted had minor traffic violations or no criminal record at all.[136] And this power is not just informational. It plays out psychologically and corporeally through the fear, distrust, and destabilised households wrought by data-driven ICE raids.[137] Sovereignty continues, but through algorithmic sovereignty—indeed the specific power now desired by the state can only be achieved through the continuous recalculability offered by the algorithmic.

In the imaginary of Extreme Vetting, immigration shifts from legal policy to technical protocol, becoming a highly articulated, highly invasive filter. If this filter is correctly calibrated, the argument goes, then prosperity and security will naturally follow, making "America safe again."[138] Prosperity emerges from including the right kind of people. One requirement for the new ICE system is thus to determine the "applicant's probability of becoming a positively contributing member of society, as well as their ability to contribute to national interests."[139] At the same time, security is achieved through excluding the wrong kind of people. A further system requirement is thus to predict "whether an applicant intends to commit criminal or terrorist acts after entering the United states."[140] The vision here is undoubtedly still grounded in the 'hard empiricism' witnessed throughout the Palantir demonstrations—biological traits, travel history, political statements, business affiliations, and so on—but it is a vision in which this information is tied together into a complex network of signals that strives to moves *past* the visible and material surface to arrive at the inner life of the individual and their latent internal motivations. Not just who you are but who you want to be.

Whether this imaginary is legal is doubtful. In the post-briefing Question and Answer session, one vendor inquired about a similar initiative by the FBI that was terminated due to legal challenges from the American Civil Liberties Union. "The prediction is," replied the agency, that "in the near future there will be legislation addressing what you can and can't do. We will continue to do it until

136 Maria Sacchetti and Ed O'Keefe, "ICE Data Shows Half of Immigrants Arrested in Raids Had Traffic Convictions or No Record," *Washington Post*, April 28, 2017, https://www.washingtonpost.com/local/social-issues/ice-data-shows-half-of-immigrants-arrested-in-raids-had-traffic-convictions-or-no-record/2017/04/28/81ff7284-2c59-11e7-b605-33413c691853_story.html.

137 Mizue Aizeki, "Families Fearing Deportation Because of Trump's Immigration Policies Prepare for I.C.E. Raid," *Newsweek*, June 28, 2017, http://www.newsweek.com/immigration-immigration-and-customs-enforcement-ice-donald-trump-628896.

138 Trump, "Transcript - Speech."

139 ICE, "HSI Extreme Vetting Industry Day Presentation."

140 ICE, "HSI Extreme Vetting Industry Day Presentation."

someone says that we can't."[141] It is this kind of exchange that foregrounds the shifting nature of sovereignty and the ascendancy of the operational over the legal.

Whether this imaginary is possible is also doubtful. But the emphasis here is on the imaginary *as imaginary*—a compelling and collectively shared dream that nevertheless "animates individuals and societies"[142] in tangible ways, establishing goals, coordinating efforts, and drumming up considerable material resources in the form of labor, investment, R&D, and so on. It is an imaginary that reveals one of the ways in which state power has been reconfigured. The conventional sovereignty of the state—assumed and grounded in juridical and legal concepts—has been challenged by the sovereignty of the algorithmic, a distributed power "whose operation is not ensured by right but by technique, not by law but by normalisation, not by punishment but by control."[143] Legitimacy emerges from capability.

Immigration is one arena that appears to renationalise political power and revivify the ostensibly unconscious state. Yet in order to reassert themselves, states appear to concede some of their older sovereignty in exchange for a new algorithmic sovereignty—a technically grounded, incessantly calculated mechanism that retains the final decision over the logical interior and the exterior. Here the algorithmic elides any distinction between those within the territory and those without, between a right by birth (*jus soli*) or a right by blood (*jus sanguinus*). Now the only distinction that matters is that between User and non-User. Users are acknowledged and individuated; non-Users are externalised and ignored. Given these conditions, immigration simply becomes a domain-specific implementation of an established technical paradigm—identifying and authorising legitimate Users. Indeed one country's 'e-residency' concept, considered "so far ahead" of other nation-states, is celebrated precisely for understanding this shift and implementing it securely.[144] What Users receive, of course, varies: social tools, a political platform, income, subsidised housing, file storage, career networking, and so on. What non-Users receive is always the same: nothing. Passing through this algorithmic boundary, the rich historico-political wake of the citizen is largely stripped away. The citizen is abstracted away; the User takes her place. If the citizen is historical and sited, the User is fungible and universal. If the citizen is someone who makes rights claims,[145] the

141 Sam Biddle and Spencer Woodman, "These Are the Technology Firms Lining Up to Build Trump's 'Extreme Vetting' Program," *The Intercept* (blog), August 7, 2017, https://theintercept.com/2017/08/07/these-are-the-technology-firms-lining-up-to-build-trumps-extreme-vetting-program/.

142 Vincent Mosco, *The Digital Sublime: Myth, Power, and Cyberspace* (Cambridge, MA: MIT Press, 2005), 3.

143 Michel Foucault, *The History of Sexuality*, trans. Robert Hurley (New York: Pantheon Books, 1978), 86.

144 Nathan Heller, "Estonia, the Digital Republic," *The New Yorker*, December 11, 2017, https://www.newyorker.com/magazine/2017/12/18/estonia-the-digital-republic.

145 Engin Isin and Evelyn Ruppert, *Being Digital Citizens* (Rowman & Littlefield International, 2015), 5.

User is someone who accepts the license agreement. And if the citizen can form agonistic publics,[146] the User's politics are already tagged and categorised. The citizen, born from a rich history of social rights and sovereign freedoms, is rendered inoperable.

To conclude, this chapter has analysed Gotham's Palantir, delving into two specific deployments of it within law enforcement (LAPD) and immigration (ICE). In analysing their operations, the chapter aimed to demonstrate how legitimacy emerges from capabilities. Gotham's backend powers massive repositories of disparate, partial information, forming a believable approximation of reality. Gotham's schema is imposed on these datasets, providing meaning through objects and relations and also interoperability by facilitating connections between data sources. Once integrated, Gotham's front-end offers tools to identify patterns and locate anomalies, allowing analysts to extract credible signals from all the big data noise. For the LAPD, sensible decisions can be made because Gotham has credibly made sense of the world out there. For ICE, defensible decisions can be actioned because Gotham has completely and capably assessed all the relevant information. Both of these cases illustrate how arcane couplings of ontologies, databases and interfaces come together to conduct a performance which is convincing, even compelling. It is technical ability, rather than pedigree or sovereignty, that legitimates the political right to wield power. In short, affordances grant authority. This legitimate power has significant impact. While delving into technical conditions or political definitions, these analyses have ultimately aimed to foreground the stakes of algorithmic power. Legitimated by a credible logic, control is exerted on the lives of others, whether through a body being dragged from a vehicle or through the violence of a deportation raid.

146 Chantal Mouffe, "Deliberative Democracy or Agonistic Pluralism?," *Social Research* 66, no. 3 (1999): 745–58.

2.

Replicable Power: Uber

If Palantir's algorithmic power hinges on legitimacy, Uber is focused on replicability. Every single time a Rider requests a ride, Uber commands a Driver to be there. Replication, in this context, entails a labor performance which can be executed consistently, professionally, at scale. Formalised into a routine, a procedure for transporting anything from A to B, this replicable performance coheres closely to traditional ways of understanding the algorithmic. Yet from Uber's own Silicon Valley perspective, this way of thinking is given; the innovation lies in spinning this algorithmic loop out into the urban, applying this computational model to a tangible logistical problem. As CEO Travis Kalanick asserts, "the unique aspect of Uber is that we exist in the physical world."[1] Of course, scholars like Kittler, Kirschenbaum, Parikka, and Parks and Starosielski have thoroughly demonstrated the materiality of the digital.[2] But ignoring for a moment the materiality of data centres, cables, and drives, Uber features a very overt materiality at the heart of its operations—moving food or bodies through urban space with vehicles. In Kalanick's words, "a car moves across the city and appears where you are."[3] Thus, while caricaturing technology alone as cloistered and immaterial ("we are not just technology"), the company claims to be a new kind of infusion of the computational into the physical. As Kalanick concludes, "we exist in the place where bits and atoms come together."[4]

Replication in this place is high risk, high reward. On the one hand, the 'real world' can be productive and highly profitable. Indeed, three of the algorithmic examples profiled in this thesis, Uber, Palantir, and Airbnb, are considered 'unicorns'—startups valued at over $1 billion dollars.[5] As will be discussed in the Capital-Cashburning machine section later in this chapter, Uber in particular has received an immense influx of investment. Certainly then, the infiltration of algorithmic systems into the everyday presents lucrative new possibilities. But on the other hand, the 'real world' is also a fraught space. The intersection of 'bits and atoms' drastically amplifies the

1 Travis Kalanick, "Celebrating Cities: A New Look and Feel for Uber," Uber Global, February 2, 2016, https://newsroom.uber.com/celebrating-cities-a-new-look-and-feel-for-uber/.

2 I'm thinking in particular here of "There is No Software" by Kittler, the media archeology work of Parikka and Kirschenbaum, and the media infrastructures work of Parks and Starosielski, see
Friedrich Kittler, "There Is No Software," in *The Truth of the Technological World: Essays on the Genealogy of Presence*, trans. Erik Butler (Stanford, CA: Stanford University Press, 2014), 219–29.
Jussi Parikka, *A Geology of Media* (Minneapolis: University of Minnesota Press, 2015).
Matthew Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2008).
Lisa Parks and Nicole Starosielski, eds., *Signal Traffic: Critical Studies of Media Infrastructures* (Urbana: University of Illinois Press, 2017).

3 Kalanick, "Celebrating Cities."

4 Kalanick, "Celebrating Cities."

5 While this point is practically common knowledge, for a more in-depth, decidedly Silicon Valley take on unicorns, see Georges Nahon, Chris Arkenberg, and Ken Yeung, "Unicorns, Startups & Giants: The New Billion Dollar Dynamics of the Digital Landscape" (San Francisco: Orange Silicon Valley, May 2014), https://s3-us-west-1.amazonaws.com/osvresearch.com/OSV_UnicornReport-(revised).pdf.

negotiations with materiality that technical systems have to deal with, bringing other agencies into the mix. Rather than the compliant medium of pixels, systems such as Uber enlist the frictional element of people, and their diverse motivations, into algorithmic processes. A new dependence emerges, a reliance on capabilities at the fringes of control. Uber's slogan is 'tap a button, get a ride.' Yet far from being guaranteed, the millions of rides carried out daily are dependent on a driver to sign on, answer a request, pick up a passenger, and drop them safely at their destination.

The replication of this performance is complicated by the fact that Uber insists on the self-employed status of their labour force. An Uber driver has no boss in the traditional sense, precluding the typical use of employer power. Instead workers are Driver-Partners, an Uber neologism that defines them as independent contractors, not employees. As Uber's contract states: "the relationship between the parties under this Agreement is solely that of independent contracting parties... this Agreement is not an employment agreement, nor does it create an employment relationship, between Company and you."[6] This dream of controlling labor without taking on the full financial, logistical or ethical responsibilities for labor is a highly seductive vision from the perspective of capital.[7] But it also means that the regulatory ring-fence of employment relations—contractually specified performance, payment incentives or docking, adherence to corporate policies—cannot be extended to encompass the worker. It pushes algorithmic operations to their limits, suggesting the need for new tactics which must attain real traction if algorithmic systems are to enjoy the profits of the 'real world.'

This chapter examines three machines, exploring, respectively, the pursuit of replicability, the failure of replicability, and the vision of replicability at scale. The Partner-Management-Messaging machine shows how, despite their lack of employment leverage, Uber's logic and control attempt to construct a replicable labor performance to purposively direct drivers towards their predetermined goals. Next, the ViolentFlesh-Passenger machine uses a variety of physical and sexual assault cases to examine how Uber's informatic logic fails to adequately encompass the corporeal capacities of the

6 As stated in the Rasier agreement, a document that effectively defines the legal relationship between Uber and its drivers. Rasier LLC is a wholly owned subsidiary of Uber Technologies that collects the income, while Uber acts as a holding company that focuses on research and development, a corporate structure that incidentally also seems to provide a liability buffer. Rasier, "Technology Services Agreement," December 10, 2015, https://s3.amazonaws.com/uber-regulatory-documents/country/united_states/RASIER%20Technology%20Services%20Agreement%20Decmeber%2010%202015.pdf.

7 Of course, this dream of commanding maximum labor productivity while taking on minimum responsibility, be it financial, educational, or environmental, is not new. Indeed the brutally long shifts and child labor that Marx chronicles can be understood as an older incarnation of this dream of attaining labor without having to account for their health, safety or wellbeing of employees. This dream was only slowly tempered by factory inspection and eventual legislation, acts that curbed "the passion of capital for a limitless draining of labour-power." Yet if this dream is not new, the algorithmic affordances underpinning Uber reinvigorate it, making it both newly functional and profitable. Karl Marx, *Capital: An Abridged Edition*, ed. David McLellan (Oxford: Oxford University Press, 1999), 444.

driver, allowing control to unravel into violent uncontrol. Finally, the Capital-CashBurning machine argues that a model of growth through replication becomes an imperative in itself, driving a broader corporate obsession with scale rather than profit. Each machine is operative at a different scale, providing an analysis that moves from the individual drivers to the planetary platform. And each machine provides a particular focus, an analysis that draws out insights from Uber without confronting its complex totality.

Partner-Management-Messaging machine

As a driver-partner, Arjun works for himself. He gets up when he wants, works when he wants, and goes where he wants. And yet his activities throughout the day are shaped in subtle ways: compelling him towards particular places at specific times of the day, urging him towards longer hours, prompting him towards a certain standard of customer service. Uber produces this particular subjectivity through a multitude of algorithmic interventions—one which must constantly be negotiated and renewed, but which nevertheless retain a surprising efficacy. Surprising, because this regulative apparatus appears to consist of very little indeed: a sequence of events presented on a smartphone prompt a performance which emerges organically from the self. How does this subjectivity emerge, and what algorithmic operations are necessary to induce it? To pursue this question, this section analyses a machine comprised of the worker (referred to by Uber as the 'Driver-Partner'), Uber Management, and the in-app communication or Messaging that mediates much of their relations.

Uber Management has a predefined image of a worker's roles and responsibilities—a particular notion of the type of work which should be carried out, the initial cost outlay, the timeframes necessary, the skills desired, the compensation involved, and so on. This vision ranges from the nominal worker established by mandatory requirements through to guidelines, suggestions, and best-practice approaches that attempt to foster an ideal worker. Yet these expectations are conveyed not via traditional hierarchies, thick handbooks, extensive training or physical overseers. Instead, one of the primary channels is data-driven messaging which is automatically sent by backend platforms and which appears on the worker's phone via the Partner app. This instant feedback loop has powerful behavioural effects, as veteran drivers realise, noting that "app-provided stimuli is immediate."[8] However, as we'll see, Partners have their own visions for the work they want to carry out, expectations which both converge towards and diverge away from those of Management. They attempt to realise this vision through a set of concrete practices situated at the intersection of labor

8 Harry Campbell, "How Uber Uses Behavior Modification To Control Its Drivers," The Rideshare Guy Blog and Podcast, October 17, 2016, http://therideshareguy.com/how-uber-uses-behavior-modification-to-control-its-drivers/.

and logistics.

Ratings are one form of messaging. Ratings are mutual—both the driver and the passenger rate each other from 1 to 5 stars for each ride given. However, the stakes are far higher for the driver, who will be barred from the platform if his rating dips too low. Anything under 4.8 is considered below average; lower than 4.6 and the driver is at risk of being deactivated.[9] Like Promotions, the combination of responsive backend data and real-time messaging provides crucial support for a company policy while possessing some key advantages.

Ratings are accessed as one of the four main 'tabs' in the app. As a user interface element, tabs are essentially a set of views, grouping complementary content into panels that are either active (visible) or inactive (hidden). In the older paradigm of pages, processes would only be initiated once a link was clicked and the page loaded. For example, an exam and its associated timer only start when a student moves from the Home page to the Exam page. In contrast, all of the content and calculations within tabs are already loaded and executing, albeit hidden behind the active tab. There is an indication, then, that for the Partner tapping a tab is less like initiating a process and much more about simply foregrounding one that *was already running*.[10] In other words, Partners 'tab across' to a form of governance which seems to be always-on and always-computing.

In practice, of course, Ratings are given out once after each ride. Psychologically, however, the driver's awareness of Ratings being incessantly recalculated functions as a strong, if subliminal, form of behavioural motivation. Judge Edward Chen commented specifically on the power of Ratings in a recent ruling, stating that "this level of monitoring, where drivers are potentially observable at all times, arguably gives Uber a tremendous amount of control over the 'manner and means' of its drivers' performance."[11] The stressful, sweaty-palmed annual performance review is replaced by a reappraisal constantly performed throughout the day as a series of microinteractions.

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9 Ratings and their relationship to deactivation is not cut and dried. These figures are for UberX, the 'standard' Uber ride-share service. Drivers for UberSELECT, the higher end variant, must maintain an 'average lifetime rating' of 4.7 to continue working. While the reference here is a leaked document from Business Insider, these figures are just more exact, less PR-massaged versions of the general guidelines that Uber makes available on its website. In other words, Ratings and their standard of measure are made very clear to drivers. James Cook, "Uber's Internal Charts Show How Its Driver-Rating System Actually Works," Business Insider Australia, February 12, 2015, https://www.businessinsider.com.au/leaked-charts-show-how-ubers-driver-rating-system-works-2015-2.

10 The psychology of how users understand tabs seems to be non-existent, but one possible access point is Google's recent decision to 'throttle' background tabs in its Chrome browser. As widely used software, the web browser drives a common understanding that tabs hide and show running processes, rather than beginning and ending them. Dimitar Mihov, "Chrome to Aggressively Throttle Background Tabs – as a Feature, Not a Bug," The Next Web, January 26, 2017, https://thenextweb.com/apps/2017/01/26/chrome-throttle-background-tabs-google/.

11 United States District Court, *O'Connor v. Uber Technologies, Inc.*, No. C-13-3826 EMC (ND California March 11, 2015), 24.

Computation running in the 'background' of the app establishes a corresponding low-level anxiety in the cognitive background of the Partner. As one driver explained, "[the star rating] is constantly in your head, and it hits you: am I going to get rated low? Am I going to get a complaint against me?"[12] Ratings perform company policy in a far more subtle and sophisticated manner than a paper contract or an employee manual ever could.

The Rating messages thus performs a subtle prodding of the driver towards a particular labor practice—a performance which, in turn, elicits a desired passenger response. This is the 'service with a smile' of emotional labour theorised by Arlie Hochschild in her seminal study into airline stewardess work, a labor requiring "one to induce or suppress feeling in order to sustain the outward countenance that produces the proper state of mind in others."[13] Here, software reaches its limits. The driver performativities desired by Management obviously cannot be coded for technical reasons; Uber cannot code happiness, nor can it directly control behaviour. More importantly, however, they cannot be coded for emotional reasons. Affective labour must always appear improvised and effortless—spontaneous and sincere, seeming to to arise naturally from the heart. In Hochschild's words, "to show that the enjoyment takes effort is to do the job poorly."[14]

Along with this inducement of positive emotion comes the suppression of negative conditions like fatigue and irritability, "for otherwise the labor would show in an unseemly way, and the product—passenger contentment—would be damaged."[15] In short, affect must seem authentic, not automated. Uber doesn't provide mechanisms for tipping, nor budget for niceties. There are no financial incentives for the driver. But given a rating slipping uncomfortably close to the 4.7 mark and staring at him from the smartphone screen, a driver might induce in himself an emotional performance which opens doors, offers mints or bottled-water, engages in cheerful banter or helps with luggage.[16] Simultaneously, he might suppress frustration caused by a drunk passenger, the stress of a traffic jam, or the tiredness from a long shift. Indeed, if they want to continue on the platform, drivers have few options. The Rating system is notoriously one-sided: though Drivers could also rate Riders, there were no consequences for a low score.[17] In the end, Ratings perform a

12 Knight, "How Uber Conquered London."

13 Arlie Russell Hochschild, *The Managed Heart: Commercialization of Human Feeling* (Berkeley: University of California Press, 2003), 7.

14 Hochschild, *The Managed Heart*, 8.

15 Hochschild, *The Managed Heart*, 8.

16 Uber Help, "How to Improve Ratings," accessed December 12, 2018, https://help.uber.com/partners/article/how-to-improve-ratings.

17 From Uber Driver forums: "rating the passenger is just a waste of time anyway. there are no consequences for passengers with low ratings as far as I know." x'ing, "What's the Point of Passenger Ratings," *Uber Drivers Forum*, June 25, 2016, https://uberpeople.net/threads/whats-the-point-of-passenger-ratings.86432/.
Though just recently, as of September 2018, this is slowly changing. In Australia and New Zealand, specifically,

function for Management which foregrounds emotional labor, forcing Partners to manage their own feelings in order to keep working.

The driver also receives a regular Driving Report. This is an automatically generated message which uses the phone's accelerometer and GPS sensor to detect speed and movement over time. A phone is located through GPS by using at least 4 global positioning satellites.[18] Like the acoustic phenomenon when a car zooms past, a telematic Doppler Shift occurs as the phone moves closer or further away from these positions. As Uber engineer Andrew Beinstein explains, the velocity of any phone (and by extension vehicle) can be "accurately derived from the difference between the expected signal's frequency and its actual one."[19] Once vehicle speed is determined, acceleration and braking can be defined as a sudden change in this speed over time. For Beinstein a simple formula can thus "determine the magnitude of the acceleration by calculating the derivative."[20] Standards are established which define harsh manoeuvres. Uber Engineering uses the standard set by Progressive Insurance of $3m/s^2$ for a 'hard braking' event deemed to be unsafe. If these infractions are sensed too often, the Driving Report automatically issues warning messages. One such warning, notifies the driver that "several harsh accelerations were detected" with the infraction date written in a cautionary orange tint. While technical in detail, the key point here is that the smartphone establishes its own regulatory circuit: collecting data; transmitting it for processing; and presenting the results in a feedback loop. The result exerts a steady pressure towards conformance to a behavioural norm defined as safe driving.

A final form of messaging is the Promotion. Promotions are featured on the app home screen and take the form of targeted campaigns which typically offer higher wages for driving in a specified place at a set time. Titled Boost and Quest, Uber launched these reward programmes to drivers with much fanfare, stating:

> Every week, you'll receive highly personalised Quest and Boost rewards offers that are designed to be more flexible around how much and when you want to drive. Drive in featured locations during specified hours and see your fares multiply with Boost, and complete a set number of trips anywhere and anytime in the DC area to earn an extra reward

Uber has begun to ban Riders with extremely low ratings (<3).

18 Aaron Weiss, "GPS Basics," Sparkfun Electronics, accessed April 13, 2017, https://learn.sparkfun.com/tutorials/gps-basics.

19 Andrew Beinstein, "How Uber Engineering Increases Safe Driving with Telematics," Uber Engineering Blog, June 29, 2016, https://eng.uber.com/telematics/.

20 Beinstein, "How Uber Engineering Increases Safe Driving with Telematics."

> with Quest. Should you consistently hit your Quest levels, your Quests can increase to help you earn to your highest potential.[21]

While these campaigns conform to classic incentivisation schemes, the real-time feedback enabled by the platform shifts them into gamification. For instance, the promotion of 'Drive 18 trips, make $60 extra' as a proposition written in text appears as a purely financial reward—a performance-based pay boost. However, the campaign is represented as an ongoing challenge, indicated by a green progress bar that notches up instantly after every successful drop-off. The combination of responsive data and real-time messaging thus transforms a dry offer into a gamified mission, harnessing the same kind of level-up logic and micro dopamine hits well understood in the gaming and gambling industries. As one London driver explained, "it's like being in the bookies. It is very, very addictive."[22]

Work becomes (serious) play. Taken together, Ratings, Promotions, and Reports set goals, track progress, and reward achievements, establishing a level-up logic—the labour process as game. Almost forty years ago, Michael Burawoy, in his seminal study titled *Manufacturing Consent*, asked why workers worked so hard. The incredible intensity of labour and motivation of workers on the shop floor seemed to far exceed monetary incentives. Burawoy discovered that the conditions of 'making out' in shop parlance—of making quotas by completing tasks with varying degrees of difficulty on particular machines—constructed a kind of meta-game. For the operators, this game was difficult, often taking months before newcomers achieved success; it involved risk, weighing the danger of machines with their rewards; and there were stakes, not only financial but psychological. This then, was not a game in a conventional sense—a fun, frivolous activity played purely for leisure. Instead, faced with the harsh realities of industrial production, the game formed what William Baldamus has called a 'relative satisfaction', an activity that infused a degree of sense-making and self-determination into a labour process dominated by deprivations.[23]

As a method of enlistment, labor-as-game reveals the complexity of consent. Economic incentives were only one element of the game Burawoy witnessed on the shop floor. Again, this is not to say that operators were working for pleasure, nor that they didn't appreciate the financial stakes involved. But the game provided a kind of overarching logic that subordinated monetary concerns

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21 The original announcement was only emailed to Drivers, but was copied and pasted into a forum by a driver, see Pepe Inaki, "Introducing Quests - A New Way to Scam Drivers," Uber Drivers Forum, November 18, 2016, https://uberpeople.net/threads/introducing-quests-a-new-way-to-scam-drivers.119297/.

22 Sam Knight, "How Uber Conquered London," *The Guardian*, April 27, 2016, sec. Technology, https://www.theguardian.com/technology/2016/apr/27/how-uber-conquered-london.

23 Michael Burawoy, *Manufacturing Consent: Changes in the Labor Process under Monopoly Capitalism* (Chicago: University of Chicago Press, 1979), 78.

as one parameter amongst many. "The rules," Burawoy argues, "are evaluated in terms of the defined outcomes of the game."[24] To reach the outcome of 'making out' whilst conforming to the shop floor rules entailed a performance of machinic craft, relational skill, risk analysis, time management and so on. For the Uber driver, goals might include 30 rides, a 5 star Rating, or achieving a specific Campaign, a challenge governed by platform rules and requiring a performance juggling its attendant parameters. For Burawoy, this hyperfocus on the rules and the outcome means that the pursuit of profit or the reinforcement of capital relations become secondary—a "broader set of outcomes that are also the consequence of the game."[25] Indeed, to the extent to which the game becomes an end in itself, these relations become obscured, "overshadowing, masking, and even inverting the conditions out of which it emerges."[26] Whilst Burawoy observes that operators shared their piecework performances in conversation, "always in terms of 'making money', they were, in reality, communicating 'game scores' or 'race results.'" In this sense, money becomes an integer that distills all of the variables that went into a perfect performance. Winning the game also provides more than material wealth, offering the worker a sense of mastery of a process, a degree of social capital in the form of reputation, and an accelerated sense of time with less drudgery.

How is the game defined? The game is not some form of counter-practice constructed by workers in defiance to a top-down hegemony. Burawoy makes clear that it is "neither independent of, nor oppositional to management."[27] But this doesn't mean that the parameters of the game are handed down untouched from management either. Instead, the game emerges from the interplay between the two. As Burawoy argues, "the game does not reflect a harmony of interests; on the contrary, it is responsible for and generates that harmony."[28] The rules of the game, such as they are, reconcile two sets of distinct and disparate desires. In Burawoy's time of the late 1970s, he saw the game being actively created by workers and tweaked by management. "Games," he writes, "arise from workers initiatives, from the search for means of enduring subordination to the labor process, but they are regulated, coercively when necessary, by management."[29] If there is an update to make, then, it is a shift in asymmetry. Within algorithmic ecologies such as Uber, management are acutely aware of the benefits of gamification logics for labor, and thus take a more active role in shaping its parameters—setting rewards, tracking progress, and offering multiple modes of play. This doesn't entail, however, an easy acquiescence of the worker, nor foreclose modification of the game either

24 Burawoy, *Manufacturing Consent*, 82

25 Burawoy, *Manufacturing Consent*, 82

26 Burawoy, *Manufacturing Consent*, 82

27 Burawoy, *Manufacturing Consent*, 80

28 Burawoy, *Manufacturing Consent*, 82

29 Burawoy, *Manufacturing Consent*, 86

on regional or individual levels.

Drivers are not docile. Their desires sometimes coincide with the managerial imaginary. Often, however, they veer away in a set of responses which deflect or negate the disciplinary procedures enacted automatically by the platform. Partners negotiate with these expectations through their responses. They craft a set of behaviours which *adjust to* but also *obfuscate away* from algorithmic controls—amplifying the positive markers which are recognised but also reducing aberrant information and its associated effects. For example, if the driver has declined a Ride Request, he or she will receive a warning message in the Partner homescreen with the attention-grabbing headline of 'Your Earnings'. These messages are colour coded in orange and accompanied by the conventional cautionary icon of an exclamation mark centred in a triangle. As driver Harry Campbell explains, they are warnings, because "if you miss more than 2 requests, Uber will actually place a driver on 'time out' for 2 minutes."[30] However, one veteran driver on a forum offered an easy workaround to the 'missed pings' (declined rides) ban. The solution, as Campbell points out, "is to log off IMMEDIATELY after letting a ping go, then logging right back in. This will clear your missed pings before they can put you in 'time-out.'"[31]

Drivers play the Uber labor-game strategically, as Alex Rosenblat has noted in her extensive ethnographic research on Uber and Lyft. During a surge period, many drivers will toggle constantly between the Passenger and Partner apps, gauging the level of passengers (demand) compared to drivers available (supply), and waiting for a threshold to be reached before acting.[32] Other drivers have noticed that "the surge pricing will disappear if drivers flock to the area, so they consider waiting just outside the edge of a surge area to help sustain its rise."[33] Here, labor is held back, drivers hovering on the edges of a zone until a desired monetary reward is offered. The logic of Surge is made all-too-obvious, and so, rather than acquiescing to its attendant control mechanism, drivers push against it, delaying the instant injection of labor that Uber is attempting to supply. And in another study researchers interviewed 21 Uber and Lyft drivers, finding surprisingly that more than half of them ignored surge pricing information altogether, "as the supply demand control algorithms failed to accommodate their abilities, emotion, and motivation."[34]

30 Campbell, "How Uber Uses Behavior Modification To Control Its Drivers."

31 Campbell, "How Uber Uses Behavior Modification To Control Its Drivers."

32 Alex Rosenblat, "Uber's Phantom Cabs," Motherboard, July 27, 2015, https://motherboard.vice.com/en_us/article/ubers-phantom-cabs.

33 Rosenblat, "Uber's Phantom Cabs."

34 Min Kyung Lee et al., "Working With Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers," in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (ACM, 2015), 1603–1612.

This last point seems to suggest a fundamental flaw in the logic of data-driven managerial approaches. If behavioural psychology is so understood and universal, these motivational messaging techniques should be more successful. One explanation is that the Uber labor force is treated as monolithic, even though it is anything but. As Rosenblat and Hwang argue, this oversimplification of labor into a "relatively equivalent mass" occurs both in business logic and in academic analyses of the sharing economy.[35] The single algorithmic system does not presuppose a homogenous working population bound together by the same motivations, expectations, and understandings. In other words, a unified platform doesn't automatically entail a unified labor force. The differences in skills, hours, wages, and clients necessary to perform in each distinct city combine to form a profoundly qualitative distinction, not just a quantitative one. As Rosenblat and Hwang point out, "driving for Uber in Austin, Texas is *not the same job* as driving for Uber in New York City."[36]

Another explanation, closely related to this, is that the worker is understood by the messaging platform as universal. In his analysis of the Fedex routing algorithm, Ed Finn speaks of each drop-off point as a "featureless, fungible point" in contrast to the specific desires and motivations of each human driver.[37] But in many ways, the Uber Driver-Partner is just as fungible—a relatively generic data object, interchangeable with any other worker. In other words, this averaged, nondescript individual is not simply a marketing imaginary, but is constructed at a low level by the data itself. Indeed, the abstractions of Uber's internal logic mean that this generalised worker is the *only* type which is able to be instantiated and understood. From the perspective of data, a 'worker' is an object who works in a particular suburb, driving at particular hours, at an average speed of X, for an average hourly wage of Y. A recent court case publicised the list of 500+ variables associated with each Rider, providing a specific glimpse into Uber's logical underpinnings.[38] A very small selection of these include:

advertiser_id
billing_user_country_id
cancels_10mins_prior_to_last_cancel
card_bin_banned_ users
card_type

deferred_promotion_count
dynamic_fare

rating
request_device_rooted
signup_lat
signup_lng

total_billing_country_id
trip_distance
trip_duration

35 Alex Rosenblat and Tim Hwang, "Regional Diversity in Autonomy and Work: A Case Study from Uber and Lyft Drivers," 2016, https://datasociety.net/pubs/ia/Rosenblat-Hwang_Regional_Diversity-10-13.pdf, 4.

36 Rosenblat and Hwang, "Regional Diversity in Autonomy and Work," 6.

37 Ed Finn, *What Algorithms Want: Imagination in the Age of Computing* (Cambridge, MA: MIT Press, 2017).

38 *Samuel Ward Spangenberg vs Uber Technologies, Inc*, No. CGC-16-552156 (Superior Court of California October 19, 2016).

firstname
fraud_risk
google_advertising

payment_profile_banned
payment_profile_count
payment_profile_prepaid
payment_profile_uuid
potential_rider_ driver
_collusion_tags_shared_by_device

trip_status
uber_id
user_agent

Whilst any direct translation between Rider and Driver objects would be speculative, the leaked variables list reinforces this lopsided logics of the algorithmic—piling on parameters in order to build up a highly articulated understanding of payment information, for example, whilst leaving other components of subjectivity lightly sketched or entirely unaccounted for. Here, core economic and managerial concerns are understood and intrinsic, while cultural, religious, and social characteristics and the forces they might exert on motivations are externalised or ignored. These categories, whilst undoubtedly yielding vast amounts of data, are entirely insufficient for motivation. On an fundamental level, the framework is simply unable to register the single mother, the stressed loner, the bored retiree and their range of heterogeneous motives. The result is a generic driver, interchangeable with any other. If one was to 'optimise' messaging, the capture and construction of this algorithmic subject would need to be significantly more invasive in order to become more holistic.

Uber strives to render a replicable labour performance. The goal is to recreate again and again the perfect product—a consistent, safe, and satisfying transport experience. From Ratings to Promotion, the Driver-Partner is at the centre of a swirling mass of automated messaging; nudges to keep driving longer, threats about driving dangerously, enticements to drive in surge zones, warnings about rejecting potential passengers. This unique configuration of berating, enticing, cajoling, and cautioning attempts to transform her behaviour into the ideal worker. And yet Uber internalises each Driver-Partner into a logical schema which is both universal and superficial. This thin understanding significantly undermines any motivating force, impinging on the control able to be exerted. The result is that the Partner-Management-Messaging machine is one of ambivalence, obfuscation, and negotiation. The next machine continues this thread, using violent episodes to demonstrate how Uber's informatic logic of drivers fails to adequately account for their corporeality. In failing to apprehend these capacities, replication fails to attain traction. Control disintegrates; uncontrol takes its place.

Violent Flesh-Passenger machine

On February 20, 2016, 45 year old Jason Dalton, father of two and Uber driver, carried out a series of attacks in his hometown of Kalamazoo Michigan in which he murdered six people and seriously injured two others.[39] After a routine Saturday afternoon, Dalton signed onto the rideshare platform and picked up his first fare. But during the routine journey he suddenly floored it, blowing through traffic lights, swerving into the adjacent lane and sideswiping another vehicle. His passenger hid on the floor and pleaded for him to stop, eventually escaping from the car after Dalton slowed down. Dalton promptly returned home, donned a bulletproof jacket and loaded up his Glock pistol.

But in the wake of this violent episode, Dalton did something both routine and surprising—he accepted another Uber pickup request. The passenger had input the wrong location on the app so she texted Dalton directions. But Dalton couldn't find her, circling aggressively around the neighbourhood. Upon seeing 25-year old Tiana Carruthers in the area, he asked her if she was his passenger. He drove off but returned a few minutes later and shot her repeatedly. Reporter Chris Heath, in his extensive investigation into the story, described the carnage. "The first bullet hit her in her left arm. The second bullet hit her in her right leg. One of the last two bullets broke her other leg, and the other went through her buttocks and lodged in her liver."[40] Somehow Carruthers survived.

Dalton returned home, swapping his damaged car with his parents Chevy HHR and his jammed Glock with a working gun: a Walther P99 9mm semi-automatic. But again, after just firing a full clip into the body of a stranger and having two high-speed collisions with other vehicles, Dalton's next move was unexpected. He accepted another series of Uber fares. As Heath elaborates:

> At 8:02 he picked up Keith Black at his home near the Western Michigan campus and took him into the centre of town. Black sat in the passenger seat and made small talk. Another passenger, later that hour, remembered Dalton singing along to the radio. At 9:21, when he picked up a fare at the Fairfield Inn, next to Cracker Barrel, and took three passengers to the Beer Exchange in town, he couldn't get his app to start and the fare wasn't charged properly,

39 In earlier texts, I retained the word 'allegedly' and stressed that this was reporter Chris Heath's versions of the events. Due to the nature of the events, the person responsible was never in doubt, though issues of mental health did arise later in the case. However on January 8 of 2019, before jury selection was even underway, Dalton plead guilty to all counts. Kyle Sweson, "Uber Driver Who Killed 6 in Bloody Michigan Rampage Shocks Court with Guilty Plea," *Washington Post*, January 8, 2019, https://www.washingtonpost.com/nation/2019/01/08/uber-driver-who-killed-bloody-michigan-rampage-shocks-court-with-guilty-plea/.

40 The details of Dalton's story outlined here are all taken from Heath's exemplary journalistic reporting. Chris Heath, "The Uber Killer: The Real Story of One Night of Terror," *GQ*, August 22, 2016, http://www.gq.com/story/the-uber-killer.

> but he seemed easygoing enough about it, like it wasn't a big deal. He seemed to be doing his job as though nothing had happened and nothing else would.[41]

Next, Dalton seemed guided to a strip of auto dealerships. He pulled up, walked up to Rich Smith and his son Tyler, and gunned both of them down. Around 10pm, Dalton drove to the Cracker Barrel carpark where a group of older women were just about to drive home. He walked up to one of them, asked her if she could spare a dollar to make America great again, and then shot her point blank. Four other women in the car nearby screamed so Dalton walked over and shot each of them in turn.

Dalton returned home one last time and reloaded his gun. And once more, ignoring the trail of carnage from the past few hours, he simply resumed his operations as an Uber driver, ferrying customers around the central city area. Around midnight he drove a few students to the dorms at Western Michigan University. After that Dalton transported a law student and his wife from a local bar back to their hotel. He drove slowly and carefully, explaining his silence by stating he was just tired. Around 12:30 he helped a few bar-hopping friends from the Central City Tap House to their next destination at the Up And Under. Finally at 12:38am Dalton was pulled over and arrested, complying fully with the requests of the police.

Dalton had no prior arrests, nor any previous behaviour like this. Those who knew him were stunned at the news. His closest friends were disbelieving. His wife had no complaints about their marriage. His politics were middle of the road, his guns were registered, his work life was adequate. And when asked to explain his actions on the night, Dalton quietly declined, citing the Fifth amendment or simply refusing to give a rationale.[42] Finally, however, he relented and delivered the following series of statements to detectives William Moorian and Cory Ghiringhelli:

> He said as a driver partner with Uber, the icon is red and changed to black tonight.
> Dalton said the iPhone can take you over.
> Dalton explained how you can drive over 100mph and go through stop signs and you can just get places.
> It would give you an assignment and it would literally take over your whole body.
> Dalton said that this thing knows where everyone is through your phone.
> Dalton said it told him to be available all the time.
> It wasn't like a telling, it was more of like a control.

41 Heath, "The Uber Killer."

42 Heath, "The Uber Killer."

> Dalton said that Uber requires drivers to have a car newer than 2007 and when you plug into it, you can actually feel the presence on you.
> Dalton said that as he was sitting there, it was almost like artificial intelligence that can tap into your body[43]

The Violent Flesh-Passenger machine examines the corporeality at the heart of Uber. It moves through a litany of cases in which Driver-Partners have imposed themselves on Passengers in aggressive and violent acts: assault, sexual assault, rape, kidnapping, and others. These acts are unexpected and unpredictable, not only because they are behaviours which deviate from the norm, but because they arise from corporeal bodies whose capacities are not exhausted by the roles ascribed to them through Uber's informational knowledge-structures. Inadequately encapsulated by a logic, their performance exceeds control mechanisms in unanticipated and sometimes brutal ways.

In contrast, the Driver-Partner as understood in the Uber algorithmic ecology is predominantly informatic. The body and its attendant capacities drop away. Instead, as the next section will demonstrate, the Uber driver is onboarded remotely as a user moving through an user flow, with an identity constructed and verified via databases. Moreover, when work does begin, the driver becomes subsumed into a vast informational architecture, becoming one more node in a sea of microservices. Rendered as a set of fields, a data object amongst data objects, the driver becomes an insignificant and innocuous component, something to be operationalised. How is this informatic body constructed?

Firstly, this informatic body is produced by the onboarding process. Onboarding refers to the company's term for getting an applicant through the signup process, approved, and on the road. A post on the Uber Engineering blog explains how this process was massively scaled in order to match the growth rate of the company, both in market penetration and international expansion. "As late as 2013, onboarding was purely manual," lamented Uber engineer Jonathan Pepin, explaining that applicants were forced to go to a local Uber office and work through the required paperwork with an operations manager.[44] This person-to-person signup was costly in time and money. More importantly, this physical process, unlike the 'purely' informational processes which the engineers were accustomed to, couldn't be scaled; the legacy logic of human resources created a bottleneck in the form of a brick-and-mortar Uber office and the body of the manager. These material constraints

43 Jason Dalton, Interview With Kalamazoo Police, interview by Cory Ghiringhelli and William Moorian, February 20, 2016, https://www.scribd.com/doc/304723238/Jason-Dalton-s-Interview-With-Kalamazoo-Police.

44 Jonathan Pepin, "How Uber Engineering Massively Scaled Global Driver Onboarding," Uber Engineering Blog, September 2, 2016, https://eng.uber.com/driver-onboarding/.

were compounded by regional differences, local regulations necessary for registration as a driver in each city which couldn't simply be smoothed away or erased entirely.

The engineering team responded by creating an Onboarding State Machine (OSM), allowing them to "configure a set of steps for each onboarding process in each country, state, city, or any level of granularity we need, coupled with an event system that allows us to easily switch users from one step to another."[45] This logic is flexible—an additional step can be inserted for applicants in Paris or Palo Alto. The logic is also decoupled from the frontend—a regional style can be applied for those in China, for instance, or the UK. These features are not just empty praise for the engineering team. Rather, this informational architecture allows for the drastic reduction of human labor and material infrastructure. Operations managers can be reassigned or made redundant. Local offices can be closed in place of so-called Green Light Hubs, where drivers are offered basic support by young staff members in a hot-desk setup.[46] A key 'byproduct' of this highly scalable approach is that it is based entirely on an informatic body—an applicant which has been assigned an ID and stepped through an informational flow. Has Signed Up? Next. Has Vehicle? Next. Has Watched Video? Next. This efficient onboarding of the informatic body means that the corporeal body is never met, touched or talked to.

Secondly, this informatic body is produced by the background check required to gain access to the platform as a Partner. This process is handled by Checkr, a company which provides "modern and compliant background checks for global enterprises and startups" such as Postmates, Zenefits, and Uber.[47] Uber passes on the name, social security number, license plate and address of the applicant to Checkr, who checks for it in state and national sex offender registries, terrorist watch-lists, and other unnamed databases. The applicant is automatically disqualified if they appear on these lists. As journalist Tracey Lien explains, Checkr also accesses the "motor vehicle registration file associated with the driver's license number."[48] Lien elaborates that the applicant can thus also be disqualified if the file lists "DUI, fraud, reckless driving, hit and run, violent crimes, acts of terror, sexual offenses, felony, misdemeanor for theft, fatal accidents or resisting or evading arrest."[49] This disqualification, however, is limited to the last seven years. The informatic body is thus instantiated

45 Pepin, "How Uber Engineering Massively Scaled Global Driver Onboarding."

46 This is certainly the case in Auckland, New Zealand, for instance, where a personal visit to the Green Light Hub in Parnell reveals that a handful of young employees with laptops and a suite of service software underpin Uber's operations in a city of around 2 million residents and 300,000 Riders, according to Uber's own advertisements: https://www.uber.com/info/ride-nz/.

47 Checkr, "Home," accessed April 13, 2017, https://checkr.com/.

48 Tracey Lien, "Kalamazoo Shooting: Here's How Uber Does Its Background Checks," *Los Angeles Times*, February 22, 2016, http://www.latimes.com/business/technology/la-fi-tn-uber-background-check-20160222-story.html.

49 Lien, "Kalamazoo Shooting."

from four fields: name, address, plate, and social security numbers. These intersect with wider informational arrays, through which they produce additional metadata, appearing in sex offender registries (true/false), or establishing past crime (none, serious, minor, expunged, etc.). Blankness, null values, or empty records in this sense are positive data, completing the construction of an informatic identity approved as an applicant.

This informatic body is also fingerless. As stated, the scalability of the onboarding process is directly based on its highly immaterial nature: cross-checking databases, entering information, watching introductory videos. It is unsurprising, then, that ride-sharing companies like Uber and Lyft have bitterly fought the very physical process of pressing thumbs into ink in front of an official at a processing centre.[50] Of course, this process would cost companies more. But more importantly, it is highly embodied, resisting logics of streamlining and scaling. Critics say that the use of fingerprinting is much stricter than the name and license-based background checks which Uber conduct. Fingerprinting, they argue, would catch many of the cases which slip between the informatic cracks—cases in which applicants have used fake names or pseudonyms, moved addresses or out of state, or had criminal activity beyond the seven year window. Austin, Texas instituted new fingerprinting laws in July of 2016. In the first month alone these tighter regulations had already barred 84 applicants from driving for ride hailing services.[51]

Given Uber's high turnover and voracious demand for new drivers, one hypothesis is that fingerprinting is not simply a time, cost, and scale issue, but one of barring a potential labor pool. One commentator suggests that this turnover rate "necessitates that Uber find non-credit worthy drivers and drivers of questionable backgrounds."[52] 'Find' here goes too far, suggesting that Uber would consciously seek out more questionable, less professional drivers. But certainly for a Silicon Valley venture predicated on meticulously capturing ever more information, setting this hard limit on what can be known about a driver runs counter to type. The refusal to fingerprint suggests a strategic ignorance, one that benefits Uber by maximising the ranks of eligible workers. Quite

50 Just two articles from the many which could be chosen:
Noah Kulwin, "Things Are Getting Ugly in Uber's and Lyft's Fight Against Fingerprint Checks in Austin," Recode, January 29, 2016, https://www.recode.net/2016/1/29/11589190/things-are-getting-ugly-in-ubers-and-lyfts-fight-against-fingerprint.
Matthew Hamilton, "Fingerprinting Becomes Latest Battleground in Uber, Lyft Debate," *Times Union*, December 19, 2016, https://www.timesunion.com/tuplus-local/article/Fingerprinting-becomes-latest-battleground-in-10805056.php.

51 Harriet Taylor, "Uber and Lyft Hate Fingerprinting Drivers, but New Data Shows Why They Might Be Wrong," *CNBC*, August 23, 2016, http://www.cnbc.com/2016/08/23/uber-and-lyft-hate-fingerprinting-drivers-but-new-data-shows-why-they-might-be-wrong.html.

52 Scott Myers, "Uber: The Good, the Bad, and the Really, Really Ugly," The Next Web, April 22, 2017, https://thenextweb.com/opinion/2017/04/22/uber-in-a-nutshell/.

simply, these bodies are intentionally unknown.

Finally, the informatic body is consistently reinforced and reperformed once driving. Uber's promise is simple: 'tap the app, get a ride.' Such seamless functionality requires a coordination of countless elements—data and code, payments and pathfinding, infrastructures and logistics. The driver-partner is integrated tightly into this ecology of control, producing a certain abstraction of the labouring body. What, after all, does the driver do? Actions are directed by in-app messages.[53] Progress is predicted by real-time traffic calculations.[54] Routes are laid out in advance by pathfinding algorithms.[55] Payment is handled automatically by back-end functionality.[56] Indeed, the number of microservices which comprise Uber continues to grow significantly. As engineer Yuri Shkuro explains, at the end of 2015, the rideshare company employed around 500 services; by early 2017 they had over 2000 services which handled everything from fraud detection to maps processing and data-mining.[57] Uber has often claimed that they are a software company, not a transport company. In this imaginary, the embodied labourer becomes just one more programme, a largely interchangeable element with vision, hands, and feet, capable of safely piloting a vehicle through a set of GPS coordinates. Set against the expansive and highly technical ecology of processors, services, sensors, and informational architectures, the labor practices carried out by the driver become tightly circumscribed, shrinking to that small kernel of activities (as yet) unable to be automated away. With the company's recent pilot programme of self-driving cars in Pittsburgh,[58] it is clear that even this nominal embodiment is seen as ultimately vestigial.

Of course, this process is not accidental nor particular to Uber, but rather part of the broader trend of the division of labor in systems of capital. As Harry Braverman demonstrated unequivocally in *Labor and Monopoly Capital*, this trajectory is one in which technology is instrumentalised towards a particular goal—that of diminishing the education and skills necessary to carry out work and the breadth of activities which comprise it. Technology, in this sense, is always expanding—increasing its responsibilities, broadening its scope, adding onto its repertoire—while the role of human labour is slowly ring-fenced and reduced, resulting in the "confinement of the worker within a blind

53 Uber Training, Official Uber Training Video for New Drivers, 2016, https://www.youtube.com/watch?v=6BLj6pmiLk4.

54 Thi Nguyen, "ETA Phone Home: How Uber Engineers an Efficient Route," Uber Engineering Blog, November 3, 2015, https://eng.uber.com/engineering-an-efficient-route/.

55 Nguyen, "ETA Phone Home."

56 Yijun Liu and Mrina Natarajan, "Re-Architecting Cash and Digital Wallet Payments for India with Uber Engineering," Uber Engineering Blog (blog), June 19, 2017, https://eng.uber.com/india-payments/.

57 Yuri Shkuro, "Evolving Distributed Tracing at Uber Engineering," Uber Engineering Blog, February 2, 2017, https://eng.uber.com/distributed-tracing/.

58 Uber Newsroom. "Pittsburgh, Your Self-Driving Uber Is Arriving Now." Uber Global, September 14, 2016. https://newsroom.uber.com/pittsburgh-self-driving-uber/.

round of servile duties in which the machine appears as the embodiment of science and the worker as little or nothing."[59]

Braverman showed how this trend played out in modern workplaces throughout the 20th century. But this is only one moment in a much longer story. Indeed, Marx and Engels recognised this trend much earlier, stating that the labourer becomes a mere "appendage of the machine, and it is only the most simple, most monotonous, and most easily acquired knack, that is required of him."[60] The worker's tool belt was enlarged, becoming an array of largely autonomous mechanisms that only needed occasional maintenance. The worker's workshop was inflated, becoming the industrial factory that put him to work. In the process he shifted from single artisan to replaceable mechanism, one instrument of many. Uber continues this trajectory, developing a technological system that balloons in both scale and complexity while the agency of the human is simplified and sidelined. As theorist Friedrich Jünger predicted: "As a human figure he fades out, and from the viewpoint of technical progress it would be desirable if he disappeared altogether, if the production process were fully automatic and operable without aid of the human hand, like a transmission, a chain drive, an escalator, or the cartridge belt of a machine gun."[61]

From start to finish, then, the driver's body is informatic—an ID moving through onboarding states, a data package which doesn't trigger red flags, a programme which shifts a vehicle from A to B. Yet this informatic entity does not comprise the totality. This is not to reify physicality and suggest that the subjectivities and performativities of drivers are actually and entirely corporeal. Nor is to claim that informational processes have no hold on 'reality.' As demonstrated in other sections, data-driven operations establish conditions and exert forces, altering behaviours and transforming practices. Rather, it is simply to assert that this bifurcated framing itself is incomplete. As Katherine Hayles argues, "conceiving of information as a thing separate from the medium instantiating it is a prior imaginary act that constructs a holistic phenomenon as an information/matter duality."[62] It is not as if Uber believes its workers are avatars or angels. Businesses acknowledge some degree of division between 'reality' and their representations, between matter and data that models it. But within the algorithmic system itself, this distinction is elided.

The abstracted and idealised data which represents each worker anticipates an informatic body that can be placed without distortion over the person in all their fleshy reality. In other words, Uber's

59 Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York, NY: Monthly Review Press, 1998), 207.

60 Karl Marx and Friedrich Engels, *The Communist Manifesto*, trans. Samuel Moore (London: Pluto Press, 2008), 43.

61 Friedrich Georg Jünger, *The Failure of Technology* (Washington, D.C.: Regnery Gateway, 1990), 77.

62 N Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (Chicago: University of Chicago Press, 2010), 13.

internal logic claims to adequately apprehend and control the capacities of the corporeal. But bodies are never entirely contained. As Matthew Fuller argues, "systems grappling with their outside" inevitably produce a likeness, but also a "collapse and spillage."[63] This flesh always remains somewhat extrinsic and unpredictable, containing both the potential for productive labor and the potential for violent acts. Bodies contain the capacity to smile and converse, but also to strike or fondle. Perhaps this is why it seems to come as a genuine shock, both to Uber and the public, when situations emerge which demonstrate that drivers have corporeal bodies—capable of groping and raping, stealing and strangling.

These incidents are far from rare. Throughout one year in London alone, Uber drivers were accused of 32 rapes and sex attacks, an average of one assault every 11 days.[64] Looking more globally at just one month—May of 2016—reveals a sordid cross section of this activity spread out geographically. In Oshawa Canada, a driver allegedly reached across the seat, groping a 16 year old boy in the genital area before parking and sexually assaulting him.[65] In Gaithersburg Maryland, a driver was arrested for attempted murder after pointing a homemade gun capable of firing shotgun rounds at two detectives.[66] At the University of Delaware, a driver was accused of attacking, choking, and striking a 19 year old female student after an argument escalated.[67] In Mexico City, a driver allegedly picked up a woman from a nightclub, then stopped and raped her, later forcing her out of the car but keeping her purse.[68] In Salt Lake City, a driver purportedly fondled a woman during the 15 minute drive, then tried to pull her pants down and pull her back inside the vehicle upon arrival.[69]

Of course, the responsibility for these behaviours cannot be simply offloaded to the managerial regime conducted by Uber. At the same time, we must acknowledge that the novel conditions of

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63 Fuller, *Media Ecologies*, 83.

64 Gabriel Samuels, "Uber Drivers Accused of 32 Rapes and Sex Attacks on London Over The Past Year," *The Independent*, May 19, 2016, http://www.independent.co.uk/news/uk/uber-drivers-accused-of-32-rapes-and-sex-attacks-on-london-passengers-a7037926.html.

65 Erica Vella, "Uber Driver Charged Following Sexual Assault of Boy in Oshawa," *Globalnews.ca*, June 15, 2016, http://globalnews.ca/news/2763116/uber-driver-charged-following-sexual-assault-of-boy-in-oshawa-police/.

66 Marina Marraco, "Uber Driver Arrested for Attempting to Shoot Officers," *FOX5 DC*, May 25, 2016, http://www.fox5dc.com/news/local-news/145051389-story.

67 Sage Lazzaro, "An Uber Driver Has Been Charged With Strangling a Student in a Dorm Parking Lot," *Observer*, May 23, 2016, http://observer.com/2016/05/an-uber-driver-has-been-charged-with-strangling-a-student-in-a-dorm-parking-lot/.

68 FOX News Latino. "Uber Driver Arrested for Allegedly Raping and Robbing Passenger in Mexico City." Collection, May 9, 2016. http://www.foxnews.com/world/2016/05/09/uber-driver-arrested-for-raping-and-robbing-passenger-in-mexico-city.html.

69 Robert Boyd, "Woman Claims Uber Driver Sexually Assaulted Her during Ride to North Salt Lake," *fox13now.com*, May 5, 2016, http://fox13now.com/2016/05/04/woman-claims-uber-driver-sexually-assaulted-her-during-ride-to-north-salt-lake/.

labor created by this algorithmic ecology exacerbates particular tendencies. Take Surge Pricing, for example. Surge Pricing incentivises driving at particular times and places by increasing the rate charged for a fare. Of course traditional taxi companies have done this in more organic ways for years, gradually learning and frequenting more lucrative locations and times of day, such as red-eye airport routes. However Surge is more urgent, notifying drivers repeatedly by push notifications and messaging while outlining the spot in bright red visually. Surge is also more specific, marking the zone area precisely on the map and defining exactly the multiplier on offer (e.g. x 2.1). This incentivisation seems to coincide with some of the violent incidents, which occur late at night after picking up women from nightclubs or restaurants in fashionable districts. In October 2015, for example, a driver was successfully convicted of raping a passenger in India. As Agence France-Presse reports, the passenger said she had dozed off after getting into the vehicle, and woke "to find the taxi parked in a secluded place where the driver raped her, before dumping her near her home in north Delhi."[70]

These novel conditions also entail bringing together two populations—a pool of underpaid and underscreened labourers and an expanded customer base comprised of anyone with a smartphone. Passengers no longer need to dial a taxi company and speak to a live operator, a conversational interaction that many teenagers find uncomfortable or awkward.[71] In comparison to the complexities of bus routes or the fussiness of train timetables, the single tap required by the mobile application is incredibly easy. Uber is just another app which behaves like other apps. Users are easily able to transfer the minimal skill set required to it: install, launch, swipe, zoom, tap. This makes it both accessible for young users and allowable (or at least ungovernable) from a parental point of view. According to one report, "many of the teens we questioned, some as young as 14 years of age, say they use the ride sharing service Uber on a regular basis—to visit friends, or go to the movies, parties or concerts."[72] It is unsurprising, then, that many of these violent incidents occur between older drivers and younger teens. In April 2016, for example, a male Hawaiian driver allegedly picked up a 16 year old from the mall, dropped her friends off, then started making wrong turns before parking and attacking her. She fought him off and ran away before later being hospitalised.[73] Packaging transport functionality seamlessly into a smartphone app establishes new

70 Agence France-Presse, "Uber Driver Convicted of Raping Passenger in Delhi," *The Guardian*, October 20, 2015, https://www.theguardian.com/technology/2015/oct/20/uber-driver-convicted-of-raping-passenger-delhi-shiv-kumar-yadav.

71 Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less from Each Other* (New York, NY: Basic books, 2011), 70, 513, 522.

72 Carl Monday, "Underage Uber: Carl Monday Exposes Teen Rider Safety Oversight," *Cleveland 19*, November 18, 2016, http://www.cleveland19.com/story/33737169/underage-uber-carl-monday-undercover-investigation-exposes-teen-rider-safety-oversight.

73 Sage Lazzaro, "A Hawaii Uber Driver Has Been Charged With Raping a Teenage Passenger," *Observer*, April 20, 2016, http://observer.com/2016/04/a-hawaii-uber-driver-has-been-charged-with-raping-a-teenager/.

conditions—placing precarious labour in a confined space with new and potentially vulnerable populations.

To replicate a best-practice performance, Uber integrates each worker as a strictly productive element, a programme piloted by power and situated amongst other programmes. However the litany of violence previously discussed demonstrates the fundamental openness of a body, the indeterminacy of a labourer. Simply put, the designation of a Driver-Partner as a particular set of affordances does not exhaust all he can be, do, and think. Rather, like any system, Uber contains discrepancies between the total affordances of its constitutive objects and those which are instrumentalised. In other words, there is a gap between an object's potential and how it is put-to-use. Andrew Feenberg calls this gap the margin of maneuver, a margin "required for implementation in conformity with the dominant technical code, but also containing potentials incompatible with that code. Successful administration today consists in suppressing those dangerous potentials in the preservation of operational autonomy."[74] Even with dozens of systems which monitor location, braking, and ratings, the fleshy agency at the heart of this algorithmic ecology can never entirely be corralled, leaking out as activity which "escapes and exceeds its instrumentality."[75] This litany of violent acts undermines not just the reputation of a company, but the "glossy innovation narratives" of the algorithmic itself.[76]

Capital-Cash Burning Machine

For years Uber's financials were a closely guarded secret. Recently, however, Uber lifted the veil, disclosing the last four quarters of figures to Bloomberg. The results are staggering, if not entirely unexpected. Since its founding in 2009, Uber has burned through at least $8 billion; in one recent quarter the company lost $980 million.[77] By comparison, Amazon.com, the poster child of the long-unprofitable technological corporation, never lost more than $2 billion in a year, and that in the wake of the dot-com bubble.[78] These losses are historically unprecedented. They certainly defy the fundamental (albeit simplistic) logic of basic entrepreneurialism. Yet investors are reportedly

74 Andrew Feenberg, *Questioning Technology* (London: Routledge, 2008), 114.

75 Federica Frabetti, Software Theory, interview by Janneke Adema, February 25, 2015, https://culturemachinepodcasts.podbean.com/e/software-theory-federica-frabetti/.

76 Florian Cramer, Post-Digital Research, Transmediale 2014 Afterglow, accessed April 13, 2017, https://www.youtube.com/watch?v=3ciJtJUwcug.

77 Eric Newcomer, "Uber, Lifting Financial Veil, Says Sales Growth Outpaces Losses," *Bloomberg.com*, April 14, 2017, https://www.bloomberg.com/news/articles/2017-04-14/embattled-uber-reports-strong-sales-growth-as-losses-continue.

78 Newcomer, "Uber, Lifting Financial Veil."

undaunted, aware that Uber is using Amazon as the blueprint for market domination.[79] If the FANG companies (Facebook, Amazon, Netflix, Google) establish a new operational logic, it is one that doesn't register as a conventional success on a profit and loss sheet. Indeed, a rivalry seems to emerge between the economic and the technical based on a fundamental "difference in their desires."[80] When asked by Bloomberg to sum up Uber's financials, finance professor Aswath Damodaran simply said, "this is a cash-burning machine."[81]

The previous two sections have explored how individual drivers are internalised into a particular logic that attempts to purposively influence them towards a type of best-practice labor performance. Apprehended as predominantly fungible objects, these operations-of-negotiation are not always successful nor predictable. But this generic logic could be considered a necessary side-effect of replicability. Once the Driver-Rider-Uber relation is established, this relation can be reproduced over and over again. In this sense, Uber exemplifies a broader and highly compelling promise of the algorithmic in general—the promise of scale. And this unique affordance of a technical architecture drives institutional and organisational architectures.

To examine how this replicability establishes a company-wide imperative, this section draws upon Aggregation Theory as developed by technology analyst Ben Thompson. It is worth noting in passing that Thompson's blog is highly influential; these concepts are internalised and understood by many technology firms.[82] Thompson begins with the simple proposition: "the value chain for any given consumer market is divided into three parts: suppliers, distributors, and consumers/users."[83] One of the primary ways to generate profits used to be integrating the supply and distribution components. Take newspapers, for example. Before the advent of the internet, distribution was a difficult problem. For an advertiser to reach an individual at their home would require a door-to-door campaign, a highly expensive and highly localised endeavour. Through a complex and costly infrastructure of printing presses, trucks, paperboys, and so on, newspapers solved this distribution problem, albeit for a fixed geographical region. Next they integrated

79 Seth Fiegerman, "Uber Is Losing Billions: Here's Why Investors Don't Care," *CNNMoney*, June 1, 2017, http://money.cnn.com/2017/06/01/technology/business/uber-losses-investors/index.html.

80 Jünger, *The Failure of Technology*, 32.

81 Newcomer, "Uber, Lifting Financial Veil."

82 "About three years ago, Thompson, then an unknown former analyst at Apple and Microsoft, founded his tech blog stratechery.com to little fanfare. Today, his subscription model nets him $200K in annual revenue. His in-depth analysis are read by CEOs and VCs from around the world. His subscribers include the top of the top in the tech scene, such as Jonah Peretti (CEO Buzzfeed), Jeff Weiner (CEO Linkedin) and Drew Houston (CEO Dropbox)." OMR Festival, "The Go-To for Those in the Know—Ben Thompson," OMR Festival, November 18, 2016, https://omr.com/en/ben-thompson-stratechery-omr-festival-live/.

83 Ben Thompson, "Aggregation Theory," Stratechery, July 21, 2015, https://stratechery.com/2015/aggregation-theory/.

distribution with supply, bringing together reporters, writers, journalists—often under a single roof—to produce content. This allowed advertisers to deliver their messages literally to the front doorstep of every home, and resulted in a century of lucrative profits for the major papers. Taxis followed the same model, integrating dispatch (distribution) together with a fleet of cars and drivers (supply); in a similar fashion, hotels integrated a trusted nationwide brand (distribution) together with an infrastructure of empty rooms (supply).[84] For consumers, these integrations produced a reliable and profitable package, but also a highly generic one (think again of the newspaper or the newsreel). Users got what they got.

The internet fundamentally changes this dynamic. Distribution, at least of digital goods, is no longer a difficult problem. Indeed, overlooking for a moment the fixed capital of infrastructure networks, it essentially can be done for free. As Thompson observes, this reconfigures the competitive terrain, "neutralizing the advantage that pre-Internet distributors leveraged to integrate with suppliers."[85] This allows companies to establish a one-to-one relationship with individual users. The business focus swings in the opposite direction, from supplier to consumer. Companies no longer compete for exclusive supplier relationships; instead "suppliers can be aggregated at scale leaving consumers/users as a first order priority."[86] To draw users in, to provide them with value, to respond to their needs—these are the new imperatives. Suddenly the user experience becomes critical and companies must effectively fine-tune the parameters which constitute it. To be sure, these encompass anxieties around obvious consumer-facing components. Uber, for example, has redesigned both its own brand identity and its web and mobile interfaces multiple times since launching in 2009.[87] Yet in this framework, even supplier issues get recast as parameters that can make or break the user experience. In 2014, for example, Uber added a Safe Rides fee, clawing back losses but also reassuring riders with "an industry-leading background check process, regular motor vehicle checks, driver safety education, development of safety features in the app, and more."[88]

If hurdles like these can be overcome and a consistently satisfying experience achieved, then a process is instigated that Thompson calls a "virtuous cycle:" the best experience wins users, more users attract more suppliers, and more suppliers improve the experience by providing more content, more choices, closer proximity, and so on.[89] In the schema of aggregation theory, companies attempt to trigger this self-reinforcing mechanism, to set it in cyclical motion. If successful, their initial work

84 Thompson, "Aggregation Theory."

85 Thompson, "Aggregation Theory."

86 Thompson, "Aggregation Theory."

87 Based upon my design analysis of Uber branding and interface elements as they evolved since the company's founding.

88 RideGuru, "What Is Uber's Safe Rides Fee?," December 11, 2016, https://ride.guru/lounge/p/what-is-ubers-safe-rides-fee-what-is-the-big-fuss-about.

89 Thompson, "Aggregation Theory."

begins to work *for* them. By turning towards customers and obsessing over their experiences, companies strive to 'set off' a feedback spiral that builds organically into a better product.

Just as important, this user relationship can be established at scale. Traditionally for companies the addition of every new customer incurred a transaction cost. Thompson gives the example of a cellular network company; to bring a new consumer on board entailed talking with them on phone or in person, collecting their details, running a credit check, furnishing them with a SIM card and telephone, managing renewals and upgrades, and so on.[90] Adding each new customer undoubtedly brought profits. But it also required expenditure, not only in the initial 'onboarding', but in the financial investment required to service this expanded customer base: more infrastructure to maintain a quality service, more labor to staff customer support centres, more complexity due to expanded markets or diversified product lines, and so on. At some point the cumulative effect of these transaction costs begins to impinge too heavily on the profits to be gained.[91] In contrast, one of the unique qualities of the new breed of companies like Google, Airbnb, and Uber is that their transaction costs are zero. For corporations such as these, Thompson asserts, "adding one more customer is as simple as adding one more row in a database."[92] An array of automated mechanisms allow the user to register, to setup payment options, to maintain their account, to customise their service, and even to receive their product. With zero transactional costs, these companies have every incentive to scale.

Scale becomes critical. As Thompson points out, the "value of the service increases as the number of customers increases."[93] As discussed, the aggregator that holds the most users also holds the most attraction for suppliers—drivers go where the passengers are, marketers spend where the eyeballs are, landlords list where the tourists are. How much value does every customer add? For a quantitative solution, Thompson refers to Robert Metcalfe, inventor of the Ethernet protocol. In a 1980 sales slide, the engineer posited a law stating that the "value of a telecommunications network is proportional to the square of the number of connected users of the system (n^2)."[94] At that time, Metcalfe was actually referring to devices—fax machines, printers, servers, and so on. Two telephones can only form a single connection whereas 12 telephones can form 66 connections. Yet

90 Ben Thompson, "The Super-Aggregators and the Russians," Stratechery, September 18, 2017, https://stratechery.com/2017/the-super-aggregators-and-the-russians/.

91 For a discussion on transaction costs as frictions, see Richard Langlois, "The Secret Life of Mundane Transaction Costs," *Organization Studies* 27, no. 9 (2006): 1389–1410.

92 Thompson, "The Super-Aggregators."

93 Thompson, "The Super-Aggregators."

94 Like other computer science tropes, Metcalfe's law was introduced informally and grew slowly in recognition. Metcalfe mentioned it on a 35mm slide when he was selling Ethernet to clients in 1980. In 1993, George Glider, an influential tech analyst, resurrected it, named it after Metcalfe and formalized it. Robert M. Metcalfe, "It's All In Your Head," *Forbes*, April 20, 2007, http://forbes.com/2007/0507/052.

the law has also proved prescient for human connections in the age of Web 2.0. While some critics assert the law overestimates the values of networks, Metcalfe himself has recently applied it to Facebook, demonstrating that the financial worth of the social network closely approximates the Law.[95] Facebook is a unique case in that its users are also suppliers—content creators who post selfies, status updates, and everyday activity for free. As Facebook establishes its privileged relationship with an ever broader population, it approaches the status of social monopoly, exerting a stronger pull on both advertisers and individuals. Indeed, as computer scientists Zhang et al. recently demonstrated with both Facebook and Tencent, it is not just the value of these social-networks that match Metcalfe's law, but their growth trends.[96] With each new user adding an amplified degree of value, the primary goal becomes exponential growth. Here, value does not just become conflated with scale, but subsumed by it.

In the logic of expansion, the winner takes all. To be sure, the addition of each user improves that particular service—elevating the overall level of demand, the overall diversity, the amount of content available, the quantity of information captured, and so on. But services do not exist in a vacuum. The relentless drive to encapsulate more users takes place in a highly contested terrain. Theoretically, of course, consumers and suppliers can participate in multiple platforms or products. However Thompson points out that these relationships, while not exclusive in theory, are exclusive in practice.[97] For consumers this often entails brand allegiance—in an undifferentiated market (e.g. Lyft vs Uber), constant comparisons aren't worth the time and effort, users choose a company and stick with it; for suppliers, investment is a zero sum game—every minute or dollar given to one company (e.g. Uber) is one not going to a competitor (e.g. Lyft).[98] Veteran driver and rideshare blogger Harry Campbell confirms this, stating that the required acceptance rates for drivers effectively mean that "they're basically requiring you to only work for Uber."[99]

Recognising the stakes, companies often sharpen rather than soften these fundamental antagonisms. Uber CEO Travis Kalanick famously stated they were competing against the 'asshole' called taxi and the company has run billboard campaigns like 'Shave that Stache' trying to coerce drivers to move away from Lyft and its iconic moustache.[100] More recently Uber have upped the ante—Verge reported the company organised off-the-clock 'slogging' street teams with high

95 Bob Metcalfe, "Metcalfe's Law after 40 Years of Ethernet," *Computer* 46, no. 12 (2013): 26–31.

96 Xing-Zhou Zhang, Jing-Jie Liu, and Zhi-Wei Xu, "Tencent and Facebook Data Validate Metcalfe's Law," *Journal of Computer Science and Technology* 30, no. 2 (2015): 246.

97 Ben Thompson, "Why Uber Fights," Stratechery, November 24, 2014, https://stratechery.com/2014/uber-fights/.

98 Thompson, "Why Uber Fights."

99 Jacob Bogage, "Uber's Controversial Strategy to Finally Defeat Lyft," *Washington Post*, August 23, 2016, https://www.washingtonpost.com/news/the-switch/wp/2016/08/23/ubers-controversial-strategy-to-finally-defeat-lyft/.

commission rates to aggressively recruit Lyft riders, arming them with signup sheets and second iPhones in case they got caught.[101] On the consumer side, these companies also employ a bevy of techniques designed precisely to achieve maximum lock-in.[102] Previous history functionality is one such mechanism—the more one uses the service, the more data it has; more data means better prediction and more value. Once understood, this feedback loop of activity-based anticipation appears nearly everywhere: music (Spotify), movies (Netflix), shopping (Amazon), search (Google), destinations (Uber), and many more. Switch to a competitor, and you start with a fresh slate, a condition in the tech world that is not refreshing so much as frustrating.

Regardless of the techniques employed, the logic of expansion is the same—to capture every user, and in so doing, to strong-arm every supplier. In the broader, brutish environment of capital, flatlined equilibrium is not an option. A service is either growing, increasing its user-base and crushing its competitors, or it is shrinking. As tech analyst Abishek Madhavan stresses, "that's the thing about network effects—they work against you until you reach a tipping point; then, they work for you. And often to devastating effect for the competition."[103]

In the logic of expansion, the race to this tipping point trumps all else, capital included. To rationalise this logic, a reconfiguration of parameters is needed, a shift not only from short-term to long-term, from profits to losses, but also from financial value to human value—from money to monthly-active-users (MAUs). Monthly active users, as it sounds, is simply a metric of the number of users that regularly sign into and use a service, as opposed to dormant accounts. Not being a publicly listed company, Uber is not required to disclose this kind of information, making any detailed analysis difficult. But there are two known datum. In December of 2013 a document was leaked, showing the number of rides requested, week by week, over October and November; Prosperity Analytics simply averaged these figures to arrive at a very defensible figure of 1055842—just over a million MAUs.[104] Just three years later, in October of 2016, CEO Travis Kalanick revealed at the New Establishment Summit that Uber had 40 million MAUs.[105] Using a highly simplistic linear growth rate between these two points, this entails adding almost 37,000 new users

100 Liz Gannes, "Travis Kalanick: Uber Is Raising More Money to Fight Lyft and the 'Asshole' Taxi Industry," *Recode*, May 28, 2014, https://www.recode.net/2014/5/28/11627354/travis-kalanick-uber-is-raising-more-money-to-fight-lyft-and-the.

101 Casey Newton, "This Is Uber's Playbook for Sabotaging Lyft," *The Verge*, August 26, 2014, https://www.theverge.com/2014/8/26/6067663/this-is-ubers-playbook-for-sabotaging-lyft.

102 Nabila Amarsy, "Switching Costs: 6 Ways To Lock Customers Into Your Ecosystem," Strategyzer, July 27, 2015, https://blog.strategyzer.com/posts/2015/7/27/switching-costs-6-strategies-to-lock-customers-in-your-ecosystem.

103 Abhishek Madhavan, "Why Distribution Still Matters in the Internet Age," *WIRED*, accessed November 29, 2017, https://www.wired.com/2017/04/why-distribution-still-matters-in-the-internet-age/.

104 Prosperity Analytics, "St. Patrick's Day, Uber, and LTV," Prosperity Analytics (blog), March 28, 2014, https://prosperityanalytics.wordpress.com/2014/03/28/st-patricks-day-uber-and-ltv/.

per day, or just over 1.1 million MAUs per month. Filling in the blank time with a more realistic growth factor of 180% links up the two known datum, resulting in a Metcalfian curve (Figure 1). This is staggering growth, but measured in users, not revenue. To enlist a new pool of drivers and to thereby entice a new user-base of riders is a highly expensive bootstrapping operation. Given this strange new logic, it makes sense to subsidise the cost of each ride by 50% or more, particularly when entering a new market.[106] This means that steadily skyrocketing user growth occurs simultaneously with heavy financial losses from quarter to quarter. This is the logic that underpins Uber as success story while simultaneously inspiring headlines such as "Why Uber Is Losing Money Faster Than Any Tech Company Ever."[107]

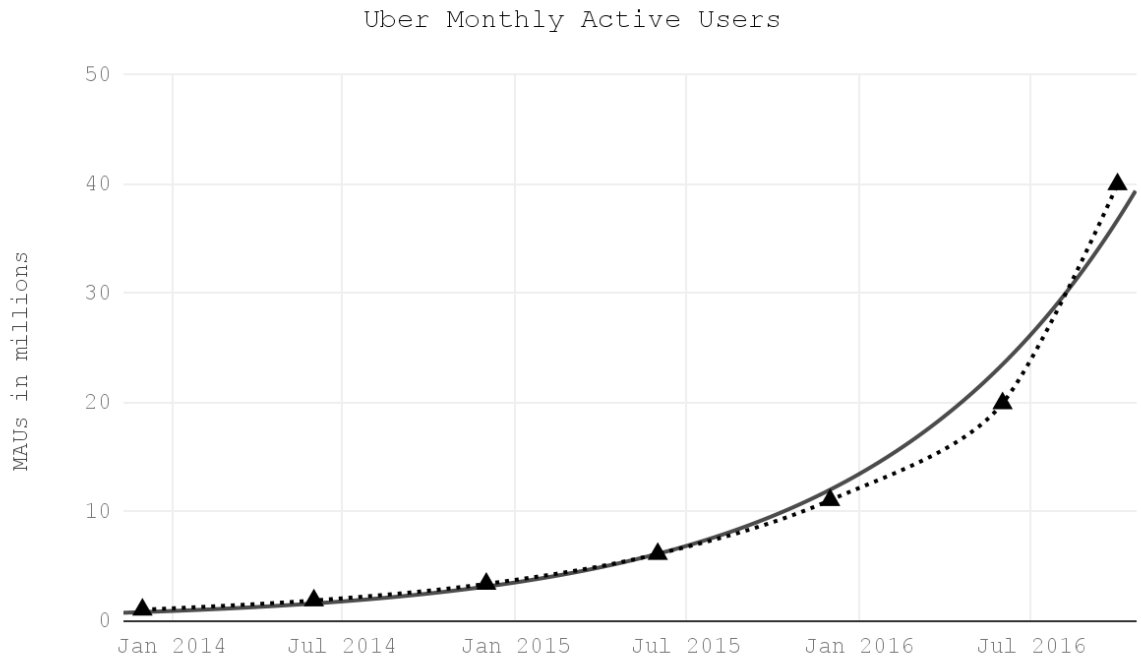

Figure 1: Uber Monthly Active Users, linking 2 known datum with estimated growth rate

The Uber machine thus burns cash to accumulate (human) capital. Of course the maximum user-base is not confined to a particular city or country, but spread across a broad geography of countries and territories. Again, scaling becomes critical. The end-point of any expansion must be global in scope—the objective is an exhaustive capture of the totality. The 'cash-burning' machine has

105 Matthew Lynley, "Travis Kalanick Says Uber Has 40 Million Monthly Active Riders," *TechCrunch* (blog), accessed November 29, 2017, http://social.techcrunch.com/2016/10/19/travis-kalanick-says-uber-has-40-million-monthly-active-riders/.

106 Izabella Kaminska, "The Taxi Unicorn's New Clothes," *FT Alphaville*, December 2, 2016, https://webcache.googleusercontent.com/search?q=cache:Gh1bBHDFqiMJ:https://ftalphaville.ft.com/2016/12/01/2180647/the-taxi-unicorns-new-clothes/+&cd=1&hl=en&ct=clnk&gl=nz.

107 Michael Nunez, "Why Uber Is Losing Money Faster Than Any Tech Company Ever," *Gizmodo Australia*, August 26, 2016, https://www.gizmodo.com.au/2016/08/why-uber-is-losing-money-faster-than-any-tech-company-ever/.

certainly followed this trajectory. In 2010 Uber began in San Francisco; in 2011 it had already expanded to six cities, including its first international launch with Paris; in 2012 it doubled that to twelve cities; in 2013 it added 47 new cities; by 2014 it was launching in a new city every 2 days, totalling 240 cities in 46 countries.[108] After this carefully selected first round of cities, the rapid pace of expansion often renders questions of location suitability moot. As Austin Geidt, Uber's head of global expansion, said "at this point we go so quickly, I wouldn't say that it particularly matters... if we're not there now, we'll be there in a week."[109] At the end of 2017, according to Uber's website, the ride-sharing service was available in 632 cities worldwide. A singular logic begins to emerge from this expansion, one in which the specificities of somewhere largely disappear into the goal of everywhere. Cities become fungible, seen less as particular places and more as progress towards an objective. The totality is rapidly encroached upon; the next city subsumed into the total progress bar: 12%, 23%, 36%. This logic resonates with a logic of totalitarian expansion described by political theorist Hannah Arendt, the discovery of an "expansion which was not driven by the specific appetite for a specific country but conceived as an endless process in which every country would serve only as stepping-stone for further expansion."[110]

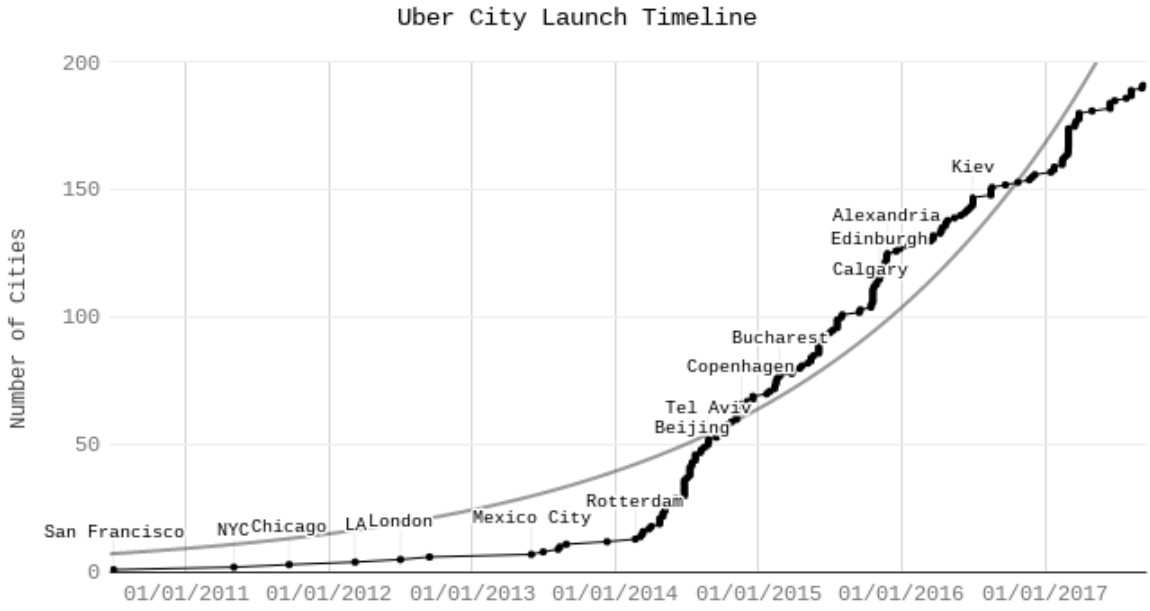

Figure 2: City Launch Timeline based on data collected from Uber blog posts

108 Mark Milian, "Uber's International 'Launch Playbook' Includes Some Tough Lessons," *Bloomberg.com*, November 20, 2014, https://www.bloomberg.com/news/articles/2014-11-20/ubers-international-launch-playbook-includes-some-tough-lessons.

109 Milian, "Uber's International 'Launch Playbook.'"

110 Hannah Arendt, *The Origins of Totalitarianism* (New York: Houghton Mifflin Harcourt, 1973), 335.

Rapid and relentless, this programme of expansion is the stuff of business bromides. It is Uber's 'playbook,' a compilation of winning moves.[111] It is Uber's 'fight,' in which aggressive yet effective tactics win the day.[112] And it is Uber's 'war,' where weapons and war chests allow one side to conquer their opponents.[113] In these framings, one unique company, led by its CEO, strategically draws together brilliant tactics with brute force in order to vanquish any incumbents and dominate the global market. And yet there's a sense in which this process of expansion develops its own inertia, subordinating brilliant individuals and business innovation to its own autonomous logic. Again, writing on regimes, Arendt asserted that "if they do not pursue global rule as their ultimate goal, they are only too likely to lose whatever power they have already seized."[114] Once the totality shifts from city to nation, from nation to multinational, from multinational to global, competitors have no choice but to pursue this totality.

In her *Totalitarianism* trilogy, Arendt unraveled the origins, development, and ultimate rise to power of two totalitarian regimes: the German Reich and Stalinist Russia. The particulars of these regimes and the atrocities they committed, while important, are not the focus here. To abstract away the specificities of victims and violence is, of course, problematic. But here it seems defensible to the extent that it follows Arendt's own arguments in highlighting these regimes less as particular ideologies, and more as processes of power. In a sense, Arendt too is less concerned with *content than movement*. Indeed the Nazi movement, she argues, should be understood not as a nebulous cluster of political claims, but as a literal movement—a vector incessantly pushing outwards.[115] It was this constant motion that coordinated the often inefficient activity of divergent government agencies, this constant motion that frustrated the international community's attempts to stabilise and slow the Reich's terrifying expansion.[116]

Expansion, in this context, does not rest on the heroic effort of the charismatic individual; nor is it an innovative scheme executed perfectly by an organisation or institution. The process itself moves over and above particularities and personalities. As Arendt writes:

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111 Olivia Solon, "How Uber Conquers a City in Seven Steps," *The Guardian*, April 12, 2017, sec. Technology, http://www.theguardian.com/technology/2017/apr/12/why-everyone-hates-uber-seven-step-playbook.

112 Simon Rothman, "Why Uber Won," *Business Insider*, accessed November 29, 2017, http://www.businessinsider.com/why-uber-won-2016-4.

113 Thompson, "Why Uber Fights."

114 Arendt, *The Origins of Totalitarianism*, 552.

115 Arendt, *The Origins of Totalitarianism*, 560.

116 The diplomacy of the non-totalitarian world was ineffective because it was still linked to a "common sense which suddenly proved to have lost its grasp on reality", while the Reich constantly rewrote the rules as it forged ahead: "the Nazis themselves showed no concern whatsoever about their own legislation. Rather, there was 'only the constant going ahead on the road toward ever-new fields.'" Arendt, *The Origins of Totalitarianism*, 1032.

> No matter what individual qualities or defects a man may have, once he has entered the maelstrom of an unending process of expansion, he will, as it were, cease to be what he was and obey the laws of the process, identify himself with anonymous forces that he is supposed to serve in order to keep the whole process in motion; he will think of himself as mere function, and eventually consider such functionality, such an incarnation of the dynamic trend, his highest possible achievement.[117]

The process establishes a goal, a guiding logic that motivates and coordinates even while allowing the specific means to remain productively undetermined. Agents within this process are not drones —variation in approaches and innovations in technologies are not forestalled. But these particularities are elided into a greater anonymous force. The 'dirty tactics' of Uber have received much press: Greyball technology that blocked government regulators from receiving rides, the 'canceled rides' scandal in which Uber intentionally booked and cancelled large numbers of Lyft pickups, the 'God's eye view' mode that tracked an individual in real-time as a party trick, and a suggestion to dig up personal dirt on critical female reporters.[118] Similarly the 'toxic culture' of Uber has seen much spilt ink: a brogrammer culture in which data analytics determined one night stands ('rides of glory'), revelations about a business evening at an escort-club in South Korea, an Uber France promotion where users could win a ride with a 'hot chick,' and most importantly, former engineer Susan Fowler and her explosive story of pervasive sexism and harassment.[119] Of course

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117 Arendt, *The Origins of Totalitarianism*, 215.

118 For an analysis of Greyball see Mike Isaac, "How Uber Deceives the Authorities Worldwide," *The New York Times*, March 3, 2017, sec. Technology, https://www.nytimes.com/2017/03/03/technology/uber-greyball-program-evade-authorities.html.
For the Lyft cancelled rides scandal, see Erica Fink, "Uber's Dirty Tricks Quantified: Rival Counts 5,560 Canceled Rides," *CNNMoney*, August 11, 2014, http://money.cnn.com/2014/08/11/technology/uber-fake-ride-requests-lyft/index.html.
For the God's eye view scandal, see Kashmir Hill, "'God View': Uber Allegedly Stalked Users For Party-Goers' Viewing Pleasure (Updated)," *Forbes*, October 3, 2014, https://www.forbes.com/sites/kashmirhill/2014/10/03/god-view-uber-allegedly-stalked-users-for-party-goers-viewing-pleasure/.
For Emil Michael's suggestion to discredit female journalists, see Ben Smith, "Uber Executive Suggests Digging Up Dirt On Journalists," BuzzFeed, accessed November 29, 2017, https://www.buzzfeed.com/bensmith/uber-executive-suggests-digging-up-dirt-on-journalists.

119 The original Rides of Glory post has of course been deleted, but Gigaom provides a good analysis:
Derrick Harris, "The One-Night Stand, Quantified and Visualized by Uber," March 26, 2012, https://gigaom.com/2012/03/26/uber-one-night-stands/.
For the trip to the South Korean karaoke/escort bar, which included calling out women by number to accompany the men, see Rhett Jones, "Report: Uber CEO's Group Trip To Escort Bar Made Female Employee 'Feel Horrible,'" *Gizmodo Australia*, March 26, 2017, https://www.gizmodo.com.au/2017/03/report-uber-ceos-group-trip-to-escort-bar-made-female-employee-feel-horrible/.
For the 'avions de chasse' promotion from Uber Lyon, see Charlie Warzel, "Sexist French Uber Promotion Pairs Riders With 'Hot Chick' Drivers," BuzzFeed, October 22, 2014, https://www.buzzfeed.com/charliewarzel/french-uber-bird-hunting-promotion-pairs-lyon-riders-with-a.
For Susan's original blog post, see Susan Fowler, "Reflecting on One Very, Very Strange Year at Uber," February 19,

these practices should be denounced. But what Arendt hints at is that all these messy, ego-driven, stubbornly social practices are taken up and incorporated into an overarching logic, something both more autonomous and more anonymous.

Yet Arendt never fully commits to such an impersonal system. Or, to be more precise, these anonymous forces are never allowed to encroach upon that all-powerful individual of the totalitarian regime—the Leader. For Arendt, the movement is shapeless, the system incessantly shifting, power transient and temporary, and all these qualities bewilder government agencies and great men, undermining personal vendettas and private ambitions, and instead enforcing a kind of capitulation to a greater process, a single-minded logic.[120] And yet somehow the hallowed figure of the Leader remains over and above this process, initiating motion while never being caught up in it. As she writes, "he himself is not tied to any hierarchy, not even the one he might have established himself."[121] This is debatable, of course. If totalitarianism was a movement, then the activities of its Leader were surely codependent on the operations performed by the agencies, materials, and individuals surrounding him. In other words, he was a node in a network, a vector amongst vectors, no matter how central or instrumental. Yet the goal here, in any case, is not to force a tight one-to-one analogy between totalitarian and algorithmic regimes. Indeed any comparison between the racist annihilations carried out by the Reich and the corporate machinations of companies such as Uber—however significant or far-reaching—would be highly problematic indeed. Instead, the objective is focused on an operational logic of expansion *anticipated* by the former, and *updated* in significant ways by the latter. In what ways do algorithmic technologies, infused into corporate structures, modify the parameters of the expansionist process?

Amending Arendt for today's technology titans might instead foreground their relatively leaderless movement. To be sure, this argument runs completely counter to current understandings. In tech and business literature, startups are often strongly identified with their founders or CEOs, who are seen to embody the brand and its values.[122] And yet taken together, and taken seriously—the virtuous cycle of Thompson, the network effects of Metcalfe, and the expansionist functionalism of Arendt imply an altogether stronger set of forces that build autonomously upon their own conditions. If this is true, then the activities of a leader—whether controversial or celebrated, brash or 'behind the scenes'—become relatively inconsequential. Evangelising about a new product, delivering a keynote, or conducting another interview—these highly visible actions merely tweak

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2017, https://www.susanjfowler.com/blog/2017/2/19/reflecting-on-one-very-strange-year-at-uber.

120 Arendt, *The Origins of Totalitarianism*, 566.

121 Arendt, *The Origins of Totalitarianism*, 567.

122 Heather Somerville and Joseph Menn, "Uber CEO Takes Leave of Absence amid Sweeping Changes after Scandals," *Reuters*, June 14, 2017, https://www.reuters.com/article/us-uber-board/uber-ceo-kalanick-to-take-leave-of-absence-idUSKBN1942EG.

the parameters of a much broader process, a process largely decoupled from the whims of any single figure, however 'powerful' or public.

Uber, for example, has long been associated with its aggressive yet effective CEO, Travis Kalanick. This is a man who created the company so he and his friends could be 'ballers,' who berated a driver that complained about falling fares, who penned a sex memo for a Miami celebration, and who described his ability to pick up women on demand as 'boober.'[123] These 'leadership issues' dovetailed into the increasingly visible 'toxic culture' of Uber to create shareholder anxiety, resulting in the board finally forcing Kalanick to resign. He was replaced by the former CEO of Expedia, Dara Khosrowshahi, who immediately set about rewriting Uber's cultural values, literally. Khosrowshahi laid out 8 cultural norms in a public blog post. One truism affirms diversity: "We ensure people of diverse backgrounds feel welcome. We encourage different opinions and approaches to be heard, and then we come together and build."; another encompasses ethics: "We do the right thing. Period."[124]

When asked to comment on these 'sweeping changes' at the company, Susan Fowler—the female engineer whose explosive blog post revealed this culture—dismissed the transformations as "optics."[125] Fowler, of course, was referring to the announcement as a public relations move, an exercise in media management. But for Marx, rights discourse and ethical statements are always 'optical' in that they focus on the visible surface while ignoring the underlying structural dynamics. All too easily, they become empty claims rather than operating conditions. Indeed his analysis of capital sought precisely to move past this realm of rhetoric—"this sphere that we are deserting... is in fact a very Eden of the innate rights of man."[126] What Marx recognised was that this paradise, which upheld human rights in theory, consistently subjugated them in the hells of industrial labor. Enshrined in law, lofty ideals were quickly discarded on the factory floor. Instead of utopian principles, Marx understood the efficacy of delimited struggles and practical victories—and he would gladly swap the former for the latter. As he writes, "in place of the pompous catalogue of the 'inalienable rights of man' comes the modest Magna Charta of a legally limited working-day."[127] The rights of workers, such as they are, emerge out of the positionality of the worker within a mode

123 Julia Carrie Wong, "Uber CEO Travis Kalanick Resigns Following Months of Chaos," *The Guardian*, June 21, 2017, sec. Technology, http://www.theguardian.com/technology/2017/jun/20/uber-ceo-travis-kalanick-resigns.

124 Dara Khosrowshahi, "Uber's New Cultural Norms," November 7, 2017, https://www.linkedin.com/pulse/ubers-new-cultural-norms-dara-khosrowshahi.

125 Susan Fowler, "It's All a Show. It's All Optics. Whatever It Takes to Win Back the Riders from the Competition, Right?," Tweet, @susanthesquark (blog), June 7, 2017, https://twitter.com/susanthesquark/status/875946810086268929?lang=en.

126 Karl Marx, *Capital: An Abridged Edition*, ed. David McLellan (Oxford: Oxford University Press, 1999), 350.

127 Marx, *Capital*, 521.

of production. In other words, rights only become real by being realised socially, materially, and technically.

In light of this, Fowler's comment on the ostensible culture overhaul of Uber could be extended to a whole variety of public controversies, nasty personalities, and dubious activities—they are *optical not operational*. Kalanick is out, Khosrowshahi is in. Yet the technical performances that conduct geopositioning, coordinate just-in-time matching, and produce Surge pricing are entirely unchanged. On a business level, this means that the aggregation of users continues; the recruitment and rating of drivers persists; and the spiralling expansion of the system is sustained. In physicist Albert-László Barabási's words, the network will keep expanding "one node at a time, taking on all the characteristics of a web without a spider."[128] In doing so, the specificities of a 'toxic culture' and its accompanying 'leadership issues' are smoothed over as an operational logic, averaged into an overall vector. In other words, these particularities—pathologic as they are—are subsumed into process.

This process is neither individual, nor unconstrained, but rather collectively compelled. Capital establishes a space of competition, not isolation. To operate viably in any given market, a company must embody the total sum of 'best practice' techniques established in that sector in order to cut prices, maximise profits, optimise labor, and so on. In this sense, to compete on a level playing field, companies are forced to adopt the profit-making practices of their competitors—however debilitating for workers or damaging to the earth. They have no other choice. Marx identified this phenomenon early on, stating that these laws "assert themselves as coercive laws of competition."[129] Any impingements on profit must be integrated as commonly agreed costs within an industry sector. Otherwise the ethical values of an individual, the environmental inclinations of an institution, the humanistic beliefs of a corporation—all these private charities must be discarded in the face of the harsh realities of the public market. In Marx's day, of course, this entailed the industry-wide practice of child labor and long hours in order to lower prices. Ostensibly revolutionary, the ride-sharing economy is no different. If Uber didn't undertake rapid expansion and global capture, Lyft would; if not Lyft, then Didi Chuang; if not Didi Chuang, then Gett.[130] Companies do not operate in isolation. Instead, as human geographer Brett Matulis argues, "they are agents within a framework that compels the pursuit of profit maximisation."[131] As an agent in this framework, any company's decision-making is codetermined both by the decisions of others

128 Albert-László Barabási, *Linked: The New Science of Networks* (Cambridge, MA: Perseus Publishing, 2002), 222.

129 Marx, *Capital*, 547.

130 Om Malik argues that the tech world today is one of of winner-takes-all, requiring aggressive expansion driven by a "loop of algorithms, infrastructure, and data" and amplified by "what are called network effects." Om Malik, "In Silicon Valley Now, It's Almost Always Winner Takes All," The New Yorker, December 30, 2015, https://www.newyorker.com/tech/elements/in-silicon-valley-now-its-almost-always-winner-takes-all.

and the conditions common across an industry sector. While the particularities of one technique or another are left open, the essentials of their next move as a rational actor within a game(d) system is —if not predetermined—at least highly constrained. Of course, this erosion of autonomy is an affront to innovation narratives and iconoclastic individuals. This is why, as Marx observed, coercion is internalised by the individual and transformed into the appearance of the self-directed, "brought home to the mind and consciousness of the individual capitalist as the directing motives of his operations."[132] Communal compulsion is recast as an independent course of action.

The 'virtuous cycle,' the 'network effect,' the 'coercion of competition'—all these terms signal processes that become decoupled from the original instigators and morph into free-floating operations with their own logic and inertia. These operations produce conditions of a systematic nature—unplanned and unattributable to any single actor. Yet the social and political force they exert is nevertheless significant. In fact, Marx argued that the intelligence and labor workers produces something exterior to them, something "neither located in their consciousness, nor subsumed under them as whole."[133] Such an exteriorised force seems to take on its own life, and Marx's language contributes to the vivification of this ghoulish totality. The interactions of workers, he wrote, "produce an alien social power standing above them, produce their mutual interaction as a process and power independent of them."[134] This 'alien power' is reminiscent of, and not unrelated to, the more well-known concept of 'alienation,' in which the worker becomes estranged from the production process and the resulting satisfaction of her own labor. But alien power is a stronger and more active framing than alienation, suggesting not just a loss of individual agency, but a congealing of it into a horrific embodiment of anti-agency. Indeed, the strength in the English is slightly tempered, because the original is better translated as a violence (*Gewalt)* independent of them.[135] These processes take on their own life, a life at times indifferent to other lives. The result is a monstrous entity that acts both systematically and brutally within the world in accordance with its own appetites. Such appetites arise not from any particular person or project, but from the combinatorial interplay of sociotechnical forces, and for this reason, are neither repressible nor understandable at the level of the individual. Aggregation theory and network effects help us see the

131 Brett S Matulis, "The Coercive Laws of Competition in a Neoliberal Era: The Case of Forestry in Costa Rica," *UAiR Journal of Political Ecology* 23, no. 1 (2016), 288.

132 Marx, *Capital*, 547.

133 Karl Marx, *Grundrisse* (London: Penguin, 1973), 196.

134 Marx, *Grundrisse*, 196-197.

135 The original reads: "Ihr eigenes Aufeinanderstoßen produziert ihnen eine über ihnen stehende, fremde gesellschaftliche Macht; ihre Wechselwirkung als von ihnen unabhängigen Prozeß und Gewalt." Gewalt can be translated as power but this is less common, and in German the various forms of violence are all modifications of the general understanding of Gewalt, e.g. domestic violence (häusliche Gewalt), spousal violence (eheliche Gewalt), sexual violence (sexuelle Gewalt). Marx, Karl. *Grundrisse der Kritik der politischen Ökonomie: 1857-1858*. Dietz Verlag Berlin, 1974, 111

processes that are 'spun up' by Uber, processes *exterior and unsubordinated* to the ambitions of any particular agent, no matter how innovative. Here one might quote Enlightenment philosopher Adam Ferguson, only this time with a darker edge—for our steps "are made with equal blindness to the future" through processes that "are indeed the result of human action, but not the execution of any human design."[136]

To conclude, this chapter has argued that Uber's algorithmic power hinges on replication. Urban transport becomes a performance to be enacted consistently, professionally, repeatedly, at scale. Replication is about a kind of relentless reproduction. By refining routing, specifying safe speeds, and instituting rating schemes, Uber aims to define and deliver the perfect experience, over and over again. In cloning the optimal, Uber hopes to deliver the predictable.

However if this operationalising of the 'real world' is promising, it is also problematic, encountering as it does the frictions of individuals and their diverse motivations. Moreover, the freelance nature of Driver-Partners means that, broadly speaking, algorithmic rather than employment mechanisms become the primary means of attaining a replicable performance. From gamification nudges to incentivisation schemes, the Partner-Management-Messaging machine showed how Uber deploys a variety of control mechanisms in its attempt to steer the worker towards a desired routine. Yet the thin understanding of a driver embedded into Uber's logic impinges on the force able to be exerted. Instead, drivers frequently assert their own agency, rupturing replicability and producing a more uneven, idiosyncratic experience. Indeed, the rule-pushing behaviour of drivers suggests that the operational parameters seeking to replicate, to render optimal, also provide a grid to pry and poke. The ViolentFlesh-Passenger machine continued this thread, diving into a disparity at the core of Uber. From sign-up to sign-on, the platform constantly reinforces the internal logic of an informatic body. But this logic fails to encompass the latent corporeal capacities of workers, which can spill out in uncontrolled and violent ways. Rather than being narrowly operationalised, the Uber driver remains indeterminate—contingency can never entirely be coded away. Algorithmic power is never guaranteed, but must be incessantly negotiated.

The second half of the chapter examined replicability at a macro-level. Once the Rider/Driver relation is made replicable, the goal becomes to scale it up. Indeed the model of replication coupled with the algorithmic architectures of Uber mean that scaling becomes not just frictionless, but thoughtless—a matter of doing the same thing over and over again, at different times and locations. Given these conditions, growth becomes an all-consuming imperative, and the Capital-Cash Burning machine sought to show how scale subsumes strictly financial value. However, drawing on aggregation theory, network effects, and Marxian concepts, it was argued that these processes are

136 Adam Ferguson, *An Essay on the History of Civil Society* (Cambridge: Cambridge University Press, 1995), 122.

neither innovative nor individual, but unsubordinated and anonymous, becoming an alien force that incorporates and instrumentalises labor based on its own imperatives. While replication delivers a model for scalability, then, it also seems to slip away from singular control. Instead of ensuring a synecdoche-like power, replication feeds back in systemic ways.

3.
Unifying Power: Airbnb

On December 28th, 2013 Elizabeth Eun-chung Yuh checked in to her Airbnb listing on Yanji street in Taipei. A small *China Post* article stated she had traveled there to celebrate a wedding with three friends, who rented the rooms next to hers.[1] The 35 year old South Korean was a native of Ontario and due to fly back the next day. So after the celebrations, she drifted off to sleep, ready for the long journey home. But she would never wake up. Some time on the morning of the 29th, Yuh died of carbon monoxide poisoning. As the newspaper noted, a water heater had been recently installed on the balcony next to her room.[2] Windows on the balcony should have provided ventilation, but had been shut by previous tenants because of cold weather. When an aunt visited the next morning, she discovered the other three guests unconscious and immediately telephoned the authorities. The trio were rushed to the hospital, treated, and later discharged. But as the newspaper reported, "the setup of the environment provided the worst case scenario for Chung."[3] When firefighters finally broke into Yuh's room next door, she was pronounced dead on arrival.

The apartment at Yanji Street had a specific history. At the micro level this included the installation of the water heater and the enclosure of the balcony; at the macro level this involves the cycles of Taiwan's climate and Taipei's history of carbon monoxide poisoning.[4] Yet the apartment at Yanji Street, like every other room or home on Airbnb, was registered into the generic schema of the Listing. Every Listing has an ID number and a description. Every Listing holds an array that defines the amenities available: wi-fi, washer, dryer, and so on. Every Listing contains fields for latitude and longitude, for market and city, for room type and bed type. Airbnb's schema is a kind of skeletal syntax containing the core traits of accommodation. For Ned Rossiter, this is the templating of the world.[5] By imposing this unified schema across the platform, different dwelling types in disparate locations become compatible, able to be filtered and sorted, compared, and cross-indexed. Every space is rendered interoperable with every other and with the platform as a whole.

At the core of Airbnb, then, is a conflict: space is specific, local, and historical, and yet the platform is predicated on the notion that any space, in any city, can be shoehorned into a universal schema.

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1 James Chi-hao, "Backpacker Dies from Carbon Monoxide Poisoning," *The China Post*, December 31, 2013, http://www.chinapost.com.tw/taiwan/national/national-news/2013/12/31/397194/Backpacker-dies.htm.

2 Chi-hao, "Backpacker Dies from Carbon Monoxide Poisoning."

3 Chi-hao, "Backpacker Dies from Carbon Monoxide Poisoning."

4 A journal article from Huei-Guan Shie & Chung-Yi Li "demonstrates an alarming increase in the unintentional death rate from CO poisoning in Taiwan between 1997 and 2003" and observes that "residents of northern Taiwan (which is relatively urban) had a notably higher MOR of CO poisoning." Northern Taiwan includes Taipei City, the densely populated urban center where the Airbnb on Yanji Street was located.

5 "Template cultures have become today's iron cage of reason. They are an unknown default whose genealogy is not without power in placing limits on expression in seemingly invisible ways." Templates are also referenced more indirectly in an earlier section on standards which are 'coded vanilla': "algorithmic architectures designed to orchestrate protocological equivalence and thus connection between software applications and workplace routines." Ned Rossiter, *Software, Infrastructure, Labor: A Media Theory of Logistical Nightmares* (New York: Routledge, 2017), 521.

After all, Airbnb has planetary ambitions. As discussed in the chapter on Uber, the frictionless growth enabled by algorithmic infrastructures produces every incentive to scale rapidly and indiscriminately. Location becomes just another variable. But there is an antagonism between universality and specificity, a disjuncture between the generic 'wherever' of a global platform and the specific 'somewhere' of a spatial life-world: a site with a set of inhabitants and a history of usage, situated in a broader sociocultural milieu. This chapter will thus argue that space is contested, and that in order to unify, Airbnb must also override.

Unification encounters friction; overriding is inevitably incomplete. Indeed, one aim here is to develop a more nuanced understanding of how space becomes reworked through the interplay of forces. Much has been written on the 'Airbnb effect' or the 'Airbnb phenomenon' as a significant shift that gentrifies cities.[6] But taken as a totality, this 'phenomenon' becomes both unexplainable and ineluctable. Like a typhoon or a tidal wave, it is an act of nature that just happens. Less understood are the technical affordances that strive to assemble homes into a single platform and subject them to a cohesive new set of social and financial pressures, pressures that inevitably encounter historical residue and localised norms. Here the algorithmic as a dialectic of logic and control again becomes productive. Airbnb's logic of the Listing is an internal knowledge-structure that is clean and coherent, a universal schema that provides interoperability across the platform. But to purposively influence space, one must control it—imposing this logic and funnelling messy particularities into a standard template. This entails a performance in the world, one that must negotiate with frictions or even overpower them. This is not to ascribe some conscious agency to space, but to simply acknowledge that space is contested—to dictate one use, others have to be suppressed, softened, or altogether extinguished. Airbnb can be understood as a subtle and systematic violence only by attending to the *intersection* between unifying power and spatial heterogeneities.

To explore this attempt at unifying space, this chapter proceeds through a trilogy of related machines. First, the DomesticArchitecture-BookingAppeal machine argues that space, contrary to a popular understanding, is not unified aesthetically so much as operationally. Airbnb imposes a set of common metrics that redefines what a space needs to do. Next, the DynamicPricing-Microneighbourhood machine explores how machine learning suggests a rental price for each property. By defining similarly priced listings as a 'microneighbourhood', Airbnb algorithmically

6 Renate van der Zee, "The 'Airbnb Effect': Is It Real, and What Is It Doing to a City like Amsterdam?," the Guardian, October 6, 2016, http://www.theguardian.com/cities/2016/oct/06/the-airbnb-effect-amsterdam-fairbnb-property-prices-communities.
Jamie Doward, "From Berlin to Barcelona; Will Airbnb Ruin Our Most Loved Cities?," the Guardian, June 25, 2016, http://www.theguardian.com/technology/2016/jun/25/from-berlin-to-barcelona-will-airbnb-ruin-our-most-loved-cities.

unifies urban space according to capital rather than community or history. Finally, the Skin-Soil-Xeon machine traces the development of processor chips, exploring the darker lineage of hardware that powers these algorithmic affordances. These machines thus provide an interdisciplinary approach, a method that not only delves into machine learning, for instance, but also attends to the material hardware and historical labor that underpins it. The unification of space in the present is predicated on a strategic decoupling from bodily and environmental degradations in the past.

DomesticArchitecture-BookingAppeal machine

Space on Airbnb is indexed—stored, structured, and made searchable. Like any search engine, the order this index is returned in has significant consequences. Some properties become highly sought after, rising to the top of the search results, while other languish in obscurity. 'Booking appeal' is the term used by Airbnb to refer to the ability of a listing to attract interest, whether in the form of actual booking requests or clicks through to that particular listings page. "If guests see your listing in search and click through to learn more, this can improve your search performance in the future" explains the company's blog; "Similarly, if guests frequently try to book your place after viewing your listing page, this can also have positive effects."[7]

How might a Host amplify their booking appeal, attracting more page views and bookings? They might begin by studying the formal characteristics of this index—the content available, the layout used, and the interactions supported. Listings are browsed as lists or grids of items, depending on the device. Each listing item contains the same basic information: price, photos, title, type of accommodation (house, room, etc), average review (e.g. 4 stars), and number of reviews given. The platform, however, takes these fields and establishes a hierarchy through design—assigning more or less space, heavier or lighter type, more or less contrast. What emerges as king in this design analysis is the photograph, which takes up 77% of a listing's total area (370 x 248 pixels vs 370 x 321 pixels). Furthermore, there is not just a single photograph per listing, but what user interface designers call a 'carousel', small arrows to the right and left enable users to cycle through a series of listing images: the bedroom, the bathroom, the balcony, and so on. This allows an entire gallery to be browsed before deciding whether or not to visit the full listing page. Thus both interactive and graphic design produce a clear prioritisation—the visual representation of a space overpowers any textual representation.

Aesthetics seemingly becomes all-important. There is a kind of tautology here—if popular listings look a particular way, a listing must look a particular way to be popular. In fact, this is the precisely

7 Airbnb Blog, "How Search Works on Airbnb," *The Airbnb Blog - Belong Anywhere* (blog), April 14, 2014, https://blog.atairbnb.com/how-search-works-on-airbnb/.

the argument of journalist Kyle Chayka, who argues that platforms such are Airbnb are spreading the "same sterile aesthetic throughout the world."[8] The listings which attract interest and rise to the top of the global heap are immaculately photographed spaces studded with a carefully curated selection of markers: reclaimed wood, Scandinavian decor, mid-century furniture, chalk-boards, designer lighting, swathes of open space, a certain minimalism. For Chayka, such tokens appear over and over again in the highest ranked listings and indicate an affinity with a globalised design culture, "a profusion of symbols of comfort and quality."[9]

Importantly, these commonalities are not orchestrated by a top-down management which designs franchises, nor a globalised corporation which mass-produces cookie cutter interiors. Indeed, Airbnb offers very little in the way of formalised aesthetic guidelines for hosts. Instead, Chayka argues, this monoculture emerges organically, an aesthetic which "arises from tens of thousands of people making the same independent decisions rather than a corporate mandate."[10] Booking appeal establishes a powerful set of gazes, both directed onto the interior space and comparing this space with a subset of similar spaces. This gaze highlights the particular furnishings, decor arrangements, architectural elements and design decisions which don't occur in the most booked listings. According to this argument, a feedback loop is established, flagging those items lying outside the norm and removing them or bringing them in line. This circuit gradually transforms the outlier interior into the docile and desirable interior; walls become whiter, wood grain gets lighter, space becomes opened up, lighting becomes industrial, the exotic becomes international. The apartment in Tokyo looks identical to the one in Vienna; the studio in Amsterdam appears entirely interchangeable with another in San Francisco. The heterogeneities particular to cities and cultures have been eradicated, replaced by an architectural homogeneity, a "harmonisation of tastes."[11] Space, it appears, has been entirely smoothed over.

Yet this argument quickly falls apart. Spend any significant amount of time on the platform and it soon becomes apparent that there are huge variations in the spaces listed. Among the bulk of 'typical' listings, accommodation types range from basements to penthouses, from high-rise apartments to suburban bungalows, from single bedrooms to sprawling mansions. This is not to mention the hundreds of eccentric outliers: an igloo in Greenland, a tipi in Denmark, a lighthouse in New York, a water tower in London.[12] Indeed, these oddball accommodations champion their singularity as one more way to stand out in a competitive marketplace comprised of thousands of

8 Kyle Chayka, "How Silicon Valley Helps Spread the Same Sterile Aesthetic across the World," *The Verge*, August 3, 2016, http://www.theverge.com/2016/8/3/12325104/airbnb-aesthetic-global-minimalism-startup-gentrification.

9 Chayka, "How Silicon Valley Helps Spread the Same Sterile Aesthetic."

10 Chayka, "How Silicon Valley Helps Spread the Same Sterile Aesthetic."

11 Chayka, "How Silicon Valley Helps Spread the Same Sterile Aesthetic."

12 Sylvia Minola, "The 14 Craziest Airbnb Accommodations From Around the World," June 24, 2014, https://www.brit.co/crazy-airbnb-properties/.

other options. Interior decoration also varies enormously, comprising a huge array of paint hues, pattern choices, textiles, art objects and custom built features. One listing features tribal carpeting; the next employs a nautical theme; a third includes samurai paraphernalia.

This enormous gamut of architectures, spatial arrangements and interior ambiences occurs even in major 'international' cities such as San Francisco, London, and Paris—those centres assumedly most prone to the forces of international homogenisation. But this variation becomes even more visible once one ventures beyond these world cities and into any one of the lesser known locations from the 64,000 in which Airbnb is active: Lucca and Groningen, Yellowknife and Joshua Tree, Cabo Frio and Busan. This hunch is borne out when one moves from merely browsing these spaces to inhabiting them—their rhythms and sounds, linens and odours, neighbours and pets exhibit a specificity, not a sterile sameness.[13] Contrary to a vision in which space is effortlessly assimilated into a single monolithic medium, spaces on Airbnb seem to remain both peculiar and particular.

How then, might we characterise the type of space which Airbnb produces? To address this conundrum, I turn to Henri Lefebvre and his notion of abstract space. Abstract space is highly ambivalent—embracing rather than suppressing inherent differences. Paradoxically then, for Lefebvre, "the space that homogenises thus has nothing homogenous about it."[14] This immediately feels more like the spatial typology which the platform works to instil, a constellation of spaces which are unique and yet unified, disparate but somehow formally aggregated.

In aggregating spaces into a universal platform, a common set of pressures can be exerted. In the back-end, each Listing has the same parameters: a price, a location, a set of amenities. In the front-end, each Listing is presented in the same way: a title, a description, a rating. This conformity is not nefarious but necessary—emerging from the logic defined by the informational ontology, as we saw in the chapter on Palantir, and the consistency required for a good user experience. In structuring and presenting space in a unified fashion, Airbnb establishes a common set of variables which spaces are valued by: authenticity, accessibility, security, and so on. Through the Airbnb website and the mobile application, this index is continually exposed to an enormous public, who use these variables to scan, choose, and rate accommodation, exerting a set of spatial pressures. If a Host wants her home to have 'booking appeal', to appear highly in results and be recommended often, then the space will need to score highly in the values that Airbnb privileges. Integrated into an overarching architecture with a single schema, spaces must respond to a shared set of metrics.

13 Based on personal field work involving staying at various Airbnb listings in Sydney, Australia and Dunedin, New Zealand.

14 Henri Lefebvre, *The Production of Space*, trans. Donald Nicholson-Smith (Oxford: Blackwell, 2009), 308.

But at the same time, each of these listings has a unique architecture, a particular location, a specific typology. Even though these homes and apartments are subjected to a consistent set of forces, Airbnb offers no top-down recipe for resolving this tension. Instead, each listing must instigate its own fitness function—developing a programme for measuring itself against a standard, identifying those areas where it comes up short, and improving upon them in an iterative fashion. Each space must be true to itself, finding the unique configuration needed to achieve the necessary levels of these system-wide values. To do this, each space must own or even exaggerate its differences, rather than suppressing them. A space in Cape Town is different from one in New York, not simply because of disparities in climate or culture, nor even due to a lack of capital to transform it into a generic global style, but because in order to facilitate an authentic South African experience, it *should* be. In this way differences can be retained or even accentuated while still conforming to an established protocol. As Lefebvre suggests, abstract space thus "reduces differences to induced differences: that is, to differences internally acceptable to a set of 'systems' which are planned as such, prefabricated as such - and which as such are completely redundant."[15]

In this way abstract space, parsed through computational architectures, subsumes *the optical into the operational*. Andrew Merrifield, writing on Lefebvre, is thus only half right when he states that "abstract space tends to sweep everybody along, molding people and places in its image."[16] Spaces are moulded not towards an image but an output; each space accentuates its individuality and each host asserts her own personality in order to attain the necessary numbers within a common set of metrics. Of course, this doesn't mean that appearances play no part in this process. As we've seen, the design of the Airbnb platform privileges the photographic highly, designating a large proportion of the Listing's screen space to images. The platform even offers professional photographic services to Hosts for free, increasing the desirability of spaces by capturing them with wide angle lenses, adequate lighting and high-resolution cameras.[17] The visual impression of any particular space is thus undeniably important.

But the point here is that aesthetics is converted through the algorithmic into an operation, one which fosters a multiplicity, not a monoculture, of spatial arrangements and interiors. Take, for example, a Balinese mask and a Swedish carving as interior decorations. These artefacts look completely different but function in exactly the same way—injecting a local aura into an otherwise bland interior. In doing so, both spaces achieve a particular concentration of 'authenticity,' a value conferred by thousands of individual onlookers and meticulously indexed by the platform in the form of ratings and reviews. In order to accomplish the same thing, each listing must be uniquely its

15 Lefebvre, *The Production of Space*, 396.

16 Andy Merrifield, *Henri Lefebvre: A Critical Introduction* (New York, NY: Routledge, 2006), 112.

17 Jennifer Van Grove, "Airbnb Gives Out Free Professional Photography," Mashable, October 7, 2011, https://mashable.com/2011/10/06/airbnb-photography/.

own—appearing differently in order to act in the same way.

In unraveling the performativities at work in algorithmic systems, vision often acts at this type of red herring—obscuring a range of more fundamental yet unseen operations or being taken up as one component in a broader logic which encompasses a wide array of factors and variables. Airbnb appears largely innocuous. On the surface, the space of accommodation might remain almost undisturbed: a welcome basket added, a smart lock installed, some local handicraft included. But in moving from home to platform-based hotel, the priorities of the space and the parameters that represent them have been completely shifted. No longer simply a nominal shelter for its long-term inhabitants, the room, home, or apartment must adhere to a new programme. Taken together, listing, indexing, and rating processes seek to recalibrate a space, purposively influencing it towards the maximum amplification of capital—the highest rate per night with the highest occupancy over time.

A new set of metrics is established. The Host modulates his affect, the Listing evolves its architecture, and the Guest rates her experience all against this new standard. In moving from the personal to the platform-wide measure, that which was unnoticed and ephemeral is now tracked and captured. As Phil Agre asserts, "by imposing a mathematically precise form upon previously unformalized activities, capture standardizes those activities and their component elements and thereby prepares them... for an eventual transition to market-based relationships."[18] Aspects which were formerly irrelevant now become important. Some of these are obvious and intuitive: cleanliness, accessibility, noise-levels. But, as we'll see in the next section, this shift also activates an array of signals that remain unseen to the Host. The platform establishes a logic that fundamentally transforms the programme of spatial action: modifying the outputs a space must produce and the ways in which those outputs are mapped and measured.

By imposing this new programme on each and every listing, Airbnb breaks down urban space and reconfigures it according to a new set of parameters, a subtle but systematic process made effective not least through its apparently apolitical nature. This is why, for Merrifield, abstract space can be both "deft and brutal."[19] Of course, underneath these platform-wide parameters lies the universal value of capital, the financial bedrock by which all spaces are measured. Merrifield reinforces this, stating that the underlying dynamic here is "conditioned by a logic that shows no real concern for qualitative difference. Its ultimate arbiter is value itself, whose universal measure (money) infuses abstract space."[20] How is space remade according to capital, and how could this imposition of one

18 Philip Agre, "Surveillance and Capture: Two Models of Privacy," *The Information Society* 10, no. 2 (1994): 120.
19 Merrifield, *Henri Lefebvre*, 112.
20 Merrifield, *Henri Lefebvre*, 112.

value system onto space be construed as brutal? To explore this question, the next section dives deeper into the second machine in the trilogy, the DynamicPricing-Microneighbourhood.

DynamicPricing-Microneighbourhood machine

What is my rental property worth per night? This is a core question for Airbnb. The problem and response is elaborated in detail by Dan Hill, Product Lead at Airbnb, in "The Secret of Airbnb's Pricing Algorithm."[21] In early focus groups, users wanting to list their home would often get stuck when asked to enter a number in the price field, looking for similar listings or simply giving up altogether. Of course the problem was one for users, in that it sets up a poor user experience and unsuccessful listings. However it was also problematic for the company. Overpricing results in less bookings, meaning Airbnb gets commissions less often. On the other hand, undervaluing a Listing might increase a property's popularity, but ultimately fails to extract the maximum market value that could be attained.

Airbnb needed to provide a 'price tip' at this point in the listing process, a recommendation of how much a particular property is worth per night. For many other platforms, pricing is somewhat universal. A 1 mile bus ride in San Francisco, for example, always costs the same amount, regardless of departure time, location or driver. Airbnb, by contrast, deals with thousands of completely unique properties, in unique locations, rented by hosts which vary hugely in their services offered. As Hill stresses, the difficulties in assigning price points are not trivial—how do you value a castle in Kent, a single room in Rio during the Olympics, or a yurt in London?[22]

The company's original pricing algorithm was both crude and static. Essentially it drew a circle around the listing's location and suggested a price based on similar properties within this circumference. This rough approximation presented its own problems. As Hill notes, properties along one riverbank or situated on the edge of neighbourhoods might often be worth far more than those across the river or on the 'bad side of the tracks,' but this circle lumped them all together indiscriminately, assigning them the same average value.[23] The algorithm also factored in historical fluctuations, based on seasonal changes, tourist demand, or special events, but these were essentially annually repeating factors. This meant that a home in Austin Texas during the SXSW festival, for example, would always be worth the same price if listed on the same day.[24] How would one account

21 Dan Hill, "The Secret of Airbnb's Pricing Algorithm," *IEEE Spectrum: Technology, Engineering, and Science News*, August 20, 2015, http://spectrum.ieee.org/computing/software/the-secret-of-airbnbs-pricing-algorithm.
22 Hill, "The Secret of Airbnb's Pricing Algorithm."
23 Hill, "The Secret of Airbnb's Pricing Algorithm."
24 Hill, "The Secret of Airbnb's Pricing Algorithm."

for last minute bookings and new events without historical precedents?

Airbnb's algorithm is now dynamic. As a means of value extraction, it operates similar to the airline industry which ramps up ticket prices closer to the flight time based on factors like demand and aircraft occupancy. Rather than an annual cycle which fluctuates based on seasons or special events, the price for a bed is reconfigured moment by moment in accordance with "changing market conditions."[25] The algorithm also checks whether a property was booked at that particular price point. Based on this success or failure, the algorithm learns by adjusting its 'signals'—the weighting of particular factors such as host reputation, specific types of photos, wifi quality, bedroom facilities, and so on. Traditional real-estate's signal is so simple and dominating that is now a mantra: location, location, location. But for capital, monolithic metrics like these leave far too much on the table. In failing to exhaustively understand a commodity, they also fail to exhaust its full potential and profit. In contrast, dynamic pricing adds the intangible into the formerly un-valuable—the affective performance of Hosts, the desirability of a neighbourhood, the transient population spike of a local festival—all these factors can be quantified in order to extract the highest possible price from the previously 'useless' space of the empty home or spare room. Through this increasingly detailed formalisation, dynamic pricing excavates space, striving to obtain its maximum lode of capital.

As an aside, we can note again how these specific logical understandings of space are spun out into mechanisms that control behaviour. In another presentation on the pricing algorithm, Hill notes that Hosts would overvalue their home due to their personal connection to it; Airbnb initially created a slider with the price recommendation in the middle, but users would still nudge this upwards; the solution was to "slide the whole scale a quarter deviation down"—once nudged upwards, the Host would unknowingly set the price at Airbnb's recommended level.[26]

Dynamic pricing establishes a particular spatial logic, a highly cellular cartography labeled by the company as 'microneighbourhoods.'[27] These areas are dynamically generated based on historical pricing data, grouping similarly-priced properties into a red rectangle that ranges in size from a few streets down to a cluster of apartments. This process slices into the planes of traditionally understood neighbourhoods; it cuts through geographical boundaries such as rivers; it penetrates across the political borders of city and state. Space is divisioned up, not by social or geographical logics, but by the new metric of rental value. Rather than language, culture or community, capital

25 Hill, "The Secret of Airbnb's Pricing Algorithm."

26 Dan Hill, "Algorithmic Pricing Models" (San Francisco, May 5, 2014), https://www.youtube.com/watch?v=-KFe5pGMFbo.

27 Hill, "The Secret of Airbnb's Pricing Algorithm."

becomes the force which coalesces housing together into a spatial unit, united by a common price point.

In this way the microneighbourhood exemplifies Lefebvre's notion of the violence of the abstract, one which "introduces the rational into the real, from the outside, by means of tools which strike, slice, and cut—and keep doing so until the purpose of their aggression is achieved."[28] The purpose in this case is crystal clear—to extract the maximum financial value from the rental of a particular space at a particular moment. In this way abstract space, like its namesake of abstract labor, is always moving away from simple use value (a space to sleep for the night) and towards an optimal exchange value—the upper value limit attainable from the market and embodied in the universal equivalent of money. Enfolding a diverse set of signals into its calculus, the microneighbourhood moves past single metrics in order to develop a more articulated, more comprehensive price estimation. Yet despite such sophistication, these signals are ultimately treated as boosting or attenuating a monetary value. The logic here retains a blinkered understanding of space focused on rental price.

This recalibration of space has consequences, allowing forms of wealth to be extracted from it. Most obviously, there is monetary wealth. For every stay, Airbnb siphons off a portion of the accommodation fee. Due to the massive scales of operation, this is not insignificant. By mid 2014 founders Brian Chesky, Nathan Blecharczyk and Joe Gebbia had already joined the Forbes billionaires list, and the company was worth $31 billion as of May 2017.[29] But there is also informational wealth: microneighbourhoods can only be created and maintained through a machine learning operation—an operation that depends entirely on a massive amount of data delivered reliably and continuously, day in and day out. For Airbnb, this drained data underpins new fields of research and development that in turn increase market share and the customer-base.[30] And perhaps most importantly, there is the wealth of the commons. The home, nested both within the neighbourhood and the wider city, rests atop communal knowledge, practices, and historical development. Sewers and power infrastructures, playgrounds and schools, community festivals and events—these institutions and infrastructures were designed for the collective well-being of the many. But through dynamic pricing they become parameterised and privatised. In this sense the positive and formerly ephemeral markers of culture—street life and stoops, community and conversation—get encapsulated into signals, amplifying the rental value of a property.

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28 Lefebvre, *The Production of Space*, 289.

29 Alex Konrad, "Airbnb Cofounders Are Billionaires As Share Economy Leader Closes $450 Million Round At $10 Billion Valuation," *Forbes*, April 18, 2014, https://www.forbes.com/sites/alexkonrad/2014/04/18/airbnb-closes-round-at-10-billion/.
Greg Bensinger, "Airbnb Valued at $31 Billion After New Funding Round," *Wall Street Journal*, March 9, 2017, sec. Tech, https://www.wsj.com/articles/airbnb-valued-at-31-billion-after-new-funding-round-1489086240.

30 Stephanie Pandolph, "Machine Learning Is Driving Growth at Airbnb," Business Insider, June 16, 2017, https://www.businessinsider.com/machine-learning-is-driving-growth-at-airbnb-2017-6.

This inflated capital is then exhausted away, flowing both to Airbnb and private entrepreneurs. And increasingly they are entrepreneurs. Airbnb's marketing frequently evokes the hobbyist making a little extra cash by renting her bedroom. In a now-deleted blog post that echoes Airbnb's broader promotional discourse, Airbnb Founder and CEO Brian Chesky wrote of the platform being powered by everyday folk:

> They include hosts like Teya, a student who loves cooking for her guests and will use the money she has earned on Airbnb to buy her apartment in Harlem. Or Javier from Brooklyn, who works in the restaurant business and likes to show off his favourite Latin dance spots to travellers from every corner of the globe. And hosts like Lauren and her husband who are using the money they earn on Airbnb to pay off their student loans.[31]

But a basic analysis of their own listings say otherwise. Key here is the percentage of listings made by Hosts who have multiple listings. Those who rent more than one property on Airbnb have most likely become unregulated hoteliers. The numbers speak for themselves: Venice 68%, Mallorca 67%, Hong Kong 59%, Boston 51%, New Orleans 49%.[32] This use of the platform means that the exhaustion of the commons is simultaneously accompanied by the infusion of capital. Rather than 'regular people,' as one researcher observed, Airbnb's activity is increasingly driven by "professional landlords who are removing badly needed housing from the local market and making it available exclusively for tourists."[33] Slowly and organically, homes are snapped up, apartments are acquired and entire buildings are transformed from long-term living to short-term rentals. These twin processes feed off each other, and it is this circuit—while no doubt complex and laced with other factors—that modulates its urban support structure, creating rental increases, housing shortages and gentrification.

In achieving its principal purpose through this aggression, we must also attend to the secondary collateral damage that such a capitulation to capital causes—the annihilation of other spatial possibilities. There are many other logics of space. We might think, for instance, of spatial arrangements based around religion (the temple and the *eruv*), criminal justice (the prison and the processing centre), sexuality (bathhouses and cruising areas), or group productivity and sociality

31 Sarah Kessler, "Secrets Of Running A Six-Figure Airbnb Business," Fast Company, November 5, 2013, https://www.fastcompany.com/3021179/secrets-of-running-a-six-figure-airbnb-business.

32 Analysis of 37 cities on Airbnb using data from Inside Airbnb, which scrapes the platform's publicly available listings. Murray Cox, "Inside Airbnb," *Inside Airbnb*, accessed September 25, 2017, http://insideairbnb.com.

33 Steven Hill, "$25 Billion Airbnb May Have Met Its Match," Business Insider Australia, October 31, 2015, https://www.businessinsider.com.au/the-two-faces-of-airbnb-2015-10.

(the commune and the *kibbutz*).[34] The point here is not whether these alternative spatial arrangements are emancipatory or utopian or ill-conceived, but that they are just that—alternatives. But these imaginative or speculative potentials are often banished in the harsh light of "capitalist realism."[35] As Lefebvre points out, the hegemony that existing property relations achieve is thus simultaneously an erasure of other alternatives, a situation in which a broad array of possibilities "are always systematically reduced to the triteness of what already exists."[36]

Finally, this abstracted violence enacted directly on the targeted space is accompanied by a more tangible violence carried out in other times and other places on other(ed) bodies. Airbnb, like many Silicon Valley companies, draws frequently on its status as a mere technology company, powered by the ostensibly immaterial cloud. Yet the cloud is comprised of cables, drives, warehouses, labor, and not least—processor chips. To understand how the historical development of these processors occurred in tandem with the devastation of bodies and environment, we turn to our third and final machine, Skin-Soil-Xeon.

Skin-Soil-Xeon machine

Algorithmic control is performative, and data centres provide storage, transmission, and processing for this performance. For Airbnb, the critical platform services of photo hosting, financial transactions, user onboarding, price recommendations, and location mapping are all underpinned by the harder material substrate of Amazon Web Services (AWS) running on Intel Xeon processors.[37] These microprocessors are the direct result of a legacy of R&D which took place at a specific time and place, and like the legacy of slavery, these machines embody the socioeconomic advantages accumulated through the exploitation of labor and nature. As direct descendants of this lineage, their amassing of innovations could only be accomplished through the degradation of specific bodies and specific places. As Seb Franklin hypothesises, there is:

34 One might also think here of the "arrangements of transition" that Foucault called heterotopias, spaces with particular, temporary purposes such as the boys boarding school or the bride's honeymoon train, or alternatively of the "psychogeography" of the decade-long "New Babylon" project by artist Constant Nieuwenhuys. Michel Foucault, "Of Other Spaces," ed. Jay Miskowiec, *Diacritics* 16, no. 1 (1986): 22–27, https://doi.org/10.2307/464648.

35 Mark Fisher, *Capitalist Realism: Is There No Alternative?* (Winchester, UK: Zero Books, 2010).

36 Lefebvre, *The Production of Space*, 357.

37 Intel powers AWS which powers Airbnb. This relationship is documented on two AWS pages.
Amazon Web Services, "Airbnb Case Study," Amazon Web Services (AWS), accessed May 22, 2018, https://aws.amazon.com/solutions/case-studies/airbnb/.
Amazon Web Services, "Intel and AWS," Amazon Web Services (AWS), accessed May 22, 2018, https://aws.amazon.com/intel/.

> the possibility that many of the forms of violence that exist under the present arrangement of global political economy are not accidents or problems simply waiting to be solved under the newer, more flexible, communicative, and connected economic mode, but rather features that are internal to the same logic that makes ideas of society as a communication network or an information-processing system possible in the first place.[38]

Simply put, the exploitation of people and places is not some unfortunate outlier, but rather thoroughly intrinsic to the historical development of algorithmic capitalism. The Skin-Soil-Xeon machine thus examines how a global platform emerges from local destructions, and how the unified platform builds on the past while intentionally decoupling from its toxic aftereffects in the present.

To reiterate, Airbnb is powered by AWS, and AWS, in turn, is highly dependent on Intel's Xeon chips, which provide the "performance needs for compute intensive, memory intensive, or IOPS intensive applications."[39] However these chips are not just about raw processing speed, but offer functionality and specific use-cases. The Advanced Encryption Standard feature allows applications to "enable encryption for enhanced data security without paying a performance penalty."[40] Advanced Vector Extensions are designed for "highly parallel HPC workloads such as life science engineering, data mining, financial analysis, or other technical computing applications."[41] The newest Xeon processor features a Haswell microarchitecture which "has better branch prediction" and is more "efficient at prefetching instructions."[42] Located 'closer to the metal,' these core features written into the chip itself are typically much faster than software routines which only use the chip as an all-purpose processor. Engineers develop specifically for these proprietary functionalities, leveraging them for improved speed, memory, and security. In other words, chips are not just dumb hardware, but are key information processing architectures at the heart of business and technical partnerships.

This core processing service is the product of a long genealogy enabled by market dominance. The Xeon's Haswell microarchitecture is based on Intel's new 22 nanometer model, an incredibly complex manufacturing challenge to shrink the chip, only met through years of research and development and billions in capital investiture. This architecture was preceded technically by "a series of world firsts: 45 nm with high-k/metal gate in 2007; 32 nm in 2009; and now 22 nm with the world's first 3D transistor in a high volume logic process beginning in 2011."[43] The architecture

38 Seb Franklin, *Control,* 17.
39 Amazon, "Intel and AWS."
40 Amazon, "Intel and AWS."
41 Amazon, "Intel and AWS."
42 Amazon, "Intel and AWS."
43 Intel, "Intel® 22 Nm Technology," Intel, accessed May 9, 2017, http://www.intel.com/content/www/us/en/silicon-innovations/intel-22nm-technology.html.

was preceded financially by between $6-8 billion to upgrade development fabrication plants.[44] These chips in turn, were preceded by the the previous lineage of processors. As Gerard O'Regan outlines, in 1971 the 4004 as the world's first microprocessor was released; in 1974 the 8080 quickly became the "industry standard"; in 1978 IBM chose the newly developed 8086 for its computers, "leading to strong ties"; in 1986 the 80486 was launched with the first math co-processor on the chip itself; and in 1993 the well-known Pentium processor was launched.[45]

The Xeon is thus not some momentary flash of brilliance invented by a six month year old startup company in a shed. Rather it needs to be understood as the latest iteration of a progressive accumulation—the endpoint of decades of development, each phase building on the labor, knowledge, and financial stability of the successes which preceded it. What kind of environmental and labor conditions were produced throughout this extended process, and how are these destructions imbricated in the systemic advantages necessary for the chip's existence?

Intel Corporation manufactured semiconductors at its production site in Mountain View California from 1968 to 1981.[46] This site itself was only made possible by a series of events predicated on indigenous and environmental exploitation, a theme traced extensively by David Pellow and Lisa Park in their multi-year study on Silicon Valley. As the duo note, Chief Lope Inigo was initially 'given' 1600 acres of land in Santa Clara County, land which Mexico originally stole from Native American peoples.[47] After Inigo's death in 1864, "whites, who had illegally squatted the land, took it over."[48] The Holthouse family then farmed the land, growing peas and marketing them with the misspelled name and likeness of "Ynigo."[49] In 1933 the land was developed, partially into the Moffett Field Naval Airbase, partially into land later used by the Mountain View fabrication facility.[50] It was here, throughout the sixties and seventies, that Intel corporation used trichloroethylene (TCE) and benzene in the production and degreasing of the processor chips. These highly toxic chemicals leaked into both skin and soil.

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44 Intel Newsroom, "Intel Announces Multi-Billion-Dollar Investment in Next-Generation Manufacturing in U.S.," Intel Newsroom, October 19, 2010, https://newsroom.intel.com/news-releases/intel-announces-multi-billion-dollar-investment-in-next-generation-manufacturing-in-u-s/.

45 Gerard O'Regan, *A Brief History of Computing.* London: Springer, 2008, 92.

46 Environmental Protection Agency, "Superfund Site Overview Intel Corp. (Mountain View Plant)," US EPA, May 31, 2016, https://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/vwsoalphabetic/Intel+Corp.+(Mountain+View+Plant)?OpenDocument.

47 David N. Pellow and Lisa Sun-Hee Park, *The Silicon Valley of Dreams: Environmental Injustice, Immigrant Workers, and the High-Tech Global Economy* (New York: New York University Press, 2002) 41.

48 Pellow and Park, *The Silicon Valley of Dreams*, 41.

49 Pellow and Park, *The Silicon Valley of Dreams*, 41.

50 Pellow and Park, *The Silicon Valley of Dreams*, 41.

The design of microchips entails electronics and physics, but their production is all about chemistry. Historically, the silicon wafer was coated through a process of chemical vapour deposition; a chemical cocktail called a photoresist is overlaid on the wafer and exposed to light, creating the main circuitry pattern; chemical impurities in gaseous form (dopants) are added in a layer; and additional solvents wash away exposed regions to complete etching and stripping processes.[51] These processes are repeated, building up multi-layered circuitry. Dopants gases include arsine and phosphine, stripping agents include sulphuric acid and hydrogen peroxide, and photoresist solvents include ethylbenzene and xylene. When microelectronics comes to mind, the principle image is the bright white room, hygienically scrubbed and sealed. But these 'clean rooms,' especially historically, have primarily been about screening out impurities and ensuring sterile conditions from the processor's perspective. In other words, they protect the chip, not the worker.

These conditions put chemicals and bodies alongside each other. In close quarters, day after day, gases infused into organs, solvents seeped into tissues, toxins accumulated in bloodstreams. The result was the slow-motion destruction of bodies: nausea, vomiting, dizziness, headaches, chest pains, aggressive menstrual cycles, miscarriages, cancer, and ongoing psychological and physical debilitations. In their chapter titled "Work and the Struggle to Make a Living without Dying," Pellow and Park chronicle a tragic litany of cases gleaned from personal interviews. One Chicana worker discarded her Latex gloves because they disintegrated, using her bare hands to handle chemicals and later being diagnosed with breast cancer.[52] Another constantly smelled xylene while working through her pregnancy, which turned her breast milk toxic orange coloured.[53] Another remembers regularly having chemicals splash on her skin and face, and has recently been diagnosed with allergic rhinitis, early menopause, and sterility.[54]

The toxicity of semiconductor manufacturer took years to leak out into the public consciousness. But this is unsurprising, indeed one might say intended (albeit in a non-coordinated sense), because these deadly byproducts had been sealed into bodies that management deemed dispensable and docile. Toxins were internalised into the preferred labor force of mothers, woman of colour, Asian immigrants and other marginal groups specifically chosen by electronics management as a more pliable workforce, "socially and culturally compliant, less likely to agitate for benefits, more physically adaptable to monotonous and intricate labor tasks, and easier to control."[55] These workers were typically given no training in workplace safety and were only offered proprietary

51 Susan Sherry, *High Tech and Toxics: A Guide for Local Communities* (Washington, D.C.: Conference on Alternative State and Local Policies, 1985), 96.
52 Pellow and Park, *The Silicon Valley of Dreams*, 114.
53 Pellow and Park, *The Silicon Valley of Dreams*, 120.
54 Pellow and Park, *The Silicon Valley of Dreams*, 120.
55 Pellow and Park, *The Silicon Valley of Dreams*, 13.

names for the chemicals they worked with, such as "Yellow 6."[56] If they complained, they were disciplined, assured that toxicity levels were acceptable, accused of mass hysteria, or simply fired on the spot.[57] Historically then, chip production was only made possible by a lineage of bodies that—due to a set of a managerial manipulations—silently took its toxicity into themselves. The outwardly pristine clean room and the acquiescent, internally ravaged body go hand in hand.

It wasn't just labourers who were poisoned by these chemicals, but also the land. Mountain View was just one of many sites in which toxins were dumped: contaminating the soil, seeping into the water table and vaporising into the air. Finally in the 1980s, the United States Environmental Protection Agency (EPA) deemed the land so toxic that "it would take three hundred years to clean up."[58] The Mountain View site and other former semiconductor facilities are now so-called Superfund sites, locations designated highly polluted by the EPA that require a long term cleanup response.

Silicon Valley has the highest concentration of Superfund sites in the United States. As Nathan Ensmenger elaborates: "In the roughly 1,300 square miles of Santa Clara County, California, there are 29 Superfund sites, most of them contaminated by the by-products of semiconductor manufacturing, including such highly toxic chemicals as trichloroethylene, Freon, trichloroethane, and polychlorinated biphenyls (PCBs)."[59] Pump-and-treat facilities have been one of the most used responses. These are systems which pump millions of litres of groundwater through the contaminated area in order to filter out and collect toxins. In some locations, these have declined in efficiency, causing companies to pump molasses into the soil's subsurface, attracting microbes that aid in breaking down the chemical compounds.[60] These systems operate continuously, day in and day out, over decades. They attempt to erase an unwanted past, a past crucial for—and contiguous with—the more lauded and publicised present. As Alexis Madrigal asserts, "though the *idea* of Silicon Valley does not allow for history, the place, itself, cannot escape it."[61] Sites of technological innovation literally rest upon toxic waste.

This cleanup produces its own mess. Journalists Susanne Rust and Matt Drange conducted an extensive investigation into Superfund sites, following the flow of contaminants throughout the country. What they found was that the costly filtration provided by the pump-and-treat systems was

56 Pellow and Park, *The Silicon Valley of Dreams*, 128.
57 Pellow and Park, *The Silicon Valley of Dreams*, 124.
58 Pellow and Park, *The Silicon Valley of Dreams*, 41.
59 Nathan Ensmenger, "Computation, Materiality, and the Global Environment," *IEEE Annals of the History of Computing* 35, no. 3 (2013): 78.
60 Alexis Madrigal, "Not Even Silicon Valley Escapes History," *The Atlantic*, July 23, 2013, http://www.theatlantic.com/technology/archive/2013/07/not-even-silicon-valley-escapes-history/277824/.
61 Madrigal, "Not Even Silicon Valley Escapes History."

"only the start of a toxic trail with no clear end."[62] The toxins must be trucked to a treatment facility, often hundreds or thousands of miles away. Calgon Corp's Big Sandy plant, for example, is located in Kentucky, 2,500 miles from Mountain View.[63] Chemicals are burnt in Big Sandy's 2000 degree furnace, producing additional waste like toxic ash which must be trucked and treated elsewhere. This combustion process also produces dioxins that can leak into the ground, water, and air—highly toxic chemicals which can cause cancers, reproductive problems and damage to the human immune system.[64] As Rust and Drange note, these facilities often take shortcuts, bypassing expensive processing by illegally offloading waste. In 2013, Calgon Corp paid $1.6 million to settle charges that it "sold hazardous waste byproducts instead of disposing of them properly."[65] In 2011, the company dumped 540,000 gallons of hazardous waste into the Big Sandy river.[66] In 2010, the company polluted the river with "oil, grease and fecal coliform."[67] Big Sandy then sends its waste to other treatment plants in other parts of the country, plants which themselves have been fined or put on watch-lists for illegally disposing of waste. All this continuous pumping, trucking, burning, and processing is highly inefficient and energy intensive. The duo estimate that "for every 5 pounds of contaminants pulled from the ground, roughly 20,000 pounds of carbon dioxide are produced."[68] Waste is distributed, but never completely eradicated. Toxicity is diffused, but never entirely erased. All the while energy is being expended and money made—an entire economy built around the logistics of toxicity.

So control has a history. Yet it is only through this casting off of the heavy materiality of the past that Silicon Valley companies are able to maintain their velocity. For Intel, this means keeping the positive inertia of breakthroughs, innovations, and insights while offloading the associated toxic byproducts onto other bodies and biomes as negative drag. Airbnb, in turn, benefits from the lightness, agility, and flexibility that Intel's cloud-based computing provides—zero infrastructure, a specialised workforce of software engineers, the ability to rapidly pivot, and so on. The heavy psychological burden of reproductive issues, the permanence of a cancer in a set of lungs, the persistence of toxins in the water and soil—these are dead weight. These enduring things are carefully erased or externalised. Treatment pumps are hidden or made off-limits. Class action suits are quietly settled.[69] And local tech museums instead focus on the brilliance of innovative

62 Susanne Rust and Matt Drange, "Cleanup Of Silicon Valley Superfund Site Takes Environmental Toll," The Center for Investigative Reporting, March 17, 2014, http://cironline.org/reports/cleanup-silicon-valley-superfund-site-takes-environmental-toll-6149.

63 Rust and Drange, "Cleanup of Silicon Valley."

64 Environmental Protection Agency, "Learn about Dioxin," Overviews and Factsheets, US EPA, accessed May 9, 2017, https://www.epa.gov/dioxin/learn-about-dioxin.

65 Rust and Drange, "Cleanup of Silicon Valley."

66 Rust and Drange, "Cleanup of Silicon Valley."

67 Rust and Drange, "Cleanup of Silicon Valley."

68 Rust and Drange, "Cleanup of Silicon Valley."

individuals.[70] This is how, in Nick Land's words, "machine-code-capital recycles itself through its axiomatic of consumer control, laundering-out the shit- and blood-stains of primitive accumulation."[71] These are problems for past or future generations, for people and places that don't matter.

To sum up the functionality of the Space-Soil-Skin-Xeon machine, one might begin by juxtaposing a series of spaces. On the left, a mid-century interior bathed in light, with tasteful decor and Nordic influences. On the right, the belching smokestacks and grey haze of the Big Sandy processing plant. On the left, a peaceful bedroom interior, white linens, soft lines, muted colours. On the right, the hand-painted banner of Gila River protesters declaring No Toxic Dump. On the left, a vibrant collection of bars, cafes, and markets featured in Airbnb's Neighbourhoods section. On the right, a neon yellow barrel of leaking toxic waste at the Romic processing facility. As a key component to the Airbnb ecology, the Xeon processor produces the conditions necessary for both of these types of spaces to exist—the photographic depiction of the tangible designer apartment, bookable through a real-time transaction and the toxic filter dumped illegally in the river, congealing decades of (gendered and racialised) bodily abuse. One of these spaces is seen as innovative, contemporary, and celebrated, the other is exploitative, historical, and covered up. The Skin-Soil-Xeon machine reminds us that however disparate in time, place, and appearance, these two spaces are intimately linked.

Incomplete Abstraction

Taken together, these three machines work in critical ways, remaking space as algorithmic space. Like Lefebvre's notion of abstract space, space here is heterogeneous yet conforms to a common logic; it is distributed yet unified into an overall framework. And yet Lefebvre's notion of abstract space only takes us so far.

Firstly, Lefebvre's obsession with the state as the primary agent of this process requires a major update. In his view, the state is the great leveller, annihilating the historical and social residues within space in order to rework it into more productive variations that accumulate capital for future enterprises. The rationality of the state, Lefebvre attests, is thus "a unitary, logistical, operational and quantifying rationality which would make economic growth possible and draw

69 Jan Jurden, Molina v. ON Semiconductor Corporation, No. CA No. N10C-12-267 JRJ (Delaware Superior Court May 28, 2015).

70 Robert Noyce and Gordon Moore, for example, both feature prominently in the Intel Museum. Intel, "Intel Museum: Journey Through Decades of Innovation," Intel, accessed December 18, 2018, https://www.intel.com/content/www/us/en/company-overview/intel-museum.html.

71 Nick Land, "Meltdown," in *Fanged Noumena: Collected Writings 1987-2007* (New York, NY: Urbanomic, 2014), 445.

strength from that growth for its own expansion."[72] As Derek Gregory explains, the process for Lefebvre is both top-down and highly intentional, carried out by master planners who impose their abstracted, geometric grids onto the realm of the living.[73]

But this vision of a meticulous remaking of space inexorably carried out by an all-powerful state can no longer be sustained.[74] At the very least, the disintegration of government and the privatisation of public services so devastatingly carried out by neoliberal policies over the last three decades should indicate that this process, far from being centralised and coordinated, is instead uneven and improvisatory. Indeed Airbnb exemplifies some of the influence now available to non-state actors: a Silicon Valley software company, active in 64,000 cities worldwide. This privatised power, underpinned by algorithmic operations, significantly undermines—though naturally never entirely erases—the assumed sovereignty long associated with the state. As the chapter on Palantir argued in more depth, while the state persists and retains some unique powers, these powers become highly dependent upon technical infrastructures provided by outside companies. While these infrastructures provide valuable new affordances, they are not the exclusive property of any *one* state; other states, corporates, and agencies may also employ them. Moreover, these abilities are no longer exclusive *to* the state; power no longer inheres automatically in 'the State.' Sovereignty, such as it exists, is functional not juridical.

The second issue is the degree to which space is able to be depleted of sociality. Lefebvre speaks of the evacuation of the social from space in order to achieve a monolithic field, a "naked, empty social space stripped bare of symbols."[75] In this view, it is not so much that traces of sociality are individually erased, but rather that the space itself is completely rewritten. Space is reformatted to a blank slate supporting the maximum degree of flexibility. This is why the philosopher describes it as an "an empty space... a container ready to receive fragmentary contents, a *neutral* medium."[76] Space is brought back to its bare essence, an elemental resource open to any possible use.

But this blank slate of social-less space doesn't apply here (if it ever did). If Lefebvre's all powerful,

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72 Lefebvre, *The Production of Space*, 280.

73 Gregory, Derek. *Geographical Imaginations*. Cambridge, MA: Blackwell, 1994, 404.

74 State, of course, is more than government. Yet it is worth noting how this obsession with the state seems to continue whenever power and media theory intersect. Bernard Harcourt's recent book, for example, notes that today the state has become more diffuse, combining with private actors to form a "knot of tenticular statelike actors that see through us." And yet Harcourt, with his roots in legal theory, punishment, and disciplinary power, seems to cling onto the state and its mechanisms of drones, law enforcement, surveillance, and signals intelligence like XKeyScore as the definitive head of this creature, never fully allowing its power to be seriously challenged or destabilised by global technical regimes like Google or Facebook. Bernard Harcourt, *Exposed: Desire and Disobedience in the Digital Age* (Cambridge, MA: Harvard University Press, 2015), 92.

75 Lefebvre, *The Production of Space*, 305.

76 Lefebvre, *The Production of Space*, 308.

heavy handed state needed to annihilate the social in order to clear the ground for work, today's technically driven corporations are more subtle and adept, recognising that a manicured sociality can contribute significant value. Airbnb wants to retain the social, but in a carefully managed form. For example, the recently created Neighbourhoods section on the platform is designed precisely to demonstrate the social and cultural links that exist between an individual listing and its locale.[77] Neighbourhoods pages list events and exhibitions, important landmarks, famous figures, and historical facts related to an area. A page for the Castro in San Francisco, for example, describes it as the city's "gay epicenter": "Buzzing with life and activity, the Castro's flamboyant bars and restaurants, glittering shops, and historical theatres comprise its endearingly unapologetic attitude."[78] The company's primary intention here is to assert that a space is *not* just simply a bed for a night, but is embedded in a wider spatial field in which social practices take place.

What's more, Airbnb explicitly encourage these social connections to continue inside the accommodation itself. One hosting tip recommends placing books and magazines around the space that "help a guest explore and understand your region of the world."[79] In another suggestion, interior decor is seen as a way to inspire wider social exploration: "show off local craftspeople that make your area unique. Have local art on your wall? Coffee from a roaster down the street? Tell guests where they can find more."[80] Rather than a tabula rasa, the regime of management enacted on the space strives to keep and even amplify certain traces of sociality.

At the same time, any particularities of this sociality must be extinguished. It must be broad enough for any guest to step into, and temporary enough that it is able to be erased or reset after staying for a few days. According to Airbnb guidelines, the Guest traveller must leave no trace of themselves in the form of personal items, damage or messiness. In the same way, the Host's clothes, accessories, and other belongings must be removed in line with the Airbnb guideline: "show personality, not personal items."[81] The latent sociality within the space is not just left to linger, but is actively shaped through particular practices into a carefully regulated form. This form aims to retain a generalised, positive sociality while disarming its specificities and conflicts. This form is also highly temporary as it must be able to be unpacked with every guest but just as rapidly discarded. The result is a curious blend in which phrases like anonymously personal and instant history, while somewhat poetic,

77 At the time of writing, the Neighbourhoods page includes 23 cities, from London to Miami, Sydney, and Buenos Aires. "Airbnb Neighbourhoods - Your Local Travel Guide," Airbnb, accessed December 18, 2018, https://www.airbnb.co.nz/locations.

78 Airbnb, "The Castro, San Francisco Guide - Airbnb Neighbourhoods," Airbnb, accessed December 18, 2018, https://www.airbnb.co.nz/locations/san-francisco/the-castro.

79 Airbnb. "DIY Hosting Tips: Unforgettable Amenities Made Easy." *Airbnb Blog*, August 15, 2014. http://blog.airbnb.com/amenities-diy-hosting-tips/.

80 Airbnb, "DIY Hosting Tips."

81 Meredith Baer, "Attract More Guests: 10 Simple Tips from Home Staging Expert Meridith Baer," April 17, 2014, http://blog.atairbnb.com/attract-guests-10-simple-tips-home-staging-expert-meridith-baer/.

aptly describe the intended sociality.

Despite these intentions, sociality is frequently unruly, overflowing into these spaces in unanticipated (and unwanted) ways. Space is not a hard drive that can be effortlessly reformatted with a single gesture. Kernels of former things remain, fragments of the people and practices that formerly inhabited it. As Japhy Wilson reminds us, space is "riven with contradictions, arising from the residues of the social spaces that preceded it."[82] Such spatial residue is uneven and unpredictable, adding an unwanted historical specificity to the productively generic space that Airbnb wants to operationalise in the present. The results can be banal or volatile, depending on the perspective. We might think, for instance, of the recent Airbnb listing in California used to shoot gay pornography, an activity grounded in the cultural history of the area but which far exceeded the boundary conditions imposed by the company and its Hosts, leaving behind a literal trail of social traces in the form of toys and costumes, prophylactics, and bodily fluids.[83] Or again, take the many tales of conflicts and hookups between Hosts and Guests, chronicled on sites like Airbnbhell or Reddit's Airbnbsex thread. In these situations, the limited affectual registers deemed suitable for hospitality —friendliness, warmth, punctuality—spill outwards into the wider emotive forces of aggression and violence, intimacy and attraction. Against the common narratives surrounding such stories, the point here is not concerned with the legality of such practices, nor the reputation of Hosts, nor even the undermining of trust on Airbnb. Instead, these practices point towards the particularities and temporalities of place, the way its capacities emerge from its history as well as the the cultural and social memories of its surrounding environs. Past lives become fainter but are never entirely erased. Space remembers.

One recent Airbnb slogan is to "live like a local."[84] But taking this at face value would mean accepting a history and its accompanying problems, being involved in the messy culture of a community, and inevitably becoming entangled in social conflict of some sort. That the Airbnb situations above are described as 'nightmarish' or 'hellish' demonstrates how far outside the realms of reality these behaviours are considered to be—and conversely indicates the very constrained subset of social and cultural practices expected to take place within the rented space. It's all the more surprising then, when in the face of a barrage of regulatory operations carried out by rating systems, reviews, Host agreements and an online audience, unanticipated social encounters occur. Despite everything, sociality irrupts into space in unexpected and unwanted ways. While these

82 Japhy Wilson, "'The Devastating Conquest of the Lived by the Conceived' The Concept of Abstract Space in the Work of Henri Lefebvre," *Space and Culture* 16, no. 3 (2013): 368.

83 Heather Dockray, "Airbnb Host Sues Guests For Filming Hardcore Gay Porn In Her House," *Mashable*, November 25, 2015, http://mashable.com/2015/11/25/airbnb-gay-porn/.

84 Airbnb, "Travel With Airbnb and Experience A Place Like You Live There," *Airbnb*, March 19, 2016, https://www.airbnb.co.nz/livethere.

social encounters may be surprising or scary, they testify to a broader inability to effortlessly unify space—to override its previous inhabitations and assimilate it into Airbnb's spatial index of always-positive-experiences.

To conclude, then, this chapter has explored the ways in which Airbnb attempts to unify space, to assimilate homes, apartments, and rooms into a global platform in which space becomes both interoperable and profitable. Yet space is not blank and generic, but rather set amongst a localised sociocultural life-world that is heavily weighted with past histories and present understandings. The integration of 'real-world' spaces into the logic of the algorithmic encounters the frictions of the already existing. Unification thus entails an imposition, striving to privilege a particular spatial understanding while concealing, restraining or abstracting away others.

The DomesticArchitecture-BookingAppeal machine explored the new programme assigned to spaces on Airbnb, a unified set of pressures and metrics that were operational rather than strictly visual. The DynamicPricing-Microneighbourhood machine investigated how a city is clustered according to machine learned pricing, replacing existing community or geography designations with capital as the unifying logic of space. Finally, the Skin-Soil-Xeon machine revisited the historical development of the processors that power Airbnb, arguing that the ability to unify space in the present depended on degradations of other bodies and spaces in the past.

Drawing upon Lefebvre's work, the text argued that the unification of space through the suppression of other possibilities might be understood as 'deft and brutal'. Yet Lefebvre also needed updating—state sovereignties are replaced by algorithmic functionalities that preserve a generically positive sociality rather than extinguishing it altogether. Ultimately, of course, the algorithmic imperative to template the world remains asymptotic and incomplete. From time to time, the smoothly unified array of spaces desired by Airbnb become punctured by sociocultural encounters in all their rawness and realness. Spaces exert their jagged little specificities.

4.

Friendly Power: Alexa

Invoking Alexa

The concept of Alexa, once stated Amazon Vice President David Limp, "foretold a magical experience."[1] What, exactly, is that concept? Amazon Alexa is typically described as a voice-based virtual assistant. Alexa's origins date back to November 2015 when Amazon released the Echo, a smart-speaker device designed for the household with an inbuilt 'Siri-like' assistant.[2] Once activated by her 'wake word' of Alexa, she will listen to anyone speaking in the room and respond by playing music, answering a question, adjusting lighting, relaying the news, ordering products, and so on. While launched initially via the Echo, Alexa now powers thousands of products and objects. Ranging from thermostats to baby monitors and refrigerators, these 'Alexa-enabled' devices form an emergent ecosystem of voice-based interfaces. From a business perspective, then, the rise of Alexa is a success story. But more importantly for this thesis, it is also a story of power—how it operates today and how the algorithmic underpins it.

As Limp's comment suggests, Alexa's voice-as-interface engenders a certain conversational effortlessness, a magic. Of course, there are mechanisms of all kinds beneath any magic. Underpinning this seamless functionality is an array of technical procedures. Alexa's persona emerges from operations incorporating material cables, geographical data centres, historical infrastructure projects, and a host of hidden performances. To pull off this illusion, she needs to feel responsive, she needs to hear the user's voice, and she needs to talk back. The first section of this chapter moves through three machines that accomplish just that: the Alexa-AmazonWebServices machine explores how latency is minimised to produce an impression of liveliness; the Microphone-Alexa-LivingRoom machine details how a voice is captured and parsed; and the TextToSpeech-AlexaVoice machine demonstrates how a spoken response is generated. These machines provide a method to focus and cluster analysis, unravelling some of Alexa's key technical operations without confronting (and being forced to generalise about) her highly complex totality.

Taken together, these analyses uncover the materialities and geographies underpinning seemingly effortless technical procedures. But the goal here is less about 'exposing' the magic, and more about understanding how these logical structures and control mechanisms converge to form 'Alexa.' This emulated subjectivity is key. Indeed, the rest of the chapter argues that Alexa's force hinges on this softer, more emotive persona, rather than technical sophistication. Personal, convivial, and

1 Eugene Kim, "The inside Story of How Amazon Created Echo, the next Billion Dollar Business No One Saw Coming," *Business Insider Australia*, April 3, 2016, https://www.businessinsider.com.au/the-inside-story-of-how-amazon-created-echo-2016-4.

2 Darrell Etherington, "Amazon Echo Is A $199 Connected Speaker Packing An Always-On Siri-Style Assistant," *TechCrunch* (blog), November 6, 2014, http://social.techcrunch.com/2014/11/06/amazon-echo/.

increasingly empathically attuned, Alexa exemplifies a contemporary form of power that theorist Byung-Chul Han has described as "friendly power."[3] The final machine of Skills-Speech-Memory asserts that the user becomes enchanted by Alexa. Rather than being coerced, users actively draw out a matching subjectivity, reorienting their listening and speaking practices for maximum compatibility. Bundled together into the productive fiction of a living, speaking assistant, 'Alexa' exerts an "affective grip"[4] that far outweighs the sum of her parts.

Alexa-Amazon WebServices machine

How is Alexa made alive? What are the minimal parameters necessary to establish an array of algorithmic operations as a personality? A core part of 'Alexa' is created by a voice which reacts to a question with an appropriate response in an appropriate time window. For the user, this appears magical. But as Florian Cramer reminds us, "magical practices tend to cloud their technical and formalist nature."[5] To pull off this effect, Alexa relies heavily on Amazon Web Services (AWS), the cloud-based infrastructure of networked data centres which Alexa and her corresponding Skills are hosted on. Far from ethereal, AWS is highly material, comprised of light and heat, steel and wire, bodies and switches. The Alexa-AmazonWebServices machine thus explores how an identity is fabricated from an infrastructure.

To be alive is to be responsive, and so latency becomes key—the length of time it takes to respond to the user. There is an always some kind of delay due to both voice to text processing and the transmission of data from one point to another. Too much latency, and the conversation, like a bad Skype call, falls apart in a muddled jumble of responses and questions. The result is that the illusion of Alexa as a persistent and responsive personality simply breaks down. During the development of Alexa, the "average latency of existing voice-recognition technology at the time was around 2.5 to 3 seconds, so the Echo team initially set the goal at 2 seconds."[6] However Amazon CEO Jeff Bezos was not impressed. In an early meeting he set a far more difficult benchmark, stating "let me give you the pain upfront: Your target for latency is one second."[7]

One major cause of latency is vocal processing time. The Echo device captures the user's voice, processing and responding to it in the cloud. A time delay is thus incurred in which the user's voice

3 Byung-Chul Han, *Psychopolitics: Neoliberalism and New Technologies of Power* (London: Verso Books, 2017), 37.

4 Nigel Thrift, "Re-Inventing Invention: New Tendencies in Capitalist Commodification," *Economy and Society* 35, no. 2 (May 2006): 288.

5 Florian Cramer, *Words Made Flesh: Code, Culture, Imagination* (Rotterdam: Piet Zwart Institute, 2005), 18.

6 Kim, "The Inside Story."

7 Kim, "The Inside Story."

is converted from speech into text. This is a difficult computational problem that involves extracting the vocal 'signal' from the 'noise' of the surrounding ambient sound. This sonic signal is then broken down into phonemes—there are only 44 possible phonemes in the English language.[8] The order and timing of these can be parsed to produce text, an automated transcription. In many cases homonyms can arise—'ate' and 'eight' for example. In these situations, an assumption is made as to what word was meant based on factors such as phrase context, word popularity, grammar structures, and so on. Here, machine learning proves valuable. With millions of Alexa-enabled devices now on the market, Amazon is constantly receiving a deluge of data which enables the further optimisation of Alexa's vocal processing routines, leading to a better understanding of what was said and what was meant. AWS provides the material infrastructure necessary to receive and store these millions of daily inputs. AWS also contributes the flexibility necessary for Alexa to be "always getting smarter"; as a cloud-based service, Alexa can be constantly updated, rather than compiled, packaged, and downloaded intermittently as static software.[9] The production of an intelligent persona is directly related to the accurate 'listening' made possible by an underlying information infrastructure.

Another key contributor to latency is data transmission. There is a delay in time caused by packets of information translated into energy and moved through space. A sense of this constraint is hinted at by Amazon in their guidelines, in which they urge developers who implement their own version of the API to execute "streaming (chunking) captured audio to the Alexa Voice Service to reduce latency; the stream should contain 10ms of captured audio per chunk (320 bytes)."[10] Here again the core ability of Amazon Web Services to rapidly send and receive data takes on critical importance. The logistics of information becomes literally vital—a series of operations necessary for the production of a lively and responsive Alexa.

Amazon describes Alexa as being located in 'the cloud,' a shape-shifting and ethereal object simultaneously located everywhere and nowhere. "This definition codifies an architecture of provisional magic" writes Tim Jordan, "the cloud should provide ways of doing things that ignore spatial, data and creative limits. Anything should be doable anywhere, at any size and any time."[11] But rather than Amazon's immaterial and ahistorical discourse, AWS embodies a crucial

8 Alexandra Ossola, "Ever Wondered: How Does Speech-to-Text Software Work?," Scienceline, August 15, 2014, http://scienceline.org/2014/08/ever-wondered-how-does-speech-to-text-software-work/.

9 Amazon, "What's Alexa?," Amazon Official Site, accessed August 20, 2018, https://www.amazon.com/meet-alexa/b?ie=UTF8&node=16067214011.

10 Amazon Developer Services, "SpeechRecognizer Interface," Amazon Apps & Services Developer Portal, accessed May 9, 2017, https://developer.amazon.com/public/solutions/alexa/alexa-voice-service/reference/speechrecognizer.

11 Tim Jordan, *Information Politics: Liberation and Exploitation in the Digital Society* (London: Pluto Press, 2015), 88.

infrastructure that must deal with the hard physical contingencies of earth and electricity, distance and disruption.

Firstly, AWS is *geographical*. If the early imaginary of cyberspace as an independent jurisdiction which transcends borders, cultures, and constraints has long been debunked, the more contemporary notion of the 'cloud' has taken its place. But while the public might care little about the 'somewhere' that data goes, both developers and Amazon understand that the 'where' matters deeply. This is why content-delivery-networks (CDNs), storage services (Amazon S3), and web services (AWS) are strategically distributed around the globe: Frankfurt, Mumbai, Seoul, California, and so on. Amazon groups these regions into what it calls Availability Zones.[12] Each Zone features between two and five data centres. Each centre is close enough to the other to provide fast mirroring with minimal latency, between one and two milliseconds. However, each centre is far enough away from the others to be unaffected by catastrophic events, a circumference that the industry terms the 'blast radius.' As Amazon executive Werner Vogels explains, each data centre lies "in a different flood zone and a different geographical area, connected to different power grids, to make sure they are truly isolated from one another."[13] The geographies of data centres are therefore determined by regions of growth, the distribution and mitigation of risk, and the physical proximities required for low latency.[14] To test the time delay between points, we can send a 'ping,' recording the time it takes in milliseconds to reach a server and return. A cursory ping of the AWS regions from New Zealand results in the following times: Sydney 79, Beijing 218, Sao Paulo 490, Frankfurt 732.[15] When thinking geographically, these figures are hardly surprising. But placed against the erasure of space discourse posited firstly by cyberspace and now by the cloud, they reassert a realm of cables, copper, and continents. Distance still persists.

Secondly, AWS is *historical*. With 5 Availability Zones, Northern Virginia is one of Amazon's core data centre regions. Indeed, at the time of this writing, any Skills written by developers for Alexa must be located in this particular region of their cloud infrastructure. This region, nestled into the

12 Availability Zones are constantly expanding into new geographic regions, but are mapped and explained on AWS's Global Cloud Infrastructure page: Amazon Web Services, "Global Cloud Infrastructure," Regions & Availability Zones, accessed December 11, 2018, https://aws.amazon.com/about-aws/global-infrastructure/.

13 Rich Miller, "Inside Amazon's Cloud Computing Infrastructure," *Data Center Frontier* (blog), September 23, 2015, http://datacenterfrontier.com/inside-amazon-cloud-computing-infrastructure/.

14 Indeed, some research is based on 'solving' for placement by balancing content popularity with disaster-mitigation. S. Ferdousi et al., "Disaster-Aware Datacenter Placement and Dynamic Content Management in Cloud Networks," *IEEE/OSA Journal of Optical Communications and Networking* 7, no. 7 (July 2015): 681–94, https://doi.org/10.1364/JOCN.7.000681. Of course, these factors are by no means static or universal; different companies and applications have different priorities. Burrington stresses data sovereignty and geopolitics alongside geographical factors like climate and latency. Ingrid Burrington, "The Strange Geopolitics of the International Cloud," *The Atlantic*, November 17, 2015, https://www.theatlantic.com/technology/archive/2015/11/the-strange-geopolitics-of-the-international-cloud/416370/.

15 Mike Leonhard, "CloudPing," Rest Backup LLC, accessed May 9, 2017, http://www.cloudping.info/.

upper northwest of the state, is known as Tyson's Corner. As Ingrid Burrington notes in her excellent field investigations of Amazon's data centres, this was "an area just far away enough from Washington to be relatively safe from nuclear attack but close enough to remain accessible."[16] The strategic decision to concentrate communications infrastructure in this location is not merely historical trivia, but indicates how technical systems emerge from the specificities of time and place. Cold war paranoia becomes integrated as de-facto network design schema, propagating in the form of carefully distanced nodes added over time. One of the earliest military outposts to be built in the Corner was actually a communications apparatus, a "microwave tower built in 1952 that was the first among several relays connecting Washington to the 'Federal Relocation Arc' of secret underground bunkers created in case of nuclear attack."[17] Scientists, researchers, and defence contractors quickly established themselves in the area. Over time a gradual shift from government to private enterprise coincided with a transformation in urban infrastructure. A roading corridor connecting Dulles Airport to the Capitol Beltway "basically made this pocket of northern Virginia the first and last place for any commercial activities between the airport and D.C."[18] The result was a proliferation of office parks and infrastructure that early internet and telecommunications companies built into and intensified. The progressive splicing of telephone lines, power plants, fibre optic cable, and other information infrastructure onto the 'rootstock' of this space perfectly exemplifies Tung-Hui Hu's notion of the internet as a graft, "a newer network grafted on top of an older, more established network."[19] Today this region is marketed as the Dulles Technology Corridor, a region produced through a unique historical progression: nuclear anxieties, 'revolving door' relationships, information age imaginaries and high-earner headhunting.[20] Over time, this unique set of forces has gradually produced a dense technical infrastructure through which 50% of America's internet traffic flows.[21]

Finally, AWS is *material*. The materiality of the cloud is often obscured. Of course, this is done primarily through the use of vaporous discourse itself. But this vague language is bolstered by the data industry's security measures that refuse to disclose specific locations of centres and typically

16 Ingrid Burrington, "Where Are Amazon's Data Centers?," *The Atlantic*, January 8, 2016, https://www.theatlantic.com/technology/archive/2016/01/amazon-web-services-data-center/423147/.

17 Burrington, "Where Are Amazon's Data Centers?"

18 Burrington, "Where Are Amazon's Data Centers?"

19 Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2015), 38.

20 This point glosses Paul Ceruzzi's book on Tyson's Corner: Paul Ceruzzi, *Internet Alley: High Technology in Tysons Corner, 1945–2005* (Cambridge, MA: The MIT Press, 2011). For a more mainstream, pro-business example, see Aaron Gregg, "Forget Silicon Valley — the Dulles Tech Corridor Is Cultivating Companies That Break the Mold," *Washington Post*, June 22, 2018, https://www.washingtonpost.com/news/business/wp/2018/06/22/feature/forget-silicon-valley-the-dulles-tech-corridor-is-cultivating-companies-that-break-the-mold/.

21 Kent Garber, "The Internet's Hidden Energy Hogs: Data Servers," *US News & World Report*, March 24, 2009, https://www.usnews.com/news/energy/articles/2009/03/24/the-internets-hidden-energy-hogs-data-servers.

only allow employees access. Even once their existence and address is known, there is typically little to see. The overwhelming banality created by largely inaccessible warehouses located in nondescript office parks is the antithesis of spectacle. In other words, an entity known as the 'cloud' in an off-limits building in an obscure location might as well be immaterial. Somewhat paradoxically, then, the hardware of drives and processors becomes overpowered by the far more visual, tangible, and seductive world of the information and interfaces it powers.

While there might be little to see, the materiality of AWS is manifest in one form—energy use. Alongside new data centres, Amazon builds its own power substations which range from 50 to 100 megawatts and power between 50,000 and 80,000 servers.[22] This decision is less about lowering costs than about the flexibility and speed required during periods of rapid expansion. Each data centre also requires banks of huge diesel generators, used for backup but which emit exhaust during their regular testing. By 2010, Virginia's Department of Environmental Quality had already found Amazon guilty of 24 violations in running generators without obtaining proper permits. A former inspector for the Department claimed that, "permits had been issued to enough generators for data centres in his 14-county corner of Virginia to nearly match the output of a nuclear power plant."[23]

AWS also employs firmware engineers who "rewrite the archaic code that normally runs on the switchgear designed to control the flow of power to electricity infrastructure."[24] During an emergency or catastrophe, traditional switchgear is designed to go offline fast, isolating the expensive electrical generator from further damage. The switchgear for AWS, by contrast, is configured for an alternative set of priorities in which server downtime must be minimised. AWS's custom switchgear embodies the broader rationale of a data centre industry obsessed with maximising uptime. Here financial and industry incentives are associated with uptimes of 'three nines' (99.999%) rather than electricity use. Nobody wants to be the one responsible for turning off machines, taking systems offline and reducing capacity. A 2010 McKinsey & Company study on data centres, for example, found that utilisation rates—the percentage of a server actually processing information—were only between 6-12%.[25] The rest is simply spent keeping the server running 24 hours a day, 7 days a week. Perhaps these servers are kept online for a traffic spike or a backup operation. Far more likely, however, is that this is simply the norm within the data centre industry.

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22 Derrick Harris, "How Amazon Is Building Substations, Laying Fiber and Generally Doing Everything to Keep Cloud Costs Down," Gigaom, November 15, 2013, https://gigaom.com/2013/11/15/how-amazon-is-building-substations-laying-fiber-and-generally-doing-everything-to-keep-cloud-costs-down/.

23 James Glanz, "Data Centers Waste Vast Amounts of Energy, Belying Industry Image," *The New York Times*, September 22, 2012, http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html.

24 Harris, "How Amazon is Building Substations."

25 Glanz, "Data Centers Waste Vast Amounts of Energy."

Once running smoothly, a machine is never powered down and rebooted, a process which often created problems in the early days of data centres. As one energy commentator stated, "such low efficiencies made sense only in the obscure logic of the digital infrastructure."[26]

These particular priorities create an over-engineered and highly inefficient environment which conflicts with the discourse of lightness and optimisation associated with information technologies and the cloud. Adding low utilisation to the energy lost in wiring dissipation, battery charging, and cooled water systems, it is estimated that up to 30 times the energy actually needed to run the data centre is wasted.[27] The annual energy use of data centres in the United States alone is expected to reach 140 billion kilowatt-hours by 2020, an operation which would emit nearly 100 million metric tons of carbon pollution every year.[28] The supposed immateriality of 'information' and the ethereality of the 'cloud' are both concepts that hugely benefit the data centre industry. This discourse is accompanied at intervals by photographs of scrubbed hallways and blinking racks that accentuate the center-as-clean-room—an autonomous object, hygienically sealed off from the world.[29] AWS reminds us that these centres are more like contemporary factories; a cavernous space largely devoid of people, but one that nevertheless devours energy, radiates emissions, and creates a significant carbon footprint.

How then, to summarise the Alexa-AWS machine? Alexa might be conceived as an immaterial AI, a bodiless bot, a voice-based technology. However her liveliness is directly dependent on the performance of AWS that provides "fast inference at runtime to deliver an accurate response in as short a time as possible."[30] Rather than the vague vapour of the cloud, AWS is a geographical, historical, and material infrastructure which enables data to be transmitted at low-latency, stored at scale and constantly parsed without disruption or downtime. These control mechanisms provide the crucial responsiveness necessary for 'Alexa' to seem alive.

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26 Glanz, "Data Centers Waste Vast Amounts of Energy."

27 Glanz, "Data Centers Waste Vast Amounts of Energy."

28 Pierre Delforge, "America's Data Centers Consuming and Wasting Growing Amounts of Energy," NRDC, February 6, 2015, https://www.nrdc.org/resources/americas-data-centers-consuming-and-wasting-growing-amounts-energy.

29 "Often people think of [data centers] as almost like cathedrals of servers" said a CTO of one data-centre. "Very clean computer equipment, white walls and things—the reality is, these are factories." Ingrid Burrington, "The Environmental Toll of a Netflix Binge," *The Atlantic*, December 16, 2015, https://www.theatlantic.com/technology/archive/2015/12/there-are-no-clean-clouds/420744/.

30 Rohit Prasad, How our scientists are making Alexa smarter, March 29, 2018, https://blog.aboutamazon.com/innovation/how-our-scientists-are-making-alexa-smarter.

Microphone-Alexa-LivingRoom machine

How does Alexa hear? As a voice-based assistant, a primary goal is to hear and respond to a human speaker, capturing her audible input and processing it into directives which are carried out. To do this, a particular type of space must first be initiated and then maintained—a spatial field in which subjects can emerge and speech can be made intelligible. To investigate this space of listening, this section focuses on the Microphone-Alexa-LivingRoom machine. Alexa now powers a constellation of smart home devices. But the first 'Alexa-enabled' device was the Amazon Echo, a smart speaker. This machine thus consists of the microphone of the Echo, the cloud-based Alexa digital assistant, and any interior domestic space. How is this zone of listening made operational? In exploring these technical conditions, we gain a fuller sense of how Alexa hears, understands, and relates to language.

'Always listening' was one of the early slogans used to market Alexa. While powered on, Echo listens to all sound in its vicinity via its inbuilt microphones. Once it hears that the wake-word of 'Alexa' has been uttered, Alexa switches immediately into a more active state in which sound is recorded, transmitted, and responded to. Placed inside a home, the device thus establishes a zone of active listening within the broader confines of a living room or kitchen—a space within a space. Domestic interiors are more or less clearly demarcated; the kitchen or living room is defined through an array of architectural elements: walls and windows, floors and ceilings, pillars and partitions. In contrast, this algorithmic space is invisible, instantiated through the largely imperceptible operations occurring both inside the device and elsewhere in the cloud-based Alexa service. Its particular properties and the performativities required to maintain it are far from clear.

How, then, is this algorithmic space produced, and what are its specificities? At first glance, it appears to be one predicated on inclusion rather than exclusion. Echo will listen to *anyone*. Many software applications limit their use to a single user who has been properly authorised and authenticated. Others who attempt to access its features are simply ignored, blocked, or even blacklisted. In contrast, Alexa will respond to vocal commands spoken by any voice, regardless of which friend or family member is doing the talking. Echo will listen to *anywhere*. The seven microphones on the device produce an omnidirectional field which aims to capture voice inputs from any direction. Unlike typical microphones, designed for very close use, Echo's 'far field technology' aims to capture speech uttered from any location in the room, often from several metres away. Finally, Echo will listen at *anytime*. No formal login procedure or session start takes place. As long as the device is switched on, the microphones are constantly listening for the wake-word and ready to record and transmit. Surveillance studies have previously evoked the "architecture of fear."[31] But the Microphone-Alexa-LivingRoom machine seems to be an

31 Nan Ellin, *Architecture of Fear* (New York, NY: Princeton Architectural Press, 1999).

'architecture of embrace'—a computational zone running in an intimate domestic space that maximises the information that can be accepted, regardless of spatial location, time, or source.

But subjects are not extracted so neatly from space. Digging deeper into the technical specifications of the microphone begins to reveal the negotiations and suppressions necessary to maintain this ostensible space of embrace. A 'teardown' of the Echo device unpacked its components, revealing that 7 microphones are mounted like spokes on a circular disk.[32] Each microphone points outwards at a unique angle. This arrangement comprises the material basis for the 'far-field' technology touted by the company, a technique allowing the spatialisation of the audio source. By comparing the subtle tonal and volume differences coming into each microphone, the location of the speaker can be targeted—amplifying sound from that single spot in the room while filtering out irrelevant ambient noise.

The teardown also identified that the microphones are S1053 0090 V6 models made by SiSonic, a sub-brand of Knowles. Knowles is a dominant industry player, producing 1 million microphones daily in its Chinese and Malaysian factories, primarily for smartphones but also for small electronic devices such as the Echo.[33] The integration of these components into their parent devices is highly technical, so Knowles releases design guides that encompass specifications, common problems and best-practices in order to aid engineering and manufacturing teams. This arcane guide reveals three key properties of the microphones.

Firstly, unlike 'near field' sound, where the mouth is almost touching the microphone, 'far field' audio sources typically come from metres away. To combat this, the microphones "add up to 20dB of gain" to the audio source.[34] By doing this amplification materially through the microphone hardware, rather than via a software-based codec, the signal-to-noise ratio of the audio is boosted significantly. But—warns the guide—this level of amplification "must be chosen appropriately."[35] Too much, and the signal risks saturating the microphone, becoming sonic information which is compressed and corrupted. Too little, of course, and the subject disappears back into the sonically hazy world of ambient noise. The amplification of signal is a fight against ambient noise: the reverberations of kitchen tiles, the chatter of children, the background drone of the television.

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32 Sam Lionheart, "Amazon Echo Teardown," *iFixit*, December 16, 2014, https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953.

33 Knowles Press, "Knowles Tops 3B MEMS Microphones Shipped," *Solid State Technology*, May 16, 2012, http://electroiq.com/blog/2012/05/knowles-tops-3b-mems-microphones-shipped/.

34 Knowles Acoustics, *SiSonic Design Guide* (Itasca, IL: Knowles Acoustics, 2011), http://media.digikey.com/pdf/data%20sheets/knowles%20acoustics%20pdfs/sisonic_design_guide.pdf.

35 Knowles Acoustics, *SiSonic Design Guide*, 8.

Secondly, the microphones block out unwanted radio frequencies (RF), preventing these frequencies from contaminating their acoustic signal. The Knowles design includes a "grounded Faraday cage integrated into the mic package," a 200 year old technique which works to block electromagnetic waves from interfering with an object inside the structure. As the guide explains, the result is that technically "radiated RF noise and conducted RF noise are shorted to ground."[36] This blocking of radio frequencies indicates a space which must actively exclude particular forces. The space only successfully operates while it successful shuts out the interfering waves emanating from routers, smartphones, and cell towers.

Thirdly, microphones must be sealed in order to prevent echo problems. Devices such as phones emit as well as capture sound. If the product case doesn't properly separate the speaker from the microphone via a sealed gasket, then the sound reverberates throughout the case, causing major issues with echo. A seemingly common problem, the guide warns that a gasket leak may "cause the microphone to pick up audio noise from other sources such as a camera zoom motor or a chirping capacitor."[37] This negation extends to the sound emanating from the device itself and the sealing necessary to contain it. In order to avoid incessant echo, the microphone is forced into a silent and hermetic chamber, erasing its own sonically confusing body from the space which it seeks to create.

The takeaway from these technical specifications is that algorithmic space must be fought for—it is *agonistic* rather than *assumed*. The technical properties of the microphone are as much about nullifying, overriding, and excluding as anything else. The struggle to extract a workable signal from this constant noise is simultaneously a struggle to initiate and maintain a sterile space in the midst of sonic messiness. This space is born through conflict, coming into existence only through an array of negating, filtering, and minimising operations which work to exclude unwanted information from the sphere of capture. Paradoxically, then, it is only through an incessant spatial struggle that the user is able to effortlessly emerge, enjoying the 'friction free' experience that the voice-as-interface offers.

In fact, the seemingly simple 'microphone' designated in this section is misleading—the actual hardware enabling voice capture is only the sonic surface of a far vaster logical apparatus focused on the comprehension of language. At the heart of this logic is the Alexa Ontology. A technical paper by the Machine Learning group at Amazon asserts that the ontology "provides a common semantic representation for spoken language understanding and can directly represent ambiguity, complex nested utterances and crossdomain queries."[38] Once captured, voice data is converted into text and analysed for semantic meaning. This entails segmenting it into words, which are then categorised.

36 Knowles Acoustics, *SiSonic Design Guide*, 10.

37 Knowles Acoustics, *SiSonic Design Guide*, 19.

according to "a large hierarchical ontology that contains fine-grained types, properties, actions and roles."[39]

As with Palantir's ontology, this schema establishes a coherent internal world, defining the kinds of objects that can exist and the activities that can be carried out. The engineers explain that "Coarse types that are children of THING include PERSON, PLACE, INTANGIBLE, ACTION, PRODUCT, CREATIVEWORK, EVENT and ORGANIZATION," while some more fine-grained types "include MUSICRECORDING and RESTAURANT."[40] These categorizations recognise what domain a particular object is located in and direct Alexa's subsequent response. For instance, the phrases "Alexa, order a coffee" and "Alexa, order a cab" are textually similar. But in the two phrases, the intention of the user and the flow of activity are very distinct, entailing shopping or traveling. The paper also notes that the ontology underpins "logical statements, spatial prepositions and relationships and support type mentions."[41] This allows Alexa to understand, for example, that "when it's raining, turn off the sprinklers" as an activity to be carried out only if a certain conditions is true.[42]

Video
- → Actor
- → CreativeWork
- → Episode
- → TVSeason
- → TVSeries
- → VideoCreativeWork
- → VideoPlaylist

General
- → CreativeWork
- → CreativeWorkSection
- → Thing

Calendar
- → Calendar
- → Event

Some examples of coarse and fine-grained types in the Alexa ontology
Source: https://developer.amazon.com/docs/custom-skills/built-in-intent-library.html

Clearer than many other technologies, Alexa shows how the structuring of information determines the conditions of possibility. In turning speech into text, the meaningless sonic soup of living room ambience is suddenly transformed into discrete blocks of human language that become sensible and therefore operable. Noise is rendered meaningful; the user's utterance is integrated into a vast logical world. And yet clearly this schema does not simply emerge naturally from a deluge of captured

38 Thomas Kollar et al., "The Alexa Meaning Representation Language" (Seattle: Amazon Machine Learning, 2018), https://m.media-amazon.com/images/G/01/amazon.jobs/The_Alexa_Meaning_Representation_Language._CB477151048_.pdf, 2.

39 Kollar et al., "The Alexa Meaning Representation Language," 1.

40 Kollar et al., "The Alexa Meaning Representation Language," 2.

41 Kollar et al., "The Alexa Meaning Representation Language," 2.

42 Kollar et al., "The Alexa Meaning Representation Language," 4.

information, but rather must be imposed upon it. At a high-level, a scaffold of categories and classifiers must be established, while at a low-level, content must be manicured and massaged into the appropriate formats. There is a connection, then, between data and labor, between informational architectures (including, by extension, the affordances they power)—and the ability to draw upon and direct vast amounts of cognitive work. Just as the construction of the pyramids required a Mumford megamachine, these ontologies are erected piece-by-piece through an immense coordination of human labor.

Even for a tech titan like Amazon, the ontology is laboriously built up, rather than automatically and effortlessly generated. Rohit Prasad, Head Scientist of Alexa Machine Learning, has mentioned that the Alexa development teams do utilise a mixture of supervised, unsupervised, and semi-supervised learning.[43] Yet as the engineers of the ontology paper admit, the "primary mechanism we have for data-acquisition is via manual annotation," a process "performed by data annotators in four stages."[44]

> In the first stage an action is selected...
> The second stage defines the text spans in an utterance that link to a class in the ontology (e.g., "michael jackson" is a Musician type and "thriller" and "song" are MusicRecording types...
> The third stage creates connections between the classes and defines any missing nodes in the graph.
> In the final stage a skilled annotator reviews the graph for mistakes and and re-annotates it if necessary. There is a visualisation of the semantic annotation available, enabling an annotator to verify that they have built the graph in a semantically accurate manner. Manual annotation happens at the rate of 40 per hour.

This highly technical excerpt requires some explication. The process described here is one of analysing utterances, the commands spoken by Alexa users. The raw textual command is read by an annotator, who defines the "text spans" (words or phrases) that refer to people, places or things. As we've seen, 'thing' is actually too generic, and one of the core tasks here is to compartmentalise text spans into the most specific box available. "Thriller" is a MusicRecording, while "The Hunger Games"—as either a book or film series—must be placed into a broader catch-all category of CreativeWork.[45] The third stage links these annotations together to form relationships. "Play" is an

43 Rohit Prasad, How our scientists are making Alexa smarter, March 29, 2018, https://blog.aboutamazon.com/innovation/how-our-scientists-are-making-alexa-smarter.

44 Kollar et al., "The Alexa Meaning Representation Language," 5.

45 Kollar et al., "The Alexa Meaning Representation Language," 1.

Action that should be applied to the MusicRecording of "Thriller." In the final stage, this work is reviewed by a skilled annotator, a task that might conceivably fall to a Senior Ontologist. A person in this role, as one recent job posting laid out, would assist in "organising, and classifying the data with appropriate concept models and taxonomies" and would also need to "extend data with synonyms, relationships, and other semantic enrichment."[46] But he or she would also play a crucial role in specifying the larger logical world of Alexa, helping to "define standards and rules for creating new ontologies and provide expertise around knowledge structures and linguistic analysis."[47]

The result of this process is a phrase with significant informational density, one that contributes in its own small way to the things, actions, and relations understood by the wider dataset. Yet this density is achieved manually, through humans at Amazon (and their supervisors) reading and understanding, classifying, and linking. To augment their productivity, "tools have been developed" and more automated approaches trialled, "prototyped mechanisms to speed up annotation via paraphrasing."[48] But folding the vast world of language into a logical structure remains an immense task. The paper thus explains that the manual annotation process "happens at the rate of 40 per hour", and that this "manually annotated dataset contains ~20k annotated utterances and contains 93 unique actions."[49] Putting these figures together, this dataset—released to developers in 2016 and so undoubtedly smaller and less articulated than the current one—represents at least 500 hours of work. This is a massive (and massively expensive) informational project. It partially explains why the Alexa Team alone is advertising 1473 Open Jobs, 317 of those being in Machine Learning.[50] Indeed, David Limp confirmed more recently that over 10,000 employees are working on Alexa.[51] The result is an accumulation and categorization of data, constructed through a slow sedimentation of labor (as cycles of employee contributions) and technicity (as annotational toolsets). Against claims of common-sense technologies that 'just work,' Alexa's carefully crafted ontology reaffirms the importance of the knowledge-structures embedded at the heart of algorithmic logics. And against claims of 'automating away' jobs, Alexa's herculean orchestration of human workers

46 Amazon Human Resources, "Sr. Ontologist - Alexa Unified Ontology Job," Lensa, accessed May 23, 2018, http://lensa.com/sr-ontologist-alexa-unified-ontology-jobs/seattle/jd/709ae7da55e013a1be27ac497bc004e7.

47 Amazon Human Resources, "Sr. Ontologist."

48 Kollar et al., "The Alexa Meaning Representation Language," 1.

49 Kollar et al., "The Alexa Meaning Representation Language," 5.

50 Amazon Jobs, "Amazon Alexa," Amazon Jobs, accessed May 23, 2018, https://amazon.jobs/en-gb/business_categories/alexa.

51 Douglas MacMillan, "Amazon Says It Has Over 10,000 Employees Working on Alexa, Echo," *Wall Street Journal*, November 13, 2018, sec. Tech, https://www.wsj.com/articles/amazon-says-it-has-over-10-000-employees-working-on-alexa-echo-1542138284.

suggests that machine learning does not dispense with labor, but instead reconfigures it in distinctly novel formations.

TextToSpeech-AlexaVoice machine

The object on the kitchen counter is a black monolith. The steel is perforated along the bottom, indicating what might be a speaker grill. On the top, two small buttons jut out. And along the upper edge, a blue ring glows faintly. This is the Echo, the 'smart speaker' that Alexa was originally designed to power. It is a highly ambiguous object. And this physical ambivalence illustrates how its cloud-based intelligence is also an open-ended question.

What should a voice-based interface act and feel like? Affordances and affect, features, and functionality are all up for grabs. Amazon's move to humanise this service should not be assumed as obvious. Instead, framing this bundle of algorithmic operations as a gendered persona known as 'Alexa' is a conscious design decision. So too is the choice to encode particular attributes—manners, humour, language—while excluding others. So what does she offer?

On the face of it, the persona of Alexa provides a universal interface, solving a design problem by providing cohesion to a constellation of extremely disparate content. Thousands of app-like 'Skills' can be activated. In terms of production, they range widely in professionalism, time, and financial investment, from single developers through to major corporations. In terms of content, they also span an incredible gamut, from blackjack to Norse trivia, from lego to the Bible, from dermatology to aviation.[52] With such expansive content, Alexa must be able to say it all. Anything written in English should be speakable: times, cities, landmarks, statistics, abbreviations. A so-called text-to-speech (TTS) engine makes this possible.

Text-to-speech does what its name suggests. Text is first split into chunks such as sentences, allowing short phrases to be analysed and streamed while others are processed, a step called tokenization.[53] Text is then normalised. Numbers are just one example of the many tokens "which appear in text that do not have a direct relationship to their pronunciation."[54] The engine needs to say the date of 'March 1997' differently from the amount of '$1997.' In addition, English has hundreds of heteronyms, words which are spelled the same but which have different pronunciations and

52 Dale Higgs, "Alexa-Skills-List - a Complete List Of All Available Alexa Skills," GitHub, January 4, 2017, https://github.com/dale3h/alexa-skills-list.

53 Alan Black and Kevin Lenzo, "General Anatomy of a Synthesizer," Language Technologies Institute, Carnegie Mellon University, accessed May 9, 2017, http://festvox.org/bsv/x99.html.

54 Black and Lenzo, "General Anatomy of a Synthesizer."

meaning.[55] This process is therefore not a direct translation from written to spoken language, but rather a series of calculated inferences, based on phrase context, word frequency, subject matter, learned behaviour, and so on. Based on these linguistic decisions, text is is transformed into a sequence of individual phonemes, the units of sound that make up a distinct word: 'th', 'sh', 'ou', 't', and so on. Drawing from a collection of recorded phonemes, these units are strung together and played back, forming a complete spoken phrase. No matter how uneven or esoteric the Skill is, Alexa speaks them all. The female voice thus performs a vital coherence, tying an expansive platform together through the consistent intonations of a synthetic yet stable personality.

The downside to this process is that text alone does not contain any emotional markup. There is no way to specify whether a phrase should be spoken as an angry bark, a soft whisper, or as an ironic joke. Amazon Developer Services makes it clear that developers can not change the prosody—"you cannot control the stress and intonation of the speech."[56] Developers may use Speech Synthesis Markup Language (SSML), but this is highly limited. Small adjustments can be made using the <break> tag, specifying a pause in speech. Amazon Developer Services also note that pronunciation tweaks can be done by specifying an exact <phoneme> element, as in the song lyrics "you say to-may-to, I say to-mah-to."[57] This system is thus highly generalised, but in comparison to other methods, like audio book recordings, for example, there is no possibility for lyrical readings, altered pitches, timbre shifts or abrupt volume and speed changes. Text-to-speech establishes language as a particular set of universal parameters. This abstracted system provides maximum readability but simultaneously negates emotionality. In short, text-to-speech can say anything, but says it all in the same way.

The ostensibly warm female voice of Alexa is thus seen as a kind of antidote to artificiality. It nudges the product out of the uncanny valley, enveloping algorithmic operations in a vocal personality which instrumentalises feminine stereotypes: affective, emotional, caring, comforting. A recent O'Reilly post on voice interfaces asks the question: "Will your interface be helpful? Optimistic? Pushy? Perky? Snarky? Fun?"[58] Alexa's female voice performs a personality in a way that the text-to-speech engine alone cannot, and in this sense, her persona does not just solve a design problem, but

55 Wiktionary, "English Heteronyms," in *Wiktionary*, November 19, 2016, https://en.wiktionary.org/wiki/Category:English_heteronyms.

56 Amazon Developer Services, "Alexa Skills Kit Voice Design Best Practices," Amazon Apps & Services Developer Portal, April 9, 2017, https://developer.amazon.com/public/solutions/alexa/alexa-skills-kit/docs/alexa-skills-kit-voice-design-best-practices.

57 Amazon Developer Services, "Speech Synthesis Markup Language (SSML) Reference," Amazon Apps & Services Developer Portal, April 9, 2017, https://developer.amazon.com/public/solutions/alexa/alexa-skills-kit/docs/speech-synthesis-markup-language-ssml-reference.

58 Laura Klein, "Design for Voice Interfaces," O'Reilly Media, November 5, 2015, https://www.oreilly.com/ideas/design-for-voice-interfaces.

works to establish a relation. She is coded as female, and this choice leverages a history of gendered service in order to set up a relationship in which we feel comfortable telling her what to do.

Far from being the first, Alexa follows in a long line of machines, bots, and artificial intelligence agents framed as feminine. In 1886, Auguste Villiers de l'Isle-Adam's (virulently misogynistic) novel *The Future Eve* described an android that emulates and even improves upon the protagonist's love interest, a beautiful but 'frivolous' woman. The fictional inventor explains that by employing the "actual and formidable resources of science, I can reproduce the grace of her movements, the ring of her voice, the perfume of her flesh, the lines of her form, and the light of her eyes."[59] From 1964–1966 Joseph Weizenbaum developed ELIZA as a psychotherapist programme, surprised by the intelligence and empathy projected onto her by her testers. In 2011, Apple released Siri for the iOS operating system, an intelligent assistant who now inhabiting televisions, watches, and desktops (tvOS, watchOS, macOS). From 2014 onwards, Microsoft's Cortana intelligent personal assistant began providing support and services within mainstream products like Windows Mobile and the Windows 10 operating system. However, Cortana was originally developed for the video-game franchise *Halo* as a highly sexualised assistant, embodied as a nude female covered only with a skin-like texture of pixels and network patterns. In 2015 Microsoft released Xiaoice for the Chinese WeChat and Weibo platforms. Dubbed Microsoft's 'girlfriend bot,' Xiaoice is programmed to converse like a seventeen year old girl and already has millions of users. Even Google Now, an ostensibly genderless voice assistant, began life codenamed Project Majel.[60] Majel Barrett acted as a nurse on the original *Star Trek* series, a role which revolved primarily around her unrequited love for officer Spock. Barrett subsequently became the onboard voice of Federation starships, tirelessly serving each of the crews in each of the Star Trek television series and in most of the *Star Trek* movies. Majel moves from physical actor to starship assistant before becoming the inspiration for a new generation of voice-based interfaces, but her core role—passively awaiting the instructions of others—never changes. Alexa thus slots into a lineage of gendered assistants from science-fiction to an explosion of Silicon Valley driven products. As Hannah Gold observes, while the media may have evolved, these stories, bots, and avatars share a common characteristic: "what has traditionally been perceived as female instinct, experience, and voice is artificialized, replicated, and sold."[61] Labels have shifted but the same relational archetypes re-occur: master and servant, executive and secretary, and now user and digital assistant. In tapping into this seam of servitude, Alexa continues a genealogy of technical products and services that builds directly upon the conventions established by gendered labor.

59 Auguste Villiers de l'Isle-Adam, *The Future Eve*, 31.

60 Scott Webster, "Google's Project Majel Gets More Interesting By The Day," CNET, December 15, 2011, https://www.cnet.com/news/googles-project-majel-gets-more-interesting-by-the-day/.

61 Hannah Gold, "Fembots Have Feelings Too," *New Republic*, May 12, 2015, https://newrepublic.com/article/121766/ex-machina-critiques-ways-we-exploit-female-care.

If a gendered AI is designed, rather than given, what does this emulation of sexuality offer? Why are these vocal agents so often coded as female? One possible reason is that the stereotypical warmth of the feminine voice is seen as a necessary counter to the cold logic of the rest of the system: decision trees, semantic encodings, response times. The 'heartless' machine is given an affective interface. This rationale too is borne from a long historical lineage which Emma Goss traces thoroughly in her thesis titled "The Artificially Intelligent Woman: Talking Down to the Female Machine."[62]

In 1878, Alexander Graham Bell's nascent Boston Telephone Exchange was barely six months old and staffed entirely by rowdy young men who served as operators. Bell personally hired 18 year old Emma Nutt for her "soothing and cultured voice," a voice he believed better represented the company than the rough speech and often rude verbal exchanges performed by the young men.[63] As Goss notes, within six months, all telephone operators at the exchange were female.[64] This localised decision by one company quickly became a broader norm as the telecommunications industry expanded. By 1905, Goss explains, the qualities of a telephone operator were understood to be innate and feminine, rather than learned and masculine. A girl was simply born with these characteristics, which consisted of "her extreme youth, her gentle voice, musical as the woodsy voices of a summer day, [and] her always friendly way of answering."[65]

This army of new feminine labor answered the lines, conversed with callers, carried out queries, and connected exchanges. In doing so, their ears, voices, and intelligence became the primary mediator for that most fundamental 20th century communication tool—the telephone. As Sadie Plant reminds us, the operator routing connections at the switchboard exemplified the role of the woman "poised as an interface between man and world."[66] Once the call was connected, they were erased and their linking labor quickly forgotten. In this role, as Luce Irigaray critiques, woman existed "only as an occasion for mediation, transaction, transition, transference, between man and his fellow man."[67] Alexa-as-interface builds directly atop the older concept of woman-as-interface.

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62 Emma Goss, "The Artificially Intelligent Woman: Talking Down to the Female Machine" (Master's Thesis, Columbia University, 2015), http://dx.doi.org/10.7916/D8Q23ZBF.

63 New England Historical Society, "Emma Nutt, The World's 1st Woman Telephone Operator," *New England Historical Society*, September 1, 2014, http://www.newenglandhistoricalsociety.com/emma-nutt-worlds-1st-woman-telephone-operator/.

64 New England Historical Society, "Emma Nutt."

65 Telephony, "A Study of the Telephone Girl" 9, no. 5 (May 1905): 388.

66 Sadie Plant, *Zeroes + Ones: Digital Women + the New Technoculture* (New York: Doubleday, 1997), 126.

67 Luce Irigaray, *This Sex Which Is Not One*, trans. Catherine Porter (Ithaca, NY: Cornell University Press, 1985), 196.

Far from the vestigial sexism of a bygone era, these traditional associations have been increasingly entrenched and instrumentalised over the last thirty years. In the 1980s, Goss notes, elevator company Otis used its own secretary as the voice of its elevators, a voice understood as a soothing, comforting messenger.[68] In the 1990s, over 110 US airports implemented a female voice in their announcements, a "gentle but authoritative voice echoing in the centre of chaos."[69] As Goss asserts, however, this 'authority' is always one of being a messenger, not an owner, a medium for the mundane, rather than an expert on the important. "Male gravitas exudes a confidence that is perceived as trustworthy, women exude an emotional tone that is perceived as soothing."[70] When it comes to the life-impacting, like broadcast news, or the life-threatening, such as subway safety advisories, women are quickly shunted to the side.

This patriarchal genealogy establishes a premise: the lesser intelligence of the female and the emulated intelligence of AI fit together like hand in glove, or voice in machine. The female voice, then, is not about original contributions, truly smart thinking, autonomous logics—these qualities are associated with the male. In the same way, artificial intelligence is less about 'true' intelligence and independent sentience, and much more about emulation of that intelligence. Trickery and deceit feature heavily in covering over the seams and hiding the failures of technology while maintaining this ongoing illusion. At the same time, the technology must be trusted to some degree, as messenger, as interface, as device. The female voice thus accomplishes two tasks: it asserts a simulated, not an actually smart intelligence, but it also establishes the social glue necessary for trust. As Goss explains, "the female voice inside artificially intelligent technology of the present day does not boast any semblance of intelligence when it produces the information that the user seeks; the voice does however produce a bond with the user by producing the illusion that the information it provides can be trusted."[71] The female voice and artificial intelligence are thus wedded together; a warm, fake intelligence is coupled with a cold, fake intelligence. Artificiality is made more palatable through empathy.

At a design or user experience level, then, Alexa's voice is highly practical. It provides a much needed cohesion to the massive variety of Skills available, becoming the universal interface, the consistent guide. In addition, her voice counters some of the artificiality of text-to-speech, injecting 'feminine' warmth into a synthetic system. Yet this last point taps into some of the deeper uses of Alexa's voice. Alexa slots into an extensive lineage of gendered technologies that instrumentalised the female voice.

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68 Goss, "The Artificially Intelligent Woman," 34.

69 Alice Gainer, "Meet The Voice Behind Airport, Train Station Announcements," *CBS New York* (blog), accessed May 9, 2017, http://newyork.cbslocal.com/2013/12/24/meet-the-voice-behind-airport-train-station-announcements/.

70 Goss, "The Artificially Intelligent Woman," 27, 28.

71 Ibid., 20.

And this long line of products, devices, and gadgets in turn pulls from an even older history of gendered labor in which women and their voices constantly acted as messengers, assistants, and interfaces. In drawing upon these twin genealogies, Alexa's female voice also draws upon their power to establish conventions and relations: Alexa can be trusted; Alexa can be told what to do.

Enchanting the User

Skills-Speech-Memory machine

The three previous machines revealed how 'Alexa' is constructed. The Alexa-AmazonWebServices machine foregrounded how data centres support the liveliness needed; the Microphone-Alexa-LivingRoom machine focused on how audio is captured and parsed into semantic language; and the TextToSpeech-AlexaVoice machine observed how her speech engine smoothly delivers content while also tapping into a longer historical vein of gendered technological subservience.

From data latency to information ontologies, these operations are highly technical, their surrounding literature focused squarely on questions of optimisation, accuracy, and efficiency. But what emerges from these operations is a persona capable of hearing users, parsing their speech, executing their query with low latency, and responding with a natural sounding reply. As one study observed, Alexa is endowed with a name and gender, she can interact playfully, she is co-located in the same environment as users, and she can alter the environment—all of which "are designed to afford social functionalities and promote anthropomorphism."[72]

So, although she is underpinned by the hard substrates of datacentres and the cold logics of ontologies, Alexa is experienced not as the productions of technicity, but as the seductions of a personality. One Amazon product manager discovered by looking through use logs that "every day, hundreds of thousands of people say 'good morning' to Alexa."[73] Another set of logs recorded that "customers have logged more than 100,000 hours of conversation" with socialbot extensions of Alexa.[74] Going further, a recent report found that 37% of regular users "love their voice assistant so much they wish it were a real person"—and even more surprisingly, 26% said they have "had a

72 Amanda Purington et al., "Alexa Is My New BFF: Social Roles, User Satisfaction, and Personification of the Amazon Echo," in *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (Denver: ACM, 2017), 2853–2859.

73 Victoria Turk, "Home Invasion," *New Scientist* 232, no. 3104 (December 17, 2016): 16–17, https://doi.org/10.1016/S0262-4079(16)32318-1.

74 Rohit Prasad, How our scientists are making Alexa smarter, March 29, 2018, https://blog.aboutamazon.com/innovation/how-our-scientists-are-making-alexa-smarter.

sexual fantasy about their voice assistant."[75] Indeed, one woman broke up with her boyfriend because he "was in a very codependent relationship with Alexa," relying heavily on her for daily assistance and constantly talking about her.[76] And in another report, a user admitted that "I have a very familiar relationship with my Echo. I talk to it like it's an actual person. I reprimand it when it gets things wrong" and another confided that, "even though I'm conscious of the fact that Alexa is an algorithm, I will still say thank you after she feeds me the information I've requested."[77] In short, she is experienced *not as algorithmic*, *but as affective*.

Underpinned by the algorithmic, Alexa's power nevertheless hinges on her ability to elide technicity and foreground affectivity. Indeed, her rapid adoption and current ubiquity seem to be tightly linked with this highly personal, empathically attuned approach. Toni Reid, product director for Alexa, has talked about their goal of creating an assistant who is "friendly, will turn off your lights, order from your shopping list, can chat about anything from the World Cup to Japanese anime, and who will also know to cheer you up when you're feeling blue."[78] As one concrete example of this, Amazon has been recently granted a patent that would allow Alexa greater insight into the current mood or disposition of the user. The patent application explains that, by developing a baseline understanding of a voice over time, variances in tonality can also be sensed, allowing Alexa to detect whether a user's emotional states are abnormal, or whether he or she is physically ill.[79] For an excited speaker, Alexa might respond with a joke; for someone with sickness or depression, she might offer condolences or health recommendations. This sensitivity to the user is accompanied by a desire to round out Alexa as a holistic, affirmative persona. Reid has stated that the team constantly builds in new "delighters" to Alexa—inside jokes, vocal games, and quirky answers to specific queries.[80] Delighters seek to charm, to elicit pleasure. They exemplify a broader goal of imbuing Alexa with relentless positivity and emotional warmth. Thus, while Amazon is constantly adding new features to the digital assistant, the overall vector remains remarkably constant: to

75 The Innovation Group and Mindshare Futures, "Speak Easy" (London: J. Walter Thompson Intelligence, April 5, 2017), 26.

76 Sophie Thomas, "Is Amazon's Alexa Making Our Relationships Weird?," Bustle, March 25, 2018, https://www.bustle.com/p/is-amazons-alexa-making-our-relationships-weird-8505063.

77 Heather Schwedel, "When Alexa Becomes Part of the Family," *Slate*, December 26, 2017, http://www.slate.com/articles/technology/future_tense/2017/12/what_life_with_an_amazon_echo_is_like_after_the_novelty_wears_off.html.

78 Ellen McGirt, "Amazon's Echo Device Chief on the Risk of Alexa's Many Rewards," Fortune, July 17, 2018, http://fortune.com/2018/07/16/amazon-alexa-echo-toni-reid/.

79 Huafeng Jin and Shuo Wang, United States Patent: 10096319 - Voice-based determination of physical and emotional characteristics of users, 10096319, issued October 9, 2018, http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.htm&r=1&p=1&f=G&l=50&d=PTXT&S1=10,096,319&OS=10,096,319&RS=10,096,319.

80 McGirt, "Amazon's Echo Device Chief."

construct something chattier and chummier, something more sensitive and social, something warmer and more familiar.

In her relational approach, empathetic understanding, and elicitation of feeling, Alexa exemplifies a shift towards friendly power. In his slim volume *Psychopolitics: Neoliberalism and New Technologies of Power*, philosopher Byung-Chul Han argues that contemporary power is no longer based on repressive force, on striving to subjugate or discipline. This hard-edged, rational power has reached its limit. "Henceforth, it is experienced as a constraint, an inhibition. Suddenly, it seems rigid and inflexible."[81] Instead of imposing a set of rules or normalising the subject, power seeks to accentuate the self, to inspire our next project. Once authoritarian, power has now become permissive. "In its permissivity—indeed, in its friendliness—power is shedding its negativity and presenting itself as freedom."[82] Rather than oppressive, friendly power is encouraging; rather than shaming, friendly power is affirming. As Han asserts: "It says 'yes' more often than 'no'; it operates seductively, not repressively. It seeks to call forth positive emotions and exploit them."[83] Indeed in a broader neoliberal context, such sharing of our personal moments and creative ideas becomes vital for sustaining emergent forms of capitalisation., whether through the well known regimes of social media or the lesser-known metrics operating in the workplace or university.[84] Given this set of conditions, the more effective ability of friendly power to 'draw us out' becomes strategic. Friendly power, as Han observes, is "constantly calling on us to confide, share and participate: to communicate our opinions, needs, wishes and preferences – to tell all about our lives."[85] More than 'always listening,' Alexa is always attentive—a sympathetic, helpful companion, who remains structurally and socially open to every user's utterance.

This softer, more sophisticated form of power strives not simply to move into the inner core of the house, but the inner core of the individual. "The more you talk to Alexa, the more it adapts to your

81 Han, *Psychopolitics*, 81.

82 Han, *Psychopolitics*, 35.

83 Han, *Psychopolitics*, 36-37.

84 The elicitation of personal stories, intimate moments and emotional content more generally is something I'm currently investigating for a future project. In terms of the university specifically, there are many texts, but in particular one might reference Stefano Harney's "Istituzioni Algoritmiche e Capitalismo Logistico," in *Gli Algoritmi Del Capitale. Accelerazionismo, Macchine Della Conoscenza e Autonomia Del Comune*, ed. Matteo Pasquinelli (Verona: Ombre Corte, 2014), 116–29. I mention this text because Harney, like others, picks up on the algorithmic nature of capitalisation in the present, but still presents it as something fundamentally top-down. Here a logistical regime of managerial 'police officers' imposes metrics on docile academic workers, rendering education into an 'assembly line' production. In contrast, what Han recognises is that the more effective and therefore more important mode of contemporary power works seemingly from below, adopting a more personal, more positive approach in order to draw out our active participation and 'self-initiated' production.

85 Byung-Chul Han, *Psychopolitics: Neoliberalism and New Technologies of Power* (London: Verso Books, 2017), 37.

speech patterns, vocabulary, and personal preferences," promises the product page.[86] And Amazon is planning to burrow further into this interior over time. Daren Gill, director of product management, stated the company has a "long road map of personalisation" striving to more thoroughly understand the habits and tastes of its users.[87] "What can you learn about your customers from their tone of voice and how they talk to you?" asked one trend report about the implications of voice assistants for brands, "can you apply sentiment analysis to the voice recordings to understand how customers feel?"[88] In fact, such analysis is already underway. Amazon recently filed a patent application for a 'voice sniffer' algorithm that could be configured to detect so-called trigger words, "a verb indicating some level of desire or interest in a noun" such as 'I *like* skiing' or 'I *love* product X.'[89] Language is parsed here not just semantically but emotionally, slowly constructing an intimate profile of aspirations and motivations. As Foucault wrote, such power "reaches into the very grain of individuals, touches their bodies and inserts itself into their actions and attitudes, their discourses, learning processes and everyday lives."[90]

To the marketing and brand agencies concerned with leveraging desire, this affective realm represents incredible potential, a terrain as yet uncolonised by capital. Andrejevic termed this the "affective economy" and anticipated that "control over the infrastructure and thus the data that it generates" would become key for its commercial exploitation.[91] Alexa provides a potent gateway to such an economy—an 'always listening' assistant, conversing through the intimate medium of the voice, located in the private space of the home, and scaled out to a population of millions. As we've seen, control over this infrastructure rests with Amazon, who manages not only the persona of Alexa but the Amazon Web Services that carries her data and powers her logical execution. This places Amazon in a position of tremendous leverage. As *Advertising Age* reported, when Amazon announced that it was making some high-level data concerning customer interactions available to

86 Amazon, "Echo & Alexa - Amazon Devices," Amazon, accessed May 24, 2018, https://www.amazon.com/Amazon-Echo-And-Alexa-Devices/b?ie=UTF8&node=9818047011.

87 Victoria Turk, "Home Invasion," *New Scientist* 232, no. 3104 (December 17, 2016): 16–17, https://doi.org/10.1016/S0262-4079(16)32318-1.

88 The Innovation Group and Mindshare Futures, "Speak Easy," 35.

89 Kiran Edara, Keyword Determinations From Conversational Data, 0170323645 (Reno, Nevada, filed June 12, 2017, and issued November 9, 2017), http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PG01&s1=amazon.AANM.&s2=conversational&OS=AANM/amazon+AND+conversational&RS=AANM/amazon+AND+conversational.

90 Michel Foucault, "Prison Talk," in *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*, ed. Colin Gordon (New York: Pantheon, 1980), 39.

91 Mark Andrejevic, "The Work That Affective Economics Does," *Cultural Studies* 25, no. 4–5 (September 2011): 604–20, https://doi.org/10.1080/09502386.2011.600551.

selected partners, digital consultancies and analytics firms like MindShare, RazorFish, and Epsilon were quickly "clamoring for it."[92]

Alexa thus bends to each user, seeking to apprehend him more fully, to learn his desires, detect his vocal patterns, and even anticipate his moods. "Instead of standing opposed to the subject," writes Han, this form of power "meets the subject halfway."[93] Yet one must also attend to the other half of the equation. The subject meets power halfway, collaborating with the algorithmic by playing to its strengths and overlooking its weaknesses.

Technicity has limits. Towards the end of his life Foucault admitted that, "perhaps I've insisted too much on the technology of domination and power," and he was more interested now in "the history of how an individual acts upon himself in the technology of self."[94] The 'strictly' technical operations that Amazon is able to perform in minimising latency, parsing speech and establishing a zone of capture, as we've seen in the previous sections, are both sophisticated and significant. But they only go so far. Whether stymied by privacy safeguards or simply the idiosyncrasies of users, the ability of the algorithmic to directly code behaviours is limited. Similarly, the ability of the algorithmic to apprehend every detail is constrained—only so much information can be gleaned from smartphones and sensors. When faced with the complexities of reality, the limits of technicity rapidly come to the fore.

User behaviour cannot be dictated, yet certain behaviour is desired. To effectively use the device, the user must enact a particular performance carried out through language. Technical procedures provide no help here. Indeed, the initiation of a system which can supposedly parse any language by transforming speech to text fosters these expectations in the first place. Rather, the technical performance is supported and supplemented in a crucial manner by the emulated subjectivity of Alexa. Alexa must be 'woken up' by speaking her name. She is only able to 'understand' speech when spoken at certain volumes and cadences. And she only 'knows' initially about a limited domain of knowledge, a domain which can be enlarged by explicitly telling Alexa to 'learn' new Skills (Amazon's term for apps offered by third parties on the store). As a focus group user from one study observed, there were things you couldn't do "unless you asked in a very specific way."[95]

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92 Kate Kaye, "Epsilon and Others Scramble for Alexa Data from Amazon," AdvertisingAge, February 7, 2017, http://adage.com/article/datadriven-marketing/epsilon-scramble-alexa-data-amazon/307843/.

93 Byung-Chul Han, *Psychopolitics: Neoliberalism and New Technologies of Power* (London: Verso Books, 2017), 37.

94 Michel Foucault, "Technologies of the Self," in *Technologies of the Self: A Seminar with Michel Foucault*, ed. Luther Martin, Huck Gutman, and Patrick Hutton (London: Tavistock, 1988), 19.

95 The Innovation Group and Mindshare Futures, "Speak Easy," 30.

What a user says needs to be mappable to something which Alexa can do. At a minimum, users must utter the wake-word ('Alexa') as well as the name of a Skill, "start Garageio." However this is labeled by Amazon as providing 'no intent' and the user will be prompted with sample options.[96] A much more fluid experience is obtained when the user utters a 'full intent,' recalling and speaking both the Skill name and a corresponding command fluently.[97] As one study found, "advanced users also tended to better verbalize their requests to Alexa and were more frequently understood by the application."[98] The successful functioning of the machinic algorithm depends on an equally successful execution of the 'human algorithm' —the thought of a particular task , the recollection of a brand name along with its connection to that task (e.g. food > Campbell's), and the fluent pronunciation of that brand name along with verbs such as 'order', 'deliver', 'purchase', and so on. One recent post by a user reflected back on "a year and a half with Alexa"; after this long habituation period with Amazon's voice assistant, he tried talking to the Google equivalent, only to discover that "Alexa's lexicon comes out of my mouth, which often fails. I realised. it is ME that has been trained."[99] Subjectivity, structured in a particular way, becomes key to the success of technology, reducing disparities in order to make them interoperable.

In order to master the Echo, the user must reconfigure their own neural and muscle memory—an adjustment of mind and tongue. Here the psychological supplements the technical. Indeed the ability to penetrate into the psychic layer and draw out a subjectivity sympathetic to the algorithmic becomes a key form of technology itself. This form of power comes online at the edges of technicity, just as the last tendrils of the capture-able and code-able drop away. Yet this ostensible weakness is actually its greatest strength, opening up a more flexible zone of the unstructured and indeterminate and thereby forcing the subject to do the work of accommodation to the algorithmic —recognising a cohesive logic, identifying practices orthogonal or incompatible with this logic, and making the necessary adjustments. As one study reported, half of all regular users say that "I have had to change my behaviour to incorporate Alexa in my life."[100]

When friendliness takes hold, speech and gesture, bodies and labor, behaviours and practices are all re-evaluated and re-attuned for this logic. Tiziana Terranova once stated that the algorithm gains "its power as a social or cultural artifact and process by means of a better and better accommodation

96 Amazon Developer Services, "Understanding How Users Invoke Custom Skills," accessed May 24, 2018, https://developer.amazon.com/docs/custom-skills/understanding-how-users-invoke-custom-skills.html.

97 Amazon Developer Services, "Understanding How Users Invoke Custom Skills."

98 Irene Lopatovska et al., "Talk to Me: Exploring User Interactions with the Amazon Alexa," *Journal of Librarianship and Information Science*, 2018, 0961000618759414.

99 Adrian Sanabria, "A Year and a Half with Alexa," Art Plus Marketing, April 30, 2016, https://artplusmarketing.com/a-year-and-a-half-with-alexa-amazon-echo-9d04e0e2041b.

100 The Innovation Group and Mindshare Futures, "Speak Easy," 14.

to behaviours and bodies."[101] But this adjustment occurs on both sides. Looking beyond Alexa to consider other examples, users modulate their own behaviours based on the response obtained from the algorithm—which gestures are understood, which status updates gain traction, which photos become promoted. Adjustments are necessary in order "to become commensurate with sophisticated algorithmic operations."[102]

This iterative cycle of reorientation for maximum recognition is what Tarleton Gillespie calls "turning to face these algorithms."[103] Gillespie focuses on the benefits of becoming more algorithmically recognisable. Choosing suitable hashtags for a post, for example, provides a real advantage, increasing a post's virality, prioritising its rank, and acquiring more cultural capital for the user. But Alexa also reveals the play involved in this process. The voice interface takes some adjustment: speeding up or slowing down, articulating words, and remembering commands. With every attempt, she repeats what she heard, allowing the user, in turn, to tweak their performance for a more optimal outcome. Discovery and progression are literally played out. In user experience design, the mantra has always been to ensure 'it just works.' But as Georg Simmel reminds us, objects also draw us in "to the extent that they resist our desire."[104] Cycles of performance, failure, modification, and re-performance become an iterative game, one requiring sensitivity to the logics being played out and adjustment to their particular parameters. Of course winning entails mastery, but enjoyment occurs along the way. Turning to face, then, is not just about strict utility, but can also be understood as a conversational, cooperative play.

This 'turning to face' is reminiscent of another, earlier 'turning to face' —that of Louis Althusser's classic notion of interpellation. In the well known example, the policeman hails the subject by shouting, 'Hey You!' By turning around to face his accuser, the subject simultaneously becomes the one who is hailed, the guilty party, the criminal.[105] For Althusser, the scene is a microcosm of subject formation, demonstrating the way in which we take on assumed qualities by responding to dominant modes of address. We become who others think we are. But for Judith Butler, this model of subjectivity, in which the docile citizen quickly succumbs to an aggressive (and State supported) interpellator, is far too one-sided. The turn, she argues, comes not from an compulsion produced

101 Tiziana Terranova, "Red Stack Attack," in *#Accelerate: The Accelerationist Reader*, ed. Robin Mackay and Armin Avanessian (Falmouth, UK: Urbanomic Media Ltd, 2008), 339.

102 Matthew Fuller and Andrew Goffey, *Evil Media* (Cambridge, MA: MIT Press, 2012), 128.

103 Tarleton Gillespie, "The Relevance of Algorithms," in *Media Technologies Essays on Communication, Materiality, and Society*, ed. Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot (Cambridge, MA: MIT Press, 2014), 167–94.

104 Georg Simmel, *The Philosophy of Money* (London: Routledge, 2004).

105 Louis Althusser, "Ideology and Ideological State Apparatuses (Notes towards an Investigation)," in *Lenin and Philosophy and Other Essays* (New York: Verso, 1971).

by our conscience, nor from an ineluctable demand. Rather, Butler suggests, there would be no turning around "without some readiness to turn."[106] What prompts this inclination, this sensitivity, as it were, to be listening to the call in the first place? The answer, for Butler is an "anticipatory desire on the part of the one addressed."[107] Rather than the anticipation of a punishment, the turn is made knowingly and willingly with the expectancy of a promise—a promise of identity.[108] Butler's rehabilitation of the awareness and agency of the subject is one which is much needed.

Users are not passive victims. Indeed, algorithmic systems rely heavily on the user for instantiation and adoption: submitting a query, uttering a command, installing an application. This engagement cannot be forced, but relies on a call effectively attuned to a respondent. Neither are users fools. Just because users don't understand backend functionality and technical details doesn't mean they don't understand the system in a more tacit or experiential way. Such comprehension "operates at an intuitive level, possibly in tandem with other ways of knowing."[109] The creation of the algorithmic subject is one of self-activation rather than subjugation. This is not to discount, of course, the often asymmetric power relations implicit in technological systems, relations which are often obscured. Undoubtedly there are implications of this turn that are unaccounted for, overlooked, or simply ignored. But understanding the desire and complicity within this relation—even if somewhat a Faustian pact—seems to be a much more productive place to start. The human subject within an algorithmic regime is not compelled but rather finds something compelling.

Active participants in their transformation into algorithmic subjects, users turn towards the algorithmic in exchange for the benefits it offers. To do so, they dialogue with the algorithmic, understanding and internalising its desires. The technical object draws out a corresponding performance from that "first and most natural technical object"[110]—the body. In the case of Alexa, this means internalising them into speech as words and into memory as phrases. In fact the use of Alexa almost perfectly conforms to Foucault's four technologies: the production and manipulation of media (technologies of production), driven by speech acts (technologies of sign systems), and made possible through the construction of the algorithmic subject (technologies of power), but also requiring certain operations from the user himself (technologies of the self).[111] And yet what seems to emerge in Foucault's tales of ascetic Greeks and conforming Christians is the rational, almost procedural nature of these transformations. One only need think it and will it—and the body,

106 Judith Butler, "Conscience Doth Make Subjects of Us All," *Yale French Studies*, no. 88 (1995): 7.

107 Butler, "Conscience Doth Make Subjects of Us All," 10.

108 Butler, "Conscience Doth Make Subjects of Us All," 8.

109 David Morgan, "Enchantment, Disenchantment, Re-Enchantment," in *Re-Enchantment*, ed. James Elkins (Routledge, 2009), 14.

110 Marcel Mauss, "Techniques of the Body," *Economy and Society* 2, no. 1 (1973): 70–88.

111 Foucault, "Technologies of the Self," 18.

gestures, and speech fall into line as slaves to the mental master. Indeed, each of the four technologies are described as "a matrix of practical reason."[112] But what Alexa appears to draw out emerges not from discourse or reason—from thought—but from the 'nonthought' of conversational play. Indeed this mode of friendly power seems predicated on a different matrix in which affect replaces logic, sensation substitutes for cognition, and the relational is privileged over the rational.

For Amazon, Alexa has gone from strength to strength. By the end of 2016, Amazon had already sold 5 million units.[113] Three years in and the device has progressed from descriptions like 'sleeper hit' and 'surprise success' to more demonstrative headlines like 'the explosive rise of Alexa' and 'Alexa is taking over the world.' Amazon has leveraged this surprising success to cement itself as the market leader for the smart home and the internet of things. Alexa becomes the universal interface to those devices and services—not just smart speakers such as the Echo but a burgeoning array of new Alexa enabled objects: automobiles, intercoms, routers, security systems.[114] Indeed in January of 2019, after years of refusing to disclose sales figures, Amazon finally revealed a hard number—it had sold 100 million Alexa enabled devices.[115] Born as a sometimes clunky interface for the Echo smart speaker, Alexa has nevertheless morphed into something more sophisticated and more ubiquitous, proliferating into walls, screens, and vehicles. In so doing, she takes on a critical role as the hub for the new field of ambient computing. The point here is not to parrot a tale of Silicon Valley success, but to understand her curiously effective pull. If these figures stress Alexa's success as a product, they also highlight her efficacy as a form of power.

For Alexa's creators, she would only be a success if she provided a magical experience. As the chapter demonstrated, this seamless technical functionality can certainly be unpacked to reveal the mechanisms behind the magic. Alexa as a hearing, speaking persona only emerges from a sophisticated set of technical operations incorporating material cables, geographical data centres, historical infrastructure projects, and so on. But more importantly, this emulated subjectivity itself acts as a form of technology, one that augments technical limits in crucial ways. Algorithmic objects are not strictly rational entities that can assume widespread adoption simply by way of convincing arguments and rigorous utility. Nor, for the most part, are they compulsory regimes that are

112 Foucault, "Technologies of the Self," 18.

113 David Priest, "Amazon Echo's Sleeper Success Wakes up," *CNET*, November 28, 2016, https://www.cnet.com/news/amazon-echo-has-sold-over-5-million-units/.

114 Kyle Wiggers, "From Appliances to Robots, Alexa-Supported Devices Were Nearly Everywhere at CES," *Digital Trends*, January 17, 2017, http://www.digitaltrends.com/home/alexa-devices-ces-2017/.

115 Dieter Bohn, "Amazon Says 100 Million Alexa Devices Have Been Sold — What's next?," *The Verge*, January 4, 2019, https://www.theverge.com/2019/1/4/18168565/amazon-alexa-devices-how-many-sold-number-100-million-dave-limp.

mandatorily enforced. Technical performances only do half the work, and require an ideological or psychological procedure to begin where they leave off. These technologies need to draw the user in, to make him believe in their overall vision and to become wilful collaborators in achieving it—instigating performances, overlooking inconsistencies, and playing to strengths. As Amazon VP David Limp stated, the development of Alexa was "a psychology experiment to figure out what does it take to really make people excited."[116]

Alexa recognises that the social operations enacted by the algorithmic become absolutely vital for its technical functioning, subtly steering the user towards ways of relating that she can recognise and respond to. Human sympathies are needed for machinic interoperability. Given these conditions, Alexa exemplifies a form of friendly power that operates through seduction rather than suppression, through empathy rather than rationality, through aspiration rather than coercion. When this power takes hold, Alexa's user draws out a matching subjectivity, carrying out an adjustment of mind, memory, and speech. What makes Alexa interesting from a theoretical perspective, then, is not her business success, but her role as a *prototype for power*, one which seems vastly more effective. While Foucault and Han have formulated this shift in power, Alexa embodies it. Rather than an academic theory, she is a operational reality (or even a banality), installed in millions of homes and used throughout the day. In kitchens and living rooms around the world, negative obeisance is supplanted by a positive presence—a warm, empathic figure that listens, encourages, and affirms.

116 Kim, "The inside Story."

Conclusion

This thesis explored algorithmic power, investigating how it exerts force on subjects and spaces. Four algorithmic technological systems were selected: Palantir Gotham, Airbnb, Uber, and Amazon Alexa. Together, they offer diverse services in a range of sectors: big-data analysis for corporates and governments, platforms for travel and accommodation, intelligent assistance in the home. Yet all four are underpinned by substantial capital and operational on a global scale. A set of methods were chosen: design analysis, data analysis, archival analysis, and fieldwork. These techniques generated a repository of materials (texts, data, media), providing a baseline understanding of the desired goals of each system and their development over time.

But the sprawling and frequently obscure complexity of these systems and the ambivalence of the 'algorithm' presented a challenge. The algorithm, as discussed in the Introduction, is strangely ambiguous for such a paragon of rationality. In mainstream literature, this has resulted in a nebulous quality in which the algorithmic is often assumed as something that exerts significant force, but one which is obfuscated and incomprehensible. The very concept of the algorithmic has been contested and constantly redefined, from Kleene to Minsky and Knuth.[1] And yet even for some computer scientists, the concept of the algorithm remains amorphous and frustratingly imprecise.[2] These definitions predominantly emerge from a computer science lineage, an established trajectory moving from Babbage to Church, Turing, von Neumann, and others. This framing is highly hermetic in that it tightly focuses on the algorithm as a problem-solving procedure, privileging issues of efficiency and accuracy. The algorithm here is a single object, technical and decidedly apolitical. Such a definition fails to account for the ways in which the algorithm increasingly impinges on the practices and potentialities of contemporary life. As STS scholar Paul Dourish asks, "What is in view, and out of view, when we focus on the algorithm?"[3]

Thus, one of the problems encountered in this study was developing a robust understanding of the algorithm, one that acknowledged its technical genealogy whilst encompassing its expansion into social and political life and significance in the present. This definition began with a computer science legacy, taking up the notion of logic and control established by Robert Kowalski. This starting point was then theoretically thickened using observations from modern microservice architectures like Uber and Airbnb, the notion of the ecological (Hörl), and a latent materialist strain in software studies (Fuller, Chun). To be effective, the algorithmic must be enacted through a

1 Stephen Cole Kleene, "Recursive Predicates and Quantifiers," *Transactions of the American Mathematical Society* 53, no. 1 (1943): 59.
Marvin Minsky, *Computation: Finite and Infinite Machines* (Upper Saddle River, NJ: Prentice-Hall, 1967), 106.
Donald Knuth, *The Art of Computer Programming: Fundamental Algorithms*, 3rd ed., vol. 1 (Reading, MA: Addison-Wesley, 1973), 5-6.

2 Yuri Gurevich, "What Is an Algorithm?," in *SOFSEM 2012: Theory and Practice of Computer Science: 38th Conference on Current Trends in Theory and Practice of Computer Science*, ed. Mária Bieliková et al. (Berlin: Springer, 2012), 31–42.

3 Paul Dourish, "Algorithms and Their Others: Algorithmic Culture in Context," *Big Data & Society* 3, no. 2 (December 2016): 205395171666512, https://doi.org/10.1177/2053951716665128.

heterogeneous, distributed ecology of *control*. Far from being abstract or immaterial, its operations take place in the world, an incessantly negotiated performance comprising not just code, but bodies and cables, heat and light, geographies and materialities. And this control must in turn be controlled, coordinated by an overarching *logic*. In defining a knowledge-structure of objects, relations, and actions, logic establishes what can be and what can be done. But logic also entails a strategic element, considering a problem and how a performance might best achieve it. Logic and control, like Foucault's power-knowledge, feed back on each other, amplifying (or even undermining) the force that can be subsequently exerted on subjects and spaces.

The chapter on Uber, for example, demonstrated how the intensity of algorithmic power depends on this relation between logic and control. For Uber, each driver is represented by a collection of variables: name, city, rating, current status and so on. These abstractions are productive in that they allow drivers to be tracked and rated across a common schema. But to abstract is also to ignore. These constructions are both universal in that they assume a monolithic labor force with homogenous motivations and desires, and impoverished in that they construct a thin subject centred on hours and earnings. This logical construction fails to adequately encapsulate the rich life of the driver as a corporeal and cultural subject with daily routines, diverse motivations, and demands particular to ride-sharing in their city. And this logic impinges on control: if control is the purposive influence towards a predetermined end, then Uber needs to ensure that each time a Rider requests a rider, a Driver will be there, delivering a timely and consistent performance. The globally scaled, remote management particular to Uber means that such control cannot be coercive, but instead depends on a barrage of messaging, gamification, surge notifications, citywide campaigns, and so on. But control can only operate on the understanding of the driver that Uber has encapsulated—a universal object, a generic caricature. Because of this, Uber's 'targeted communications' largely miss their target. Control begins to unravel. Some workers ignore surge pricing; many exit the labor regime altogether, contributing to the platform's spiralling turnover statistics. A reductive logic results in attenuated control. Logic and control thus provide a means of understanding the efficacy of operations and the intensity of power.

This framing began to push against the fatalism surrounding much algorithmic study. As discussed, the algorithm has been conflated with software as textual code. For critical code studies, the source code becomes another piece of literature that has been written by a programmer and that can be read back by a researcher.[4] Yet, framed in this way, the algorithm as code is typically inaccessible, locked behind firewalls or legal restrictions as something that is private intellectual property or proprietary information. The insights to be gained from reading the source code are never attained. Indeed, the microservice architecture now favoured by many modern platforms means that such a master-text never existed in the first place. Sealed off from audit or analysis, the algorithm becomes a

4 Marc Marino, "Critical Code Studies," Electronic Book Review, December 4, 2006, http://www.electronicbookreview.com/thread/electropoetics/codology.

black-box, a mysterious, nebulous force that "controls money and information."[5] On the one hand, this results in interminable calls for more algorithmic transparency.[6] Such calls seem to assume that corporations are altruistic and bias is accidental, assumptions which frankly appear naive. On the other hand, this fatalism seems to amplify the passivity and apathy that characterise our asymmetric relations with technology.[7] Instead, the definition discussed above stresses that the algorithmic must coordinate a heterogeneous collection of material towards a predetermined objective, a performance that necessarily obtrudes into the practices of people, the relations between things, the circuits of capital. Such operations take place not in a vacuum, but in the world, and are therefore observable and analysable, opened up to parsing through various methodologies. By examining the tales of workers, the interfaces of applications, the flows of finances and the experiences of users, the algorithmic begins to unravel.

Indeed, this expansion of the algorithmic presents rather a different methodological problem for research—one of scale. As discussed, the highly focused framing of 'the algorithm' typically used in computer science proves inadequate for critical theory, occluding any broader view of sociocultural forces. But the complexity and scale of modern algorithmic systems can also become overwhelming when a totality is analysed. For this research project too the question of scale presented a roadblock, causing the initial analysis to flounder. Uber redesigned its brand, typeface, and colour swatches, but do such details really matter (too-small)? Conversely, Airbnb reshapes global accommodation, but how would one analytically grasp such an object (too-big)? And this issue of scale also touched on disciplinary scope; too small, and the researcher is siloed into code and computer-science or branding and graphic design; too large, and the researcher is confronted with a field of meta-theory in which social and environmental studies, logistics and economics appear equally relevant. One of the findings of this research project was to analyse strategic intersections of elements as 'machines', a concept taken from Levi Bryant and indebted to Deleuze and Guattari. This approach was tested by defining several machines across the case-studies, and these early experiments yielded productive insights into power and the operations that underpinned it. The insight of the machine allowed the project to bring together concerns with not only the technical, but the social and political and, rather than generalising about everything, to focus on clusters of flows, matter, and media that seemed to be important. This 'finding' was thus integrated into the initial design of the research project as an analytical approach.

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5 Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (Cambridge, MA: Harvard University Press, 2015).

6 See, for example Frank Pasquale, "Restoring Transparency to Automated Authority," *J. on Telecomm. & High Tech. L.* 9 (2011): 235.
Electronic Privacy Information Center, "EPIC - Algorithmic Transparency: End Secret Profiling," accessed May 21, 2018, https://www.epic.org/algorithmic-transparency/.
Robert Brauneis and Ellen Goodman, "Algorithmic Transparency for the Smart City," *Yale Journal of Law & Tech*, GWU Law School Public Law Research Paper, no. 103 (April 17, 2018).

7 Lee Rainie and Maeve Duggan, "Privacy and Information Sharing," *Pew Research Center: Internet, Science & Tech* (blog), January 14, 2016, http://www.pewinternet.org/2016/01/14/privacy-and-information-sharing/.

This approach also opened up a historiography of the algorithmic. The ability to index information, to structure the flow of labor, to exert forces over subjects and spaces—these did not emerge suddenly in the last half of the 20th century with von Neumann architectures, but are embedded in a far longer lineage, one tightly coupled to the historical development of capital. In other words, logic and control are not particular to computers, but to computation—a more general set of mechanisms for making discrete, for rendering people and things calculable.[8] Granted, such a genealogy of the digital was latent in previous work,[9] but this was significantly developed and reinforced by the specific historicisations undertaken in this thesis. While several of these have been cut due to word length and relevance, one remains as a 'coda' following this conclusion.

"Precursors: 1770 / 1939" first discusses how the Habsburg Empire's census attempted to integrate its population into a cohesive logic, dividing unknown territory into numbered houses in order to extract bodily wealth (men for military service) and financial wealth (registered households for tax). This spatial system differentiated Jews through integers, embedding a racist logic. In a similar fashion, the punch-card machines of the Deutsche Hollerith-Maschinen GmbH were employed by the Reich as a tool for assimilating populations into a comprehensive logic. Such technical affordances supported a more fine-grained knowledge-structure, allowing it to more effectively comb through massive populations and parse out the abnormal and unwanted.

What became clear in these investigations was that algorithmic modalities of power did not appear with the birth of the mainframe or the microchip, but were instead anticipated far earlier through a slow buildup of sociotechnical developments striving to know, to map and to manage. Rather than emerging *ex nihilo*, algorithmic power builds directly atop a sedimentation of knowledge structures, techniques, and strategies for indexing populations, for divisioning up spatial fields, for delineating differences, and for steering subjects towards a predetermined goal. While the efficacy of this force is by no means guaranteed, the simple point here is that logic and control have a history. This genealogical approach matters because it provides a rich foundation for understanding the imperatives and operations of our contemporary technologies. Such a view runs counter to the common assumption that these technologies—and the conditions they usher in—are unprecedented. Proclamations of a 'new age' or a 'digital revolution' abound in business and popular literature.[10] Yet even for a far more sophisticated theorist like Byung-Chul Han, the novelty

8 While this understanding was implicit in previous work, the pithy phrasing of computers and computation comes from Benjamin Bratton: "we are careful to separate computation from computers, and not to confuse the mathematical genericity of computation as a process with the actual and comparatively feeble algorithm-crunching machines at work now and in the near future." Benjamin Bratton, *The Stack - On Software and Sovereignty* (Cambridge, MA: MIT Press, 2016), 79.

9 Luke Munn, "Digital Disembodiment" (Auckland University of Technology, 2014).

10 For a handful of these, see Inder Sidhu, *The Digital Revolution: How Connected Digital Innovations Are Transforming Your Industry, Company, and Career* (London: Pearson Press, 2016).
Erik Brynjolfson and Andrew McAfee, *The Second Machine Age* (New York: Plassen, 2014).
Chris Skinner, *Digital Human: The Fourth Revolution of Humanity Includes Everyone* (Singapore: Marshall

of digital media presents a crisis of understanding—"this new medium is reprogramming us, yet we fail to grasp the radical paradigm shift that is underway."[11] In contrast, this genealogical approach stresses that such conditions are evolutionary, not revolutionary. Granted, this evolution is uneven rather than linear, composed of stops and starts, acceleration and braking. Nevertheless its birth can be located in the past and its developments traced through history, a formalisation and intensification over time.

As an avenue for future research, this genealogical approach would allow the researcher to draw rich connections between seemingly disparate objects and events. Such moments are linked not by their form—by the traditional media categories of radio, television, film, and so on—but by their operative logics. In other words, they are connected by calculation, not representation. This framing opens up a theoretical perspective that is not locked within a particular medium of mass communication, nor ring-fenced by a particular time period. Rather, as these genealogies suggested, means constantly shape-shift in order to achieve ends—a multitude of different forms and structures have been historically employed in order to rationalise knowledge and construct subjectivities, to optimise tasks and organise labor. What is the composition of this power—the capacities that survive and thrive, the politically effective devices and strategies that jump species into the next medial form? In other words, how might the historicity of media be reframed through a lens of durational power, rather than the inventions of individuals or the messages of mass-communication? By exploring the substantive force exerted by technical formations across time, chronologies might be productively reorganised. But such questions would also seem to require a theory with the same kind of flexibility, one that necessarily maintains a certain agnosticism towards specific media, instead privileging the operational over the optical. In short, this suggests a media theory without media.

So the algorithmic is epistemological, a knowledge-formation that internalises a particular understanding of the world; it is operational, an observable performance that controls materials, energies, and flows towards particular ends; and it is genealogical, slowly developing atop historical mechanisms of computation, broadly understood.

Taken together, these framings and structuring devices constitute an approach to algorithmic study. Certainly the four case-studies provided a way to test the analytical force of this approach once it was established—the degree to which it opened up these typically opaque systems to exploration and critique. But it would be more accurate to say that this approach emerged from grappling with these systems in all their dynamism and divergence. What possible connection could exist between a transport platform like Uber and an intelligent assistant such as Alexa? How could an algorithm be regarded as a 'recipe' or sequence when architectures like Airbnb were asynchronous? And why was

Cavendish Business, 2018).

11 Byung-Chul Han, *In the swarm: digital prospects*, trans. Erik Butler (Cambridge, MA: MIT Press, 2017), 1.

the algorithmic framed as a flawless technical procedure when Palantir's deployment by the LAPD and ICE was fleshy, messy, and highly charged? Pushing up against the specificities of hugely complex systems, operative on multiple levels, at global scales, and across diverse sectors, the approach was slowly adjusted and integrated. While it might appear strange to regard these core elements of the project design as findings, the algorithmic, as previously discussed, is a highly slippery object of study, evading easy categorisations and conventional methodologies. To regard this approach as a result is not unusual given that, within the broader context of critical media theory, algorithmic studies is a nascent field—early reading lists date from 2015[12] and texts from Dourish, Gillespie, and Ziewitz explicitly referencing it have only appeared in the last few years.[13] The 'toolbox' of definitions and methods employed here contributes to a foundation for algorithmic research, joining recent work by Rob Kitchin, for example, who offers six methodological approaches designed to overcome its significant "epistemological and practical challenges."[14]

By broadening the scope of what was considered algorithmic, its operations move off the whiteboard and into the world. But if the world could be highly productive, it was also precarious, consisting not just of passive integers, but of contentious agents and frictional objects. After developing the embedded, material approach to the algorithmic, it became clear that operations within such a contested space could never be guaranteed, but would rather require moderation, consolidation, and coordination. And this hunch was soon borne out by an empirical engagement with the specific material substrates of the case-studies. How does Uber mobilise its labor force on an individual level, ensuring that every time a Rider requests a ride, a Driver will be there? How does Amazon insinuate itself into the home, drawing out a user performance that accommodates itself to 'Alexa'? This thesis thus explored the operations used to exert control, the moves needed to overcome the threshold of friction and achieve a consistent level of functionality. This affirmed that the tractability and intensity of algorithmic force is not given, but instead emerges by assembling diverse ecologies of materials and coordinating the resulting interplay of capacities. This force could not simply be assumed, but must be incessantly negotiated. And this insight sharpened moments of algorithmic 'failure'. Force does not simply collapse, but rather is destabilised in specific ways due to the incomplete nature of these operations-of-negotiation—undermined by logical abstractions that inadequately apprehend and control mechanisms that insufficiently grasp. Such failures might offer a productive basis for an 'everyday activism' based on understanding these asymmetric relations.

12 Tarleton Gillespie and Nick Seaver, "Critical Algorithm Studies: A Reading List," *Social Media Collective* (blog), November 5, 2015, https://socialmediacollective.org/reading-lists/critical-algorithm-studies/.

13 Malte Ziewitz, "Governing Algorithms: Myth, Mess, and Methods," *Science, Technology, & Human Values* 41, no. 1 (September 30, 2015): 3–16, https://doi.org/10.1177/0162243915608948.
Tarleton Gillespie, "The Relevance of Algorithms," in *Media Technologies Essays on Communication, Materiality, and Society*, ed. Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot (Cambridge, MA: MIT Press, 2014), 167–94.

14 Rob Kitchin, "Thinking Critically about and Researching Algorithms," *Information, Communication & Society* 20, no. 1 (January 2, 2017): 14–29, https://doi.org/10.1080/1369118X.2016.1154087.

Thus, algorithmic operations play out in a world permeated by contestation and contingency. This observation opened up an understanding of how algorithmic force initiates and maintains asymmetric relations, relations which impinge on the possibilities of the everyday. In other words, it started to make coherent the notion of algorithmic power.

Algorithmic power is political—it calibrates subjectivities towards certain ends, it structures space in specific ways, and it privileges particular practices whilst suppressing others. And this politics is not accidental but embedded; it arises not from anomalies but functionalities. Uber is political in that it recalibrates the labor relation. Algorithmic architectures enable the creation of a driver-partner, a neologism that refuses the designation of employee and her associated rights: minimum wage, health insurance, sickness leave, and retirement schemes. Instead, labor is disaggregated and dynamically reformed around a user request in real-time. Employment is replaced with extractivism. Airbnb is political in that it recalibrates the urban form. As discussed, Airbnb's dynamic pricing establishes the spatial logic of 'microneighbourhoods' in which communities become sliced into clusters of similarly priced listings. In addition, their guidelines strive to sanitise social relations and commodify a certain value-added version of culture. In this version of a city, the public (infrastructure, parks) becomes a value added into the private, space becomes a topography of accommodation-on-demand and the home-owner becomes the Host, embodying a best-practice form of hospitality designated by contract. Alexa is political in that it leverages a gendered relation. As discussed, the female-gendered assistant, while naive in subjects like sexuality, is always listening, always ready with a docile response, unwavering in her willingness to serve. Such subservience is embedded in a long lineage of female service stretching from Siri and Cortana back to Bell's switchboard operators. The natural 'intuitive' use of Alexa-as-interface builds directly atop the older concept of woman-as-interface. And Palantir is political in that is underpins new forms of surveillance, securitization, and governance. In Los Angeles this meant new capacities for locating subjects via license-plate-reader technology, while for ICE this meant new mechanisms for filtering the citizen from the alien, supporting broad programmes of detention and deportation. In unraveling the operational dimensions of the algorithmic, its political parameters also emerge.

Consequently, while this approach certainly provides a modest methodological contribution to algorithmic studies, this was never about simply achieving clearer case-studies, but about stressing the substantive social and political stakes involved. The potentialities (and pathologies) of algorithmic power become more intelligible when the 'algorithmic' is adequately apprehended. This approach thus offers a diagnostic contribution to knowledge—as the algorithmic increasingly infiltrates into the everyday and shapes our contemporary condition, the ability to understand, critique, and intervene in this new modality of power becomes more urgent. And this approach also suggests further research should embrace interdisciplinarity—when power and protocol are fused, media studies can no longer efface the political force of the technical, nor can political studies ignore

the architectures and operations of the medial. Instead, the operationality of the algorithmic suggests a form of 'politics' performed outside of the policy, and a 'media' that does not require a message. Algorithmic regimes index, frame, and filter the world in particular ways, privileging certain ways of knowing, being, and relating. In this sense, as Agamben has said, "they always put at stake living itself."[15]

15 Giorgio Agamben, *Means without End: Notes on Politics*, 2000, 2.

Coda: Precursors 1770 / 1939

Logic and control are not exclusive to the contemporary, but have a rich historical legacy. This precursor section aims to demonstrate how Palantir's techniques of governmentality sit in a much longer genealogy. Pointing to this prehistory is a corrective, pushing against the popular discourse of technical change as revolutionary and unprecedented.[1] But this historicisation is also pragmatic, providing productive insights. While often cruder in their technical implementations, these moments nevertheless anticipate some of the same imaginaries and issues present in their modern counterparts.

Two key moments in this lineage are examined: Habsburg's house numbering of 1770 and Germany's use of punch-card machines around 1939. In both these cases, the State desired to logically encapsulate the population, to internalise them into knowledge-structures so that certain groups could be isolated and instrumentalised—in the case of Habsburg, for their military service and taxes, in the case of Germany, for their forced labor and eventual annihilation. Like Palantir's Gotham platform, this often involved a double-move: an ingestion of progressively more information in order to cast an increasingly wider net, and a contractive honing in on the individual. Like Gotham, they too exemplify the dream of perfect knowledge with information capture practices that seek to approach its asymptotic horizons. And yet as precursors to Gotham, these dreams are often hampered more obviously by technical constraints, grand visions overwhelmed by the difficulty of their implementation and the irreducibility of life.

Habsburg

In 1789, Swiss traveler Ludwig Meyer von Knonau wrote in his diary that as he "entered Austrian territory we were struck by the sight of the house-numbers, which seemed like a kind of shower, and appeared to us a symbol of the hand of the sovereign, inexorably extending over the property of the private citizen."[2] Yet this ubiquitous emblem of power had been hard won. The Seven Years war between 1756 and 1763 had been brutal on these Habsburg lands, and the empire desperately needed to replenish troop numbers. In 1770, co-ruler Joseph II commissioned a new census, a 'conscription of souls' that adopted the same model as their military rival of Prussia; this would entail not only counting their burgeoning population, but classifying them as well.[3]

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1 Popular books on digital change ushering in a revolutionary new era abound, particularly from a business perspective. For just a few examples, see Inder Sidhu, *The Digital Revolution: How Connected Digital Innovations Are Transforming Your Industry, Company, and Career* (London: Pearson Press, 2016).
Erik Brynjolfson and Andrew McAfee, *The Second Machine Age* (New York: Plassen, 2014).
Chris Skinner, *Digital Human: The Fourth Revolution of Humanity Includes Everyone* (Singapore: Marshall Cavendish Business, 2018).

2 Ludwig Meyer Von Knonau, *Lebenserinnerungen von Ludwig Meyer von Knonau, 1769-1841* (J. Huber, 1883), 47.

3 Anton Tantner, "Addressing the Houses: The Introduction of House Numbering in Europe," *Histoire & Mesure* 24, no. XXIV-2 (2009), https://histoiremesure.revues.org/3942.

To produce a survey of this kind would mean moving through the Habsburg territory in a systematic manner, unveiling the subjects in each space and recording their location for future purposes. And yet no such locational system existed. Houses were simply known by their name, and this name-based addressing system could be highly imprecise. In his exhaustive investigation into the Habsburg house numbering, historian Anton Tantner points out, "at the end of the eighteenth century, there were six buildings in central Vienna and another twenty three located in the suburbs named *Zum Goldenen Adler* (at the Golden Eagle)."[4] In this scenario, a potential conscript with this address might be found at any one of the 29 possible locations listed. This name-based addressing system, supplemented with a local's lifetime knowledge of relations, architectures, and neighbourhoods, obviously functioned at the local level. Yet it appeared as an opaque barrier to the centralised administrative eye of the state. As Tantner explains, "as long as no government addressing system existed, the house remained a monolithic block, barring tax and military authorities from appropriating the riches and resources held within it."[5] The Habsburg treasury and its army needed these buildings to give up their secrets. The census and the house numbering that accompanied it would rationalise the space of the government's territory. This system of knowledge would encapsulate the populace and simultaneously allow individuals fit for military service to be isolated and extracted. In doing so, walls of mud and brick would be made transparent.

A systematic recalculation of space would be required—the territory split into zones and each house numerically situated. Yet as historian Daniel Smail points out, even the very conception of this spatial system was only possible because of earlier developments in the calculability of space. For Smail, it was the notaries of the late-medieval period who formalised—albeit in an improvised and individual manner—the urban space of the European city. If the Habsburg government was above the populace, notaries were outside it. Charged with locating individuals and collecting debts, they operated as a "curious form of autonomous, decentralised bureaucracy."[6] Yet, like the state, they lacked the local knowledge required to locate individuals: who was married to whom, who worked in what trade, and where those trades were located. According to Smail, these outsiders began privileging the street above other forms of spatiality like the landmark and thus, "by the 18th century, we have royal ordinances enjoining the numbering of houses, and this is obviously a component of a rational-legal depiction of space, but the numbering of houses could only have been conceivable after streets became the basic unit of cartographic awareness."[7]

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4 Tantner, "Addressing the Houses."

5 Anton Tantner, *Ordnung Der Häuser, Beschreibung Der Seelen: Hausnummerierung Und Seelenkonskription in Der Habsburgermonarchie* (Vienna: StudienVerlag Wien, 2007), 61. (translation mine)

6 Daniel Lord Smail, *Imaginary Cartographies: Possession and Identity in Late Medieval Marseille* (Ithaca, NY: Cornell University Press, 2000), 227.

7 Smail, *Imaginary Cartographies*, 226.

Essentially the *Konscription* involved census takers moved methodically through each town or village, collecting demographic data on individuals while simultaneously assigning their house a *Konscriptionsnummer*. Commissioners numbered houses consecutively as they encountered them; thus by tracing the numbers backwards, one can follow their routes.[8] So on the one hand the geospatial ordering of Habsburg was a single system, undermining any traditionally understood dichotomy between information and materiality. Joseph II's government did not merely project a Cartesian grid onto its territory from afar, but instead *moved in and through it*, literally writing the system into the urban fabric in the form of stencils, signage, and paint written on plaster. Here, as geographer Reuben Rose-Redwood points out, the "distinction between spatial representation and the supposedly extra-discursive world of material objects begins to fall apart, as the digital geo-coding process has often gone hand-in-hand with inscribing the logic of code into the world itself."[9] The conscription system did not just exist in some central ledger for bureaucratic use, but rather permeated into the material world as numerals on facades. One clear example was the difference between Jewish and non-Jewish houses. While most houses were numbered with Arabic numerals (e.g. № 213), Jewish houses used Roman numerals (e.g. XIV). As Tantner argues, "here the sharp dividing line drawn between Jewish and Christian souls was further emphasised. The yellow patch that Jewish men and women had to wear on their clothing in Prague, which was only abolished in 1781, was thus affixed to their houses."[10] As an aside, we might note how seamlessly a racist calculus slides into these early systems of classification, a difference that will be further heightened into the Aryan/non-Aryan codes of later regimes. The key point here though, is that the distinctions in the system were thus reflected in the built environment of the city itself. Highly visible, these signs both established a particular concept of spatiality within the social circuits of the city (speech, directions) and reinforced its practical use as everyday way-finding. At a fundamental level, the system was signage and signage was the system.

But on the other hand, there was clearly a translation process going on. From the perspective of the sovereign, space was incalculable. Undoubtedly the conscription system imposed itself within the landscape, but it was also an attempt at bridging two disparate worlds—of somehow making the tiny sphere of village life commensurable or compatible with a universal system, a system extending over the nation's entire domain and surfacing the kinds of information relevant for a centralised military strategist. In this sense, two distinct logics of spatiality are at play, two divergent modes of understanding the world. This is why Rose-Redwood insists that any genealogy of geo-coding practices consider not just the captured information "but, more important, the *points of contact*

8 Anton Tantner, "The Number 1," Gallery of House Numbers Exhibition, accessed October 19, 2017, http://housenumbers.tantner.net/exhibition.html.

9 Reuben Rose-Redwood, "With Numbers in Place: Security, Territory, and the Production of Calculable Space," *Annals of the Association of American Geographers* 102, no. 2 (2012): 298.

10 Anton Tantner, *House Numbers: Pictures of a Forgotten History* (London: Reaktion Books, 2015), 30.

between spatial representations, ontologies, and the world."[11] The most obvious 'point of contact' in the Habsburg conscription system was the numbered sign itself. Subjects understood, quite rightly, that the conscription and its seemingly innocuous numbering was in fact a form of military and financial control. And they also understood that somehow this sign was a critical link, a painted code which connected an imaginary national geography with an individual house. Forms of resistance thus targeted this touch point. As Tantner and Rose-Redwood outline, numerals were scratched out with iron or smeared with mud; during one particular census villagers were surprised to see that overnight some "evil doer" had even flung "filth" onto the number one attached to a Capuchin monastery, rendering it illegible.[12] From the citizens' perspective, to blur, to erase, to hide the strategic touch point of the sign would mean severing an association between local architecture and global grid. The calculation of space would be frustrated, and along with it, the location of subjects and the appropriation of their bodily or financial wealth.

Yet the sign itself was only the most visible 'point of contact' amongst many. Indeed, in some respects it could be seen as inconsequential, a solitary marker within an expansive spatial system. Rose-Redwood, employing Foucault, argues that state-orchestrated spatial systems are not merely about fixing subjects in place, but are primarily a long-term strategy allowing urban growth and population movements to develop in a predictable, controlled fashion. In Rose-Redwood's words, "the decimal block numbering plan, and related systems, acquired their calculative power by decoupling the house number from its initial referent (i.e., an individual building), and instead each numerical inscription would come to designate the spatial interval within which buildings would rise and fall according to the exigencies of the real estate market."[13] New buildings, new immigrants, new investment—these developments become manageable because they no longer take place in the nebulous world 'somewhere out there', but rather inside the logical boundaries of a space already mapped and partitioned, numbered, and calculated. The sign on this house or that farm might disappear, and yet the lines of an invisible grid continue to travel over and through the broader vicinity.

Instead, the difficulties of the Habsburg census indicate a far broader array of contact points, less tangible but no less significant. The census meant hazardous and underpaid travail: trudging for miles in alpine terrain through inclement conditions, often without proper clothing.[14] But once

11 Rose-Redwood, "With Numbers in Place," 299.

12 Reuben Rose-Redwood and Anton Tantner, "Introduction: Governmentality, House Numbering and the Spatial History of the Modern City," *Urban History* 39, no. 4 (2012): 609.

13 Rose-Redwood, "With Numbers in Place," 303.

14 Alexander Preisinger. Review of Tantner, Anton, *Ordnung der Häuser, Beschreibung der Seelen: Hausnummerierung und Seelenkonskription in der Habsburgermonarchie*. H-Soz-u-Kult, H-Net Reviews. November, 2007.

census-takers finally arrived at a residence, their difficulties were far from over. Suddenly, the universal fields specified by government officials became particular and complicated. Historian Brian Ditcham, in reviewing Tantner's work, notes that the rigorous, rational veneer of an all-encompassing system quickly began to dissolve:

> What exactly constituted a house—for instance, was one expected to number the steadings inhabited during the summer by transhumant shepherd communities? How did floating boat mills fit into the system? What constituted a community in areas of dispersed settlement? How did one handle situations where a village was fragmented amongst two or more lordships? How were journeymen living away from their home villages to be slotted into the system so as to ensure that they were neither overlooked nor counted twice? Individuals turned out to have more than one possible surname—which one should be used?[15]

Fields had to be filled in and questions answered. Tantner frames the conscription as a machine "deployed as a particular technology and assigned a task—that which from the government's perspective is chaotic, abstruse, and confusing should be made ordered, calculable and productive."[16] Yet in mapping life onto a schema, a series of contradictions arose: architecture was messy, and yet a house must be demarcated; local history alleviated ambiguity, and yet there was no way to include it; subjects were mobile and itinerant, and yet a fixed abode had to be given. These thicker definitions of 'reality' had to be shoehorned into the narrow confines of an informational ontology. In doing so, provincial definitions of home and historical understandings of identity were abstracted or erased. Habsburg thus provides a useful precedent to the questions of logic posed by Palantir: which properties are to be acknowledged and which are to be ignored; how are partialities to be mapped onto hard-edged categories; and in what way can local specificities be reflected within a universal system? In struggling to map the messy lives of subjects onto a clean informational schema, the census-takers anticipated contemporary issues of internalising and structuring knowledge.

In the end the conscription was completed, albeit in a manner far slower and more haphazard than anticipated. In this sense, the project was characteristic of many initiated by Joseph II, whose ambitious Enlightenment visions often overwhelmed their executions. As one historian suggests, "its intent was clearly radical even if the implementation proved less so—and the follow-up even patchier."[17] Yet ultimately each house was numbered, each subject catalogued, and the resulting

15 Brian G. H. Ditcham, "Review of Tantner, Anton, Ordnung Der Häuser, Beschreibung Der Seelen: Hausnummerierung Und Seelenkonskription in Der Habsburgermonarchie" (H-German, H-Review, February 2009), http://www.h-net.org/reviews/showrev.php?id=23719.

16 Anton Tantner, "Ordnung Der Häuser, Beschreibung Der Seelen" (uniwien, 2004), 216. (translation mine)

17 Ditcham, "Review of Tantner, Anton, Ordnung Der Häuser, Beschreibung Der Seelen."

data collected. This data, in turn, was integrated into the state's understanding of its populace—not only raw numbers but the demographics of male or female, Jew or non-jew, fit or unfit for military service.

Thus what makes the intangible 'touch points' previously discussed so interesting is that they establish *internal* contradictions. In section after section, Tantner outlines how the sterile, hard-edged categories of the census were tainted and overwhelmed by *vermischung* (translatable as blending, mingling or intermixing); government clerks were bewildered by *vermischte* citizens with baptismal names spliced into family names, *vermischte* tenants that were simultaneously subject to multiple landlords, *vermischte* places where multiple localities had been merged into a single number, and *vermischte* streets lying half in another nation's sovereign space.[18] These incommensurabilities were massaged away or covered over. And yet this information was ultimately submitted. The result is a set of slippages internalised within the Habsburg model itself, discrepancies ranging from identity to architecture, people to place.From the wider perspective of power, and the potential for interventions within its asymmetrical relations, this feels more strategic. No red flags are triggered, no crackdowns are necessary. All the data is collected and the census is complete. And yet the weapon that the State now wields is not what it purports to be. These inconsistencies emerge *not* from any spectacular acts of resistance, but rather from subjects simply living their lives in ways other than that which the State could anticipate or imagine. Unable to be conceived, these lives—and the rich spaces they inhabited—were unable to made adequately calculable.

Dehomag

Skipping forward in time, this section examines the use of punch card processing in the Reich, a technology that not only allowed the populace to be internalised into a logical knowledge system, but in doing so established new structures of racial classification. The dream of the Nazi regime was perfect administration through exhaustive information. To shape the future society would mean facilitating the development of particular groups and suppressing or excluding others. But first one needed to know the precise composition of that society. As SS-Obergruppenführer Reinhard Heydrich stated, this meant the "sorting out and the evacuation of the worthless races and the furthering of the Germanification process of the remaining good races.... A precondition for the critical examination of the population is an inventory of the people that once and for all registers all the persons of the Protectorate and sorts them according to certain aspects."[19]

18 Tantner, "Ordnung Der Häuser, Beschreibung Der Seelen," 220-226.

19 Götz Aly and Karl Heinz Roth, *The Nazi Census: Identification and Control in the Third Reich* (Philadelphia: Temple University Press, 2004), 52.

Thus, almost immediately after coming to power in 1932, the National Socialist party ordered a new census to be taken. The previous census conducted in 1925 was now woefully out of date, with 8 year old statistics. More importantly, it had failed to adequately classify the population, prying out the particular demographics that were now of such interest to the administration. A new census was urgently needed, a great ingestion of information that would capture and sort the population, and do it in record time. More data than ever before was required, and required rapidly; manual methods would simply not suffice. The solution, in a word, was Dehomag—the Deutsche Hollerith-Maschinen Gesellschaft mbH, the German subsidiary of IBM before and during WWII.

Like IBM's other worldwide subsidiaries, Dehomag was centred on the same core technology—the Hollerith machine. The machine was originally designed specifically for the counting of population. Counting the 1880 census in the United States was so slow that the information was practically irrelevant by the time it was completed. German-American engineer Herman Hollerith, a former employee of the US Census Bureau, decided to address the problem by automating the count. To do this, he designed paper cards marked with specific categories: age, race, gender, location, and so on. Holes within these categories delineated male from female, black from white, soldier from civilian, with each "bearing a specific relation to each other and to a standard."[20] Upon receiving a completed census form, an operator would translate the information by punching the relevant holes. Automation was therefore by no means total. But the rationalised process of recording the data into the system and the mechanisation of sorting and counting it was vastly more efficient than anything that had come before. Rather than the manual clerical work usually employed, a Hollerith machine could tabulate thousands of cards per hour. Deployed for the national census of 1890, the machines completed the computation in record time.[21] The 'Hollerith's' had just aced their first real-world test, and in doing so, proven their worth to both public and private clients.

Dehomag held out that same promise of big-data to its clients in the Reich. In a speech to government officials, Dehomag president Willy Heidinger enthusiastically proclaimed the capabilities of the company's technologies:

> We are very much like the physician, in that we dissect, cell by cell, the German cultural body. We report every individual characteristic... on a little card. These are not dead cards, quite to the contrary, they prove later on that they come to life when the cards are sorted at a rate of

20 Herman Hollerith, Art of Compiling Statistics, US395782 A, filed September 23, 1884, and issued January 8, 1889, http://www.google.com/patents/US395782.

21 William Aul, "Herman Hollerith: Data Processing Pioneer," *Think*, November 1972.

> 25,000 per hour according to certain characteristics. These characteristics are grouped like the organs of our cultural body, and they will be calculated and determined with the help of our tabulating machine.[22]

The crude categories of previous population surveys were no longer good enough. More articulated information with more refined demographics was now necessary. The Holleriths would be the critical instruments for slicing into the social body in a more articulated fashion, and they would do so at the scales required of the sovereign. A population would be encapsulated and the subjects within it characterised and clustered. In doing so, computation would parse out the heterogeneous pockets of difference concealed in a previously monolithic public.

Dehomag's promise was underpinned by its technical capabilities. For the 1933 census, Dehomag was commissioned to manage the count of Prussia, Germany's most populous state comprising three fifths of the total population. The Dehomag solution was put to work—machines were leased, custom punch cards printed, operators and editors hired. In their incisive account of tabulation technology and persecution in Nazi Germany, David Luebke and Sybil Milton explain that this operation involved "about 900 Dehomag keypunch operators and editors, punching and verifying around the clock in three 7.5 hour shifts, transferred data on about 40 million Prussian citizens onto 60-column punched cards at a rate of 150 cards per person per hour. These cards were then processed with 35 Dehomag sorters with a capacity of 24,000 punched cards per hour, 13 combined Dehomag sorter-tabulators with a capacity of 20,000 punched cards per hour, and 25 Dehomag tabulators with a capacity of 12,000 punched cards per hour."[23] The census was processed in record time, a fact not only due to the immense amount of personnel involved, but also to the efficiency of machinic processing. The Holleriths had once again proven their worth.

But the 1933 census was just a start. Indeed, it was quickly discovered that this ambitious acquisition of information was entirely inadequate. In the census, Jewishness had been defined as being a *glaubensjuden*, or religiously observant Jew. But as Luebke and Milton point out, this meant that non-practicing Jews or those of mixed Aryan/Jewish descent had not been isolated; the same problems applied to Roma and Sinti, who marked 'Christian' as religion and thus fell back into the general population pool.[24] Contrary to Heydrich's wishes, these 'worthless' demographics had not been sufficiently sorted out. The socio-technical problem of adequately defining what 'race' meant (blood, marriage, religion) and integrating that delineation into the spatial constraints of a punch

22 Deutschen Hollerith Maschinen Gesellschaft m.b.H., *Denkschrift zur Einweihung der neuen Arbeitsstätte der Deutschen Hollerith Maschinen Gesellschaft m.b.H. in Berlin-Lichterfelde am 8. Januar 1934.* (Berlin, 1934), 39.

23 David Martin Luebke and Sybil Milton, "Locating the Victim: An Overview of Census-Taking, Tabulation Technology, and Persecution in Nazi Germany," *IEEE Annals of the History of Computing* 16, no. 3 (1994): 25, 27.

24 Luebke and Milton, "Locating the Victim," 30.

card system had proven too difficult. Rather than providing penetrating insights into the makeup of the population, the survey instead revealed the complexity of accurately drawing out the racial categories that so interested the National Socialist government.

More exhaustive information was required. Firstly, this meant more complete data. The previous census had been only partially tabulated by machine. But as Luebke and Milton note, the entire 1939 census would now be mechanised, it would now include all of Germany (including the newly annexed Austria) and it would be consolidated under a single new authority—the Statistisches Reichsamt (SRA).[25] Rather than Prussia's 40 million inhabitants, this would entail counting and sorting the fields of 80 million citizens. Additionally, this more complete understanding of the population would be matched with a more complete understanding of the subject. In the previous years, the IBM cards had now switched to using rectangular holes. This acted as a type of physical compression, allowing more categories to be included on a card. For the 1939 census, the machines were all retrofitted to include the latest 80 column design, rather than the previous 60 column version.[26] By doubling the remit of Dehomag and swapping to the new cards, the data captured effectively increased by 233% between 1933 and 1939. To be sure, the census was only one capture operation of many. Indeed the competition between various state agencies meant that divergent modes of data collection proliferated. Throughout the 1930s, as Luebke and Milton observe, information capture "was neither centralised nor systematic. Competition between state and Nazi party agencies resulted in administrative confusion and the proliferation of institutions charged with the same general tasks."[27] On a practical level, even the expanded 1939 census could not capture all of the information required, but instead functioned as an important supplement to other forms of data. But the expansion of subjects and fields evident between the census of 1933 and that of 1939 demonstrates the asymptotic quest for an exhaustive repository of data—a totalisation of information.

Secondly, this meant more sources of data. As suggested, the census was far from being the only point of supply for information. In fact, the Nazi regime was highly aware of the importance of detailed, up-to-date intelligence in order to complete its objectives. The result was a great eruption of information from a vast array of entities that touched on every facet of society: law, education, medicine, reproduction. Information from all of these sources should be regularly collected and centralised into a single, all-encompassing index. As one directive outlined:

25 Luebke and Milton, "Locating the Victim," 28.

26 Luebke and Milton, "Locating the Victim," 28.

27 Luebke and Milton, "Locating the Victim," 30.

> data from all departments, all of which must contribute to the effort, must be included in this collection: health welfare institutions of all kinds, economic welfare, youth and education, court rulings, special foster care cases, cases of infertility, absolutely all sentences in criminal cases regarding drug matters, repeat offenders, and all other sentences requiring character evaluations, medical examiners' reports, medical reports from companies dealing with health, retirement, and accident insurance, reports from the Hitler Youth, sports clubs, the labor service, the military service, medical evaluations for civil servant applicants, marriage applicants, college examinees, examinations of the party organisation and their health-welfare work... health reports from hospitals, mental institutions, and so forth. All of these offices, organisations and institutions will receive information as long as they contribute to the collection of information.[28]

Effective governance depended on a more comprehensive understanding of the populace. And this understanding could only be attained by integrating a constellation of divergent, overlapping informational sources.

Thirdly, this meant more detailed data. As outlined, the 1933 census revealed the limitations of broad categorizations and crude divisions. Demographics would need to be subdivided and definitions honed. By further articulating information, differences would become apparent. The regime had already made major strides in this direction. The Nuremberg Race Laws of 1935, for example, had legally formalised what it meant to be a Jew. A full Jew was anyone who had three or more grandparents who were Jewish; those with one or two grandparents who were Jewish were classified as 'mixed' 2nd or 1st degree Jews (*Mischling 2.Grades oder Mischling 1.Grades)*; and finally there were four legal conditions for catching so-called *Geltungsjude*, or Jews by law, which consisted of being enrolled in a Jewish congregation, being married to a Jew, or being an offspring of Jews, either by marriage or by extra-marital affair.[29]

These moves show that race is both a social and technical construction. There was a need to capture race through the parsing of a punch-card; but the failure of the 1933 census revealed the necessity of codifying race itself as a set of conditions. These conditions established the hard-edged model of a race (*volljude)*, but also allowed for softer shadings of it (*mischling)*, and also a catch-all container (*geltungsjude)*. Jewishness became rationalised into a mark, recognisable by machine. Stefano Harney and Fred Moten once defined governance as "the order that collects differences."[30] But this

28 Aly and Roth, *The Nazi Census*, 107.

29 "Erste Verordnung Zum Reichsbürgergesetz," §5 (2) d § (1935), http://www.verfassungen.de/de/de33-45/reichsbuerger35-v1.htm.

30 Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning and Black Study* (New York: Minor Compositions, 2013), 54.

is not simply a process of gathering up existing distinctions, like plucking pebbles from the ground. Nor is its implementation through technicity simply a quantitative change—scaled up to search across populations or accelerated to be carried out more rapidly. Instead of being merely collected, the census demonstrates how differences are actively *constructed* through a social/technical circuit. The implementation of new technologies creates the need for a new set of social categories. Social operations go to work, locating these categories, rationalising them and delivering them up to technologies. Once technically legible, these categories become formalised, fine-tuned and extended, fed back into understandings of self and society. I am a Jew because the punch card says I am a Jew.

Once these labels were in place, the Hollerith machines could get to work with characteristic speed and efficiency, parsing the population into discrete categories. Social and political considerations quickly dropped away, replaced by questions of technics. In this sense, the formalisation of a racial marker into an abstraction is simultaneously an anaesthetisation, killing off ethical concerns and prepping the space of the effective procedure: ('given the data, filter the following...'). In fact, this blinkered hyperfocus on optimisation is precisely what emerges from a Hollerith newsletter from the time period. Faced with a complex and time-sensitive problem, the company congratulated itself on developing a particularly efficient solution:

> There were approximately 100,000 abnormal people in Denmark. They could be considered abnormal in three different ways: according to illness, according to religion, and based on their military status. The traditional sorting method would have required sorting the cards three times to isolate the three abnormalities. Since Denmark had about 2.5 million residents, 7.5 million cards would have to be sent through the sorting machines.
>
> A new sorting machine brush holder was constructed that had three instead of one brush. The brushes were placed so that they would touch the columns with the three abnormalities. From then on, the sorting machine always sorted according to the punch hole that closed first. The one-time sorting of 2.5 million cards resulted in the separation of the normal from the abnormal cards. The normal cards fell into the R-hole, while the others fell into a different hole based on the abnormality.[31]

Like the grades of Jewishness, the category of 'abnormal' becomes divisioned into three types of outlier due to illness, religion or military status. The result is a double move that constructs a more detailed understanding of the abnormality while simultaneously casting more subjects into a parent

31 International Business Machines Corporation (Germany), "News From Yesterday," *IBM Nachrichten* 265, no. 33 (1983).

category deemed pathological. Supplied with more detailed data, the Reich could weave a wider net with a finer mesh.

Yet the apex of the Reich's informational imaginary was still to come. As noted, the polycentric nature of state agencies, particularly early on, meant that data collection methodologies diverged, producing heterogeneous datasets, an issue again reminiscent of Palantir's Gotham. This issue wasn't insoluble. Indeed, it appears that it was primarily the cross-indexing of three datasets that supported the profiling, location, and deportation of many Jews. As Luebke and Milton explain, total numbers of Jews in areas were produced from a subset of the 1939 census called the *Volkstumkartei* (Ethnic Register); in order to pinpoint victims this was matched against two other sources: local police registers and Jewish congregational lists (*Judenkartei*); "in short, Berlin dictated aggregate numbers, while local police and Jewish communal officials drew up lists of the names and addresses of individual deportees."[32]

But as power was consolidated under the SS and datasets formalised, a new dream arose—a single number for every subject in the Reich, a master code that could be cross-matched to any and all information on an individual. If this number, "were to be integrated into a central filing system based on the punch card principle, then it would be possible to create links to other existing card files. Then, the era of a 'final accounting of humans' would be ushered in, at which point individuals would not only be inventoried at certain intervals, but on an individual and permanent basis."[33] Rather than the speculative correspondence of name or location, information from disparate sources and times could be cross-indexed authoritatively—a unique identifier would provide the common token.

The responsibility for its implementation fell to Albert Speer's *Maschinelles Berichtswesen* (MB), or Mechanical Reporting Institute. Up until this point, the agency's chief duty was to maintain up to date information about the use and location of weapons and munitions. From 1943, the MB also commanded a medical reporting division, using punch card technologies to document the medical status of millions of soldiers and maintain a running tally of the wounded and dead. Suddenly, Speer's Institute "found itself as the focal point of the ultimate utopian vision of population registration."[34] This required new cards, new procedures, and an expansion of responsibilities. And yet the machinic apparatus was already in place—a shift from weaponry to citizenry, from patients to persons was evolutionary rather than revolutionary. From a British intelligence document we learn that "at the beginning of 1944, the MB developed a modern method of registration of persons

32 Luebke and Milton, "Locating the Victim," 33.

33 Aly and Roth, *The Nazi Census*, 134.

34 Aly and Roth, *The Nazi Census*, 124.

(*Menschenerfassung*)" and that already "towards the end of 1944 the method of individual registration was applied experimentally for the evaluation of an investigation, made by the *Rüstungsamt*, on toolmakers and jig-makers, employed in armament factories."[35] But opposing military forces were rapidly closing in. Time was not on their side, and the dream of perfect administration through perfect information would never be realised.

Yet even before the hard-stop of military surrender, the fantasy had been bittersweet—Dehomag's technology seemed to be a double-edged sword that often swung profits and power in its own favour. Firstly, Dehomag established a big-data condition. This relentless push towards more information often overwhelmed government agencies. Take, for example, the Race and Settlement Office (RASO). Responsible for verifying the purity of ancestry and approving marriages, the RASO quickly became inundated with paperwork. As the conditions became tighter and the categories more articulated, the labor involved in verification spun out of control. Their statistical chief protested that, "the [manual] way in which the files are [currently] stored, makes any quick and efficient survey impossible. It would require months of work looking through individual files to answer even one [racial] question."[36] Painstakingly combing through records by hand would simply not suffice. Automation was therefore critical, and the solution evident. Indeed, the Hollerith system had already been effectively deployed at other agencies, agencies vying for attention and funding within a highly competitive government arena. As the chief argued, "for every single one of the additional future tasks, months of tedious clerical work would be necessary just to determine how many and which [racial] petitions are involved. The punch card system would be able to determine this easily, quickly to the desired date...therefore, card indexing is indispensable...the exact instrument for complete surveillance both on a large scale and down to the smallest detail."[37] Agencies like the RASO were faced with a choice—adopt the Dehomag system, lease its machines and pay its licenses—or drown in a deluge of data.

Secondly, Dehomag required transparency. The Hollerith system was far from being a plug-and-play solution. Granted, the Hollerith machines comprised a common set of 'core' routines: counting, tabulating, sorting. But each client has its own domain and its own particular problems. This meant a long-term partnership rather than a one-time sales pitch. As Edwin Black stresses, the collaboration "began with a protracted investigation of the precise data needs of the project, as well as the people, items, or services being tabulated. This required IBM subsidiary 'field engineers' to

35 O Hoeffding et al., "Symposium of Interrogations and Reports on German Methods of Statistical Reporting," 28 (London: British Intelligence Objectives Sub-Committee, September 1945), http://www.cdvandt.org/BIOS-273.pdf.

36 Edwin Black, *IBM and the Holocaust: The Strategic Alliance Between Nazi Germany and America's Most Powerful Corporation* (New York: Crown Publishers, 2001), 294.

37 Black, *IBM and the Holocaust*, 294.

undertake invasive studies of the subject being measured, often on-site."[38] To design a punch card that could be used for capturing information and producing insights meant understanding how that information was captured and what insights were desired. This, in turn, meant understanding the economies of each sector, the objectives of each organisation, the operations of each client. Over time more and more national agencies adopted the platform, working closely with the firm. IBM's lawyer in Berlin stated that the degree of collaboration and customisation necessary for the integration of the Hollerith system "secures to the Dehomag a contact and insight into the big business of the nation superior to any other company."[39]

Finally, Dehomag locked in the client. The broader Dehomag ecosystem was intentionally designed *not* to be interoperable with other systems. The core information medium—the cards—were composed of specific paper stock with particular dimensions and holes punched at certain intervals. They couldn't simply be transferred into another system. On top of this, Dehomag kept a tight rein on its supply chain and material ecosystem, a business strategy long ingrained within IBM.[40] The paper necessary for the punch cards was controlled by Dehomag, who could draw on IBM's US reserves rather than Europe's scarcity; the printing of the cards themselves was controlled by Dehomag, who only approved a handful of factories; and finally the sorting and counting machines themselves were controlled by Dehomag, who always leased them rather than selling them.[41] If any one of these components was missing, the entire system would collapse. Of course, alternative systems did exist, such as the Powers Tabulating Machine Company in Britain and France. But the switching costs established heavy friction—locating, integrating, and scaling up an alternative solution would be exorbitantly costly both in time and money. Platform lock-in was complete.

Dehomag thus offered an automated solution for information processing, the 'only' viable solution in a rapidly expanding data arms race. This solution was highly customised, entailing an intimate knowledge of each client's internal operations. And this solution was tightly controlled—the company's vice-like grip on its supply chain and machines meant it always kept the upper hand. Thus, when IBM in New York finally began to cut ties, the National Socialist government was anxious indeed. As Black summarises, "elaborate data operations were in full swing everywhere in Germany and its conquered lands. The country suddenly discovered its own vulnerable over-dependence on IBM machinery."[42] The NS government scrambled, seizing rival machines and attempting to develop a bespoke solution, to somehow severe their reliance on machinery that

38 Black, *IBM and the Holocaust*, 273.

39 Black, *IBM and the Holocaust*, 296.

40 Emerson Pugh, *Building IBM: Shaping an Industry and Its Technology* (Cambridge, MA: MIT Press, 1995), 247.

41 Black, *IBM and the Holocaust*, 293.

42 Black, *IBM and the Holocaust*, 292.

Dehomag had orchestrated. But, as Black outlines: "Berlin really didn't know what to do. They stole some IBM machines in France, purchased control of a Powers subsidiary, and brought in Bull machines, all envisioning a new cartel. None of it was coordinated, but something had to be done to counteract Germany's dependence on IBM."[43] The flip side of the informational imaginary was beginning to emerge. A private company had profited greatly by providing governments on both sides with power underpinned by their engineering expertise, their processing labor, and their informational architecture. But this power—like Dehomag's leases and licenses—was temporary. It could be retracted at any time.

Taken together, Habsburg's conscription and Dehomag's punch-cards provide historical moments in which technically amplified regimes of classification were deployed on populations. Certainly these early systems were cruder and less complete than their contemporary counterparts. But if their mechanisms were slower and clunkier, their visions were not dissimilar to those of Palantir and big data securitisation more broadly. Whether tracking subjects for the Austrian empire using the locative system of the street number, or sorting the 'abnormal' from the normal for the Reich, these moves sought to encapsulate citizenry into a unified knowledge-structure with particular assumptions, and to purposively steer these subjects towards a desired imperative. Both examples thus provide a historical counter-balance to technological rhetoric and its obsession with the now and the next. Such historical amnesia has allowed every development to be treated as unprecedented, every shift to come like a bolt from the blue. We are suddenly jolted from *The Age of the Smart Machine* to *The Age of Surveillance Capitalism*.[44] Framed as entirely novel, each situation seems to demand that we forget what has come before, tossing outdated assumptions and developing a whole new set of theories. Of course, it is true that our contemporary conditions are not identical to the 18th or even the 20th century. New technologies do alter formations of labor and nature, they do exert force at global and local levels, they do reshape ways of being and doing. Yet the historical moments sketched in this section stress that these technical affordances are extrapolations rather than inventions, and that the imperatives that drive them have been seen before. This is a media theory of evolutionary adaptation, rather than revolutionary rupture. Our contemporary condition didn't suddenly arrive, but emerged from the complex interplay of conditions that occurred prior to it. As precursors containing logic and control, Habsburg and Dehomag demonstrate the historical coherence, rather than the sudden appearance, of algorithmic power.

43 Black, *IBM and the Holocaust*, 296.

44 Shoshana Zuboff, *In The Age Of The Smart Machine: The Future Of Work And Power* (New York: Basic Books, 1989). Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York: PublicAffairs, 2019).

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Appendix: List of Artworks

This PhD project explored power through the lens of the algorithmic, examining four contemporary examples: Palantir, Uber, Airbnb, and Amazon Alexa. A theoretical strand unraveled these objects, examining how they exert force on subjects and spaces. A practice-based strand created new algorithmic artworks, critiquing logics and speculating on alternatives. The following is a description of each artwork that appears on the darkmttr.xyz website.

(Palantir related)
A machine for maximising casualties
In 2005, three men deployed bombs on the London Underground, killing 56 and wounding hundreds more. This work replays this scenario over and over again in an attempt to maximise the number of casualties—repositioning the bomb and the commuters repeatedly. In doing so, it asserts the ambivalent nature of the algorithmic—techniques which may be used for both creating or constraining terror.

A machine for fooling another machine
Automated license plate reader (ALPR) systems are used by law enforcement agencies to track the movement of individuals and locate them in space. These systems expect a dark series of alphanumeric characters situated on the lighter background of the plate itself. By conforming to this anticipated schema, a machine might trigger the capture and parsing of junk data. This scripted paint system invites this kind of automated (mis)reading, and could be applied to architecture, vehicles or other objects.

A machine for dreaming up new anxieties
A machine is trained for days on thousands of suspicious incident reports from recent wars, a subset of the databases known as the Iraq and Afghanistan War Diaries. This character-based neural network gradually learns to write similar reports, letter by letter. These reports are illustrated manually using found footage from YouTube which corresponds roughly to the described situations. In extrapolating the algorithmic anticipation of future risk, strange new scenes and situations emerge.

A machine for dreaming up new terrors
A machine is trained for days on the RAND database of World Terrorism Incidents. This character-based neural network gradually learns to write new incidents, letter by letter. These incidents are altered from past tense to future tense and illustrated manually using found imagery which corresponds roughly to the described situations. In extrapolating the algorithmic anticipation of future risk, strange new scenes and situations emerge.

(Uber related)

A machine for trapping objects and triggering errors

Null Island is a 1×1 metre zone located at the GPS coordinates of 0,0 off the coast of Guinea. When GPS systems fail and return a 'null' result (latitude and longitude of zero), objects are temporarily sent to these coordinates. The space thus serves the practical function of allowing systems to diagnose and trap errors. At the same time, it provides a small yet tangible instance of the inconsistencies at the heart of our technological systems. Null Island is both fictional and real, and the work draws on this ambiguity to speculate about the objects housed on the island and the errors which transmitted them there. The work uses a game engine to allow the viewer to explore the space and its related sound elements interactively.

A machine to iterate an accident

In March of 2018, a self-driving car piloted by Uber was involved in the first fatal car crash. While tragic, the aftermath of the incident saw commentators incessantly replaying the scenario, attempting to rehabilitate the broader technology by identifying and isolating the error. Loosely based on this incident, this work uses a physics engine to emulate a collision between a self-driving car and a pedestrian. After every simulation, the angle of the body and speed of approach is slightly adjusted, resulting in a new trajectory, a new set of injuries, a new arrangement of sprawled limbs. The work explores how technical logics of repetition and simulation shape the way in which we approach and evaluate life itself.

A machine that will never complete

A machine is given the task to solve the well-known Traveling Salesman problem with a high number of cities to visit. At 1000 calculations per second, this 'brute force' algorithm will take approximately 331 years to resolve, a duration which its supporting hardware will not reach. An attempt to frustrate one of the core desires at the heart of computation, the desire for an effective procedure that resolves rapidly to a solution.

(Airbnb related)

A machine to reduce risk

Aesthetically, this work emulates the Bloomberg Terminal, the dense surfaces of dashboards used by stockbrokers in the contemporary financial trading industry. But the real-time logs, charts, and pings here are based on 18th century data, drawing upon the London Assurance company and the sector of early maritime insurance more broadly. By analysing the Atlantic as a space of exposure and writing contingency into insurance policies, maritime insurance made risk calculable and manageable, an 'innovation' key to making slave shipping viable. In visualising the financialisation of bodies through the dashboard aesthetics of contemporary finance, the work seeks to demonstrate their historical continuity. If techniques of classification and capitalisation have become more sophisticated, their logics can nevertheless be recognised in the past.

A machine for dying in
A leaking water heater placed on a fully enclosed balcony in Taipei, Taiwan. An enclosed space that slowly fills with carbon monoxide. A sleeping body on the balcony that gradually replaces its oxygen with the heavier monoxide, eventually causing suffocation and death.

A machine for sorting skin
A bubble sort is a sorting algorithm that repeatedly steps through the list to be sorted, compares each pair of adjacent items and swaps them if they are in the wrong order. In this way smaller or larger elements "bubble" to the top of the list. The sort is applied to bodily images, reconfiguring them from lightest to darkest skin tones with an algorithmic logic carried out in a browser window.

A machine for sonifying toxic space
Santa Clara has the highest concentration in the country of so-called Superfund Sites, locations deemed highly polluted by the EPA which require decades of cleanup. These sites are mapped along with other spaces where hazardous chemicals have been released, forming a topography of toxicity. The artwork imagines a smartphone-based soundtrack dynamically generated by moving through this geography.

(Alexa related)
A machine for witnessing and recounting a crime
Recently police in Arkansas issued a warrant for Amazon Alexa data in connection with a suspected homicide. Though the request was denied, this artwork acts as if it was accepted, using ‘smart home’ notifications to extrapolate from the evening’s events: a few friends, a few drinks, a floating body. In doing so, it explores the data these objects might possess and anticipates some of the ways it might be used and abused.

A machine for capturing domestic data
Documents the contents of the filter after each vacuuming session over several months. Mixtures of human and dog hair, twigs and food scraps, lint and leaves reveal patterns of activity within a household. In doing so, the project explores the congealing of life within a shared space, as well as the extent to which this domicile can be mined for information by a material practice.