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After measurement

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abstract

This paper looks at the relationship between computational forms of knowledge, optimisation and politics. The paper develops an expanded definition of computation beyond that with which the term is most generally associated (i.e. with electronic computing machines). In particular, the paper examines the link between measurement and computational logic, proposing that computation creates *hybrid-objects* composed of both physical entities and their abstractions. The paper goes on to identify how computational ways of knowing give rise to particular forms of optimisation. Finally, the paper proposes that in the case of increasingly technologically mediated societies an understanding of the ways which we measure, and the way in which this knowledge is deployed, becomes a central function of contemporary political critique.

Introduction

Computation, it can be argued, has become one of the dominant structuring forces of contemporary human society. In making this claim, however, it is necessary to go beyond the definition of computation that is generally understood as something occurring upon the semiconductor substrates of modern computing machines. Instead, the contemporary logic of computation can be expanded to include activities that permeate those spheres of existence situated upon the biological substrates (bodies, flesh, organisms) from which we are formed, and the material and immaterial

substrates of culture (hearts, minds, souls) in which we are formed, and which we constantly form and reform. Central to this expanded logic of computation is the concept of measurement, i.e. the formalisation of systems of abstraction through which the world can be described. Whilst this paper will, by way of introduction, briefly discuss this expanded notion of computation that permeates contemporary society, its focus is on that which follows computation and measurement – namely, optimisation and its place in contemporary politics.

Optimisation is a term or concept that is most familiar to those in the fields of mathematics, engineering and management and is the process of making the best or most effective use of a resource. This paper will discuss how the act of measurement within the contemporary logic of computation exposes individuals to the possibility, or perhaps inevitability, of optimisation in many areas of their existence. However, what this paper shows is that the concept of *best* or *most effective* is an expression of politics and can act as an expressor of control. In particular, this paper will discuss the existence of two processes of optimisation; the first, optimisation *through performativity*, will be described within the context of Lyotard's notions of knowledge performativity, whereas the second, *optimisation through normativity*, will be described within the context of Foucault's notions of norms. Finally, the paper will explore the power dynamics contained within these processes of optimisation in order to suggest the importance of this understanding of computation in the critique of contemporary power.

A logic of computation

There is little consensus as to what defines computation in the machine, human or in nature. In functionalist accounts, initially stemming from Putnam, systems are variously considered as computational when there exists a mapping that describes their changes between states (Copeland, 1996; Putnam, 1960; Tegmark, 2008). This position, however, creates the possibility that any process can be considered computational. As has been noted by others, the possibility that any system can be considered computational renders the discussion trivial (Godfrey-Smith, 2009; Horsman

et al., 2014). As such it is necessary to develop a definition that can be more useful in understanding the role of computation in contemporary society. The general term *computation* is widely understood and predominantly associated with those electronic devices that we call *computers* – be they smartphones, keyfobs, cloud servers or fighter drones. To focus on computation as bound only to these and similar machines, however, fails to fully account for the range of historical and contemporary processes of computation in which humans have engaged. There also exists an understanding of computation that can be considered beyond the realms of computing machines but which does not become trivial in doing so. Semantic accounts of computation which were developed by Fodor (1981) describe computation through its relationship to abstraction. Computation can be considered as the processing of information, which represents in some abstract formal structure some other process. This understanding is developed and generalised more clearly in the Abstraction Representation (AR) theory developed in the paper 'When does a physical system compute?' (Horsman et al., 2014) in which the relationship between the abstract and physical domains is defined. For clarity, this paper will use the term physical to refer to the subject of abstraction whilst acknowledging that these subjects can be both material and immaterial such as individuals, their emotions, or the relationships between them.

This abstracting relationship is common to all of the computing machines mentioned above, and Fodor proposes that 'there is no computation without representation' (Fodor 1981: 120). AR theory describes just such a representational relationship between the physical and the abstract, describing computation as being built on the *good enough* equivalence of the result of a transformation in the abstract domain of an abstract entity with the result of an abstracted transformation of an entity in the physical domain. In other words, computation in these accounts is based on the assumption that the abstraction has a relation to the physical entity it represents that allows for decisions to be made about the abstract that can be considered as equivalent to decisions in the physical domain. The relationship between the physical and the abstract domain is the process of measurement. Measurement is the *way* of getting the physical *in* to the

abstract domain, representing a physical phenomenon in an abstract formal system (Krantz et al., 1971: 1). Thus it can be suggested that any process that acts on the results of a measurement process can be considered as computation. However, this understanding of computation is still limited inasmuch as the representational relationships described in these semantic accounts are unidirectional. What is be explored below is that in a contemporary logic of computation abstractions are increasingly inseparable from that which they represent.

It is possible to think of this understanding of computation and its limitations through some practical examples. At one end of this scale are simple analogue measuring devices – rulers, weighing-scales and thermometers – converting physical phenomena into numerical representations. Then there are sensors for encoding physical properties such as heat, light or vibration through the production or manipulation of voltage signals into digital bits and bytes, undergoing multiple steps of abstraction. At the other end of this spectrum, highly abstracted relationships are created; Facebook profiles encode relationships, images (themselves abstractions) and sentiments via friendship circles, facial recognition and through the use of emoji symbols for liking, disliking or surprise. Meanwhile, Fitbit and other bodily trackers measure exercise in terms of pulse rate, distance travelled, or a range of other metrics. In each case, these abstract representations, resulting from the measurement process, become the subjects about which decisions are made in place of the physical phenomena they represent.

It is thus possible to think of computational logic as having existed in various forms for almost as long as historical records allow or at least for as long as we have records of measurement. In its earliest forms, computation can be recorded as having taken place with systems of time recording and in the first forms of money – in each case, some abstract system was used to measure some physical phenomenon. In contemporary society, however, these abstract entities increasingly become the primary site for engagement between individuals and others; commercial entities, institutions and the state, and in many cases engagement with the self. No longer solely correlates for physical entities, the abstract entities become intrinsic parts of

the subjects in themselves. Thus the relationship is no longer a unidirectional abstraction of an unchanged physical entity. Instead, the act of measurement creates what Rouvroy (2015) describes (in the case of individuals) as 'Supra-Individual' subjects composed of an individual and infra-individual abstractions. We can think of these supra-individuals more generally as hybrid-objects, composed of their physical and abstract components. In this understanding, the abstraction and the real can no longer be held as separate. The importance of the abstraction in the relationships between individuals and institutions is easy to see across many areas of society. Credit ratings, user reviews, purchases (Clover, 2016), Facebook comments (Ruddick, 2016) and prison sentencing algorithms (Angwin et al., 2016) are used to determine trustworthiness or risk; DNA records are used to determine predisposition towards certain illnesses or to determine life assurance premiums (Joly, Feze and Simard, 2013); self-tracking and employer tracking practices seek to extract value from abstracted physical (Brown, 2016) and affective activities (Moore and Robinson, 2016), more examples of which can easily be found. While the phrase 'If it's not on Facebook it didn't happen' is generally used in a throwaway fashion, research has shown that online autobiographical recording practices influence the mental recording of our activities (Wang, Lee and Hou, 2017). Lupton has highlighted that amongst users habituated to self-tracking practices using fitness trackers, activities that have not been tracked become mentally discounted (Austen, 2015). Meanwhile, amongst users of sexual tracking technologies, users report pressure to perform for the datafied recording of the sexual act rather than for themselves and their partners (En and Pöll, 2016). In each case, complex social, cultural and psychological factors and activities become bound up in their representation as measured data points upon which decisions and understandings are based. These abstractions act on and as part of a hybrid-object within which the abstract and physical can no longer be separated.

These practices of abstraction raise many questions in and of themselves about the ethics, effectiveness or viability of abstract representations as surrogates for complex physical phenomena. At the same time, the generation of hybrid-objects as subjects of contemporary computation

challenges the notion that computation can accurately be described as a relationship between two domains, the physical and the abstract. The focus of this paper, however, is not on the viability of abstraction or computation but rather what happens after measurement – in particular, how these hybrid-object assemblages of physical and abstract entities become exposed to the process of optimisation.

Optimisation through performativity

Optimisation, as discussed briefly in the introduction, is the process of making the best or most efficient use of a resource. *Best*, or *most efficient*, however, is, of course, a subjective determination. All optimising processes are subject to what is known as an objective function, i.e. the selection of a feature with respect to which the optimisation must take place. For example, in the case of a car's engine, the designer may optimise for power, efficiency, carbon monoxide emission or any number of other variables of interest, which may require competing design decisions (the choice of which is an expression of politics operating on a different scale or register). Optimisation is a selection of preferences, a choice of values and an expression of selective biases. Importantly, it is possible to say that nothing can be optimised of itself, instead an entity is *subject* to optimisation relative to some external criterion. Some criteria, however, present themselves for optimisation in ways that others do not. Returning to the car engine example, a designer may find it difficult to optimise the engine for *beauty* or *goodness* in the absence of some measurement system with which to determine one design's level of such a property from another's. This problem is further compounded when the designer finds their colleagues' ideas of beauty at complete odds with their own.

To optimise for something one needs to have a way to measure the results of our actions. If we consider the hybrid-objects of contemporary computation we can suggest that only that part which is measurable can be optimised. This selection of optimisation variables is therefore related to the way in which knowledge can be held and shared about a particular phenomenon. Knowledge that is subjective, contingent and embodied cannot easily be held

in the abstract representations of computing technologies, whereas forms of knowledge that are easily encoded within measurement systems and about which broad agreement exists become easily encoded within the measurement systems of computation. This property of knowledge, or knowledges, is related to what Lyotard (1984) calls the 'performativity criterion' – the ability of knowledge to be shared, transferred and verified independently of its holder or creator; that is, the ability of the knowledge to perform independently. Computational knowledge forms, the abstract part of hybrid-objects, have high levels of performativity. On the other hand, embodied, affective, communal or implicit knowledge forms have low levels. Thus it would be possible to suggest that only those elements that can be represented computationally are subject to optimisation.

It is possible, however, to suggest that the creation of hybrid-objects is itself a form of optimisation. The selection of what is measured is based on the performativity of the knowledge about the phenomenon itself. The hybrid-objects that occupy the logic of computation are governed by this performativity criterion; their abstract components are composed of forms of knowledge with high coefficients of performativity. As such these hybrid-objects are composed of the physical entity and abstractions of parts of that entity based on the performativity of knowledge about those parts. Thus the creation of hybrid-objects is subject to the objective function of performativity – the selection of only those features that can be abstracted. This performativity criterion is central to the ideas of measurement that underpinned the techno-scientific revolution during the Enlightenment. Knowledge forms that could be transferred and verified between the knowledge institutions of Europe gained their legitimation through their repeatability, and in turn, the power to legitimate was inferred upon those who could produce knowledge in this way. This reciprocation between knowledge and the power to legitimate it was, and remains, a political decision. This choice, which Lyotard explicitly describes as the link between scientific truth, ethics and politics in the notion of rational authority of 'the Occident' is that in which

> knowledge and power are simply two sides of the same question: who decides what knowledge is and who knows what needs to be decided? (Lyotard, 1984: 8)

As argued by Poovey, numerical and highly performative forms of knowledge were central to the *making meaningful* of the world in the liberal and neo-liberal orders that gave rise to the contemporary conditions of computation. Optimisation by performativity can thus be thought of as a choice over the types of knowledge that are considered legitimate and thus give authority in the abstraction of the physical world.

It is possible to see the increased prevalence of this form of optimisation across society. For example: social media commentary is measured in likes and shares, rather than in the thoughts/emotions/responses engendered in the reader; health is measured in heartbeats, steps and calories rather than in terms of its physiological, social or psychological effects; and intimate relationships are measured in terms of the completion of particular acts, the amount of time spent or even the number of strokes in the (presumably male) sexual act rather than as a complex social, emotional and physical process. In each case, a physical phenomenon is conceptualised within the metrics of a computational framework. However, of interest here is not whether some part of reality is encoded within computational forms, but rather how the existence of these computational forms tends towards the reconception of these activities within the terms of the computational forms. In other words, the existence of these metrics influences our participation in these activities in such a way as to optimise them for the types of metrics that are highly performative within a logic of computation.

Many examples of this sort of optimisation can be easily seen in daily life. Users of social media regularly engage in narcissistic practices of self-curation and self-censorship intended to increase the number of likes, shares and retweets for the content they produce (Bergman et al., 2011; Buffardi et al., 2010; Kleek et al., 2015), or to improve their position within the metricised ordering systems of the various platforms they occupy (Gerlitz and Lury, 2017). In a different sphere, academic researchers increasingly mould their research outputs and directions to meet the measurable criteria of citation indices (Rijcke et al., 2015). In each case, the

reconceptualisation of the activity through specific metrics has an optimising effect wherein the activities are thought of in terms of measured aspects only rather than in terms that include aspects that are not easily measured. In other words, the hybrid-object is reconceived of primarily in terms of measured aspects that have high levels of performativity. This reshaping of the world in terms of those computational features is what can be called optimisation through performativity.

Optimisation through normativity

The second process of optimisation that occurs in the logic of computational hybrid-objects is that which is related to the existence or generation of norms. In this case, the optimisation occurs after the act of measurement and as such is already subject to the first form of optimisation discussed above. Thus this form of optimisation already follows from the selection of that which is considered valid knowledge. In particular, this second form of optimisation relates to the proposal for the existence of normal values for the metrics of abstract entities and by extension for those real entities contained within computational hybrid-objects. This concept of normative values, or normative behaviours, is that which Foucault develops in *Discipline and punish*, in which he elucidates the existence of the *normal* subject as s/he who is a rational subject with and in whom the good of society is embodied (Burchell, 1991: 142). Critically, however, Foucault's normal 'man' has as his complement the existence of the abnormal subject who sits outside of the realm of established norms. Whilst in *Discipline and punish*, Foucault highlights the necessity of this denormalisation in a judicial/psychiatric system of control; it is in 'governmentality' (Foucault, 1991) that he develops the idea of *good* governance. Good governance, the production of a harmonious social order by various forms of power, is, he proposes, related to the presence of *good* existence in both upward and downward directions. A position that proposes the adherence to and encouragement towards the norms of *good* living (be it in health, economics or social interaction) is the necessary practice of governance. This he notes is achieved through the practices of governmentality in which tactics exist to encourage the adherence to such norms of behaviour. He says,

> With government it is a question not of imposing law on men, but of disposing things: that is to say, of employing tactics rather than laws, and even of using laws themselves as tactics – to arrange things in such a way that, through a certain number of means, such and such ends may be achieved. (Foucault, 1991: 95)

It is, as Ian Hacking notes in his contribution to *The Foucault effect* (1991: 83), no surprise that the idea of norms and governmentality are associated with the history of statistical measurement, abstract entities with which to relate to a population, from which the *normal* can be separated from that those who are not.

Optimisation through normativity then is that which proceeds through the idea of normative values to which the computational part of a hybrid-object can be compared. Furthermore, certain values are implied as being within a normal range or around which certain normative directions exist (an increase or decrease in a particular numerical value for example). Following from optimisation through performativity, optimisation through normativity is the manipulation of hybrid-objects through the frame of those features that have been made computable through measurement.

In other words, hybrid-objects live in a world in which not only can their construction be compared on equal terms with others, but where normative values for those constructions exist. So, there is a right number of steps, a right number of friends, a right amount of time spent having sex, a right pattern of genetic markers – or even a right postcode, race, gender that is considered preferable. Thus, in the creation of hybrid-objects, the physical subject is exposed to the process of optimisation. As we have seen, nothing can be optimised of itself; optimisation requires an *objective function*. In Foucault's terms, the creation of abstract versions of real-world bodies subjugates them such that their control or manipulation is made possible. In the case of the hybrid–objects of computation, those things that can be or are measured become subjects with respect to these objective functions.

The politics of optimised entities

Hybrid-objects exist as both normative and normalising structures – i.e. they are generated through the idea of normative modes of existence but also help to generate the norms that legitimate the use of measurable and optimisable computational structures. As such optimisation through normativity expresses Foucault's power dynamics in the sense that norms act to separate that which is *normal* from that which is not. However, at the same time, the reconceptualisation of phenomena in computable forms acts to produce hybrid-objects that can be subjected to control through the measured parts of their existence. Thus the act of measurement that gives way to optimisation can be related to the modern urge to annihilate ambivalence that Bauman (1991) highlights as central to the logic of modernity. Ambivalence represents that those parts of existence that remain outside of classified or computable understanding, but also out of generally conceived norms. This can be seen, as in the examples above, in the increasing preponderance towards bringing ever-new areas of life into schemes of computation.

In the case of the abstract entities created as part of hybrid-objects in contemporary society, these normative values do not always appear to be generated monolithically, for example by the state (as in Foucault's ideas of governmentality). Instead, norms are generated from disparate sources, be they governmental, institutional, commercial or social. The contention that 'if you can't measure it you can't improve it' is a tenet of neo-liberal technics and management science. However, given that norms appear generated from a multitude of sources, including by individuals themselves, what is proposed here is that the very act of measurement creates the possibility of optimisation, by the reconceiving of that which is measured as a computable and controllable subject. What can also be seen, however, is that abstract entities are composed of the types of highly performative knowledges that can easily be shared, transferred, encoded and decoded independently of that to which the knowledge pertains. As computation encodes phenomena in such a way that they can be decoded at another point upon the network (be it a physical network or networked understanding of a concept), certain types of non-performative knowledge cannot be

transferred. For example, the subjective and embodied forms of knowledge that cannot be encoded externally to their holder cannot be encoded computationally. Thus in understanding the contemporary logic of computation, it is necessary to recognise that the subjects of computation reflect political choices about the legitimacy of different forms of knowledge. Furthermore, the types of knowledge that are considered legitimate are those that allow hybrid-objects to be compared and computed such that they can be understood in terms of normative values. Thus that which is not measured, or not measurable, is considered as primitive, ambivalent or abnormal (as demonstrated in the works of Lyotard, Bauman or Foucault discussed above), but more importantly, cannot exist within a society built around a logic of computation.

The combination of these effects is that the hybrid-objects of contemporary society become increasingly conceptualised as functional units through their abstracted measurable elements. Thus their existence is conceived of not only as subjected to those parts that are capable of being measured but as subjects that can be altered in order so that these measured aspects are brought within the bounds of given norms. Taking as a parallel, for example, the British land enclosures in the 17th and 18th centuries, the act of enclosure reconceived of the land as an improvable subject within a fixed set of metrics, and as such as a productive entity within a capitalist system of production. By enclosing land, it became possible to measure its economic productivity and to compare this to other pieces of land that could be measured as having similar traits. Enclosure, however, also meant the division of previously common space into one privately owned space in which use became strictly defined (in the general case for the production of food). A similar action takes place in the logic of computation. Measurements, such as physical tracking, social profiles or credit scoring, are forms of enclosure that create abstract subjects of those elements of physical existence. In so doing they conceive of them as functional which exposes them to control as optimisable units of a particular political, economic or other regimes. This *being functional* strips individuals of those elements of humanity that unmeasured remain without function, their *being without function*. Measurement thus exists as the first and necessary step in

reframing the lived world in terms only of its measurable functions - thinking of the world through what it *does* rather than what it *is*. This choice, as we have seen, is not determined by the nature of phenomena themselves but is a political choice of what is valued, and how we value it.

The question of objective functions normative values and performative knowledge bring to the fore the question of legitimation. As described by both Foucault and Lyotard the question of what knowledge is allowed to be described as legitimate is linked with the ethico-judicial questions of who is allowed to describe knowledge as legitimate or to promulgate such knowledge as law or norm. However, as the tendency towards optimisation does not appear to be monolithically generated (through state or institutional power), it can be suggested as stemming from the process and result of measurement itself. This contemporary condition that knowledge legitimacy has been decided towards the primacy of the measurable and thus is therefore inseparable from the tendency towards optimisation. This suggests that the way in which knowledge is conceived of in computational societies is a necessary precursor to understanding the way in which computational power is expressed.

In short, the measurement processes that are at the centre of the logic of computation that pervades contemporary society act to reconceptualise human life as a collection of functional subjects such that they can be manipulated and controlled. Once conceived of in this way, the question of how and to what end this control operates, these questions of objective function and the tools we use to describe it, become fundamental questions of politics in contemporary computational society. Preceding this, however, how we create the hybrid-objects of computation and the way in which we understand that which can and cannot be measured, must also become a central part of contemporary critique, if we are to generate meaningful understandings of an increasingly computational world.

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