Software-Sorted Geographies

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Abstract

This paper explores the central role of computerised code in shaping the social and geographical politics of inequality in advanced societies. Arguing that 'software-sorting' techniques are now being widely applied in efforts to try and separate privileged and marginalised groups and places across a wide range of sectors and domains, the paper analyses recent research addressing three examples of software-sorting in practice. These address physical and electronic mobility systems, online Geographical Information Systems (GISs), and face-recognition Closed Circuit Television (CCTV) systems covering city streets. The paper finishes by identifying research and policy implications of the diffusion of software-sorted geographies within which computerised code continually orchestrates inequality through technological systems embedded within urban environments .

Key Words

Code   Software-Sorting   Surveillance   Unbundling   Inequality   Remediation

Mobilities   Geodemographics   CCTV

I Introduction: Code and the Remediation of Inequality

"The modern city exists as a haze of software instructions"

(Amin and Thrift, 2003, 125).

"Values, opinions and rhetoric are frozen into code"

(Bowker and Star, 1999, 35)

Computer software mediates, saturates and sustains contemporary capitalist societies. Enrolled into complex technoscientific and machinic systems, stretched across time-space, a vast universe of code provides the hidden background to the functioning and ordering of such societies (Lessig, 1999). The flows, mobilities, and transactions; the folded geographies of inclusion and exclusion; the construction, consumption and experience of place; the very operation of distanciated webs of production, distribution, and consumption – all, very literally, are now *performed* -- at least in part -- through the continuous agency of vast realms of computer software.

With computerised systems now actually becoming the 'ordinary' socio-technical world in many contemporary societies (Amin and Thrift, 2002), code orchestrates a widening array of public, private, and public-private spheres and mobility, logistics and service systems and spaces. These are based on ubiquitous, pervasive, inter-linked arrays of computerised spaces, systems, and equipment which increasingly blends seamlessly into the wider urban environment (Thrift, 2004a, Cuff, 2002). The technosocial complexes of code, and their supportive hardware and organizational systems, have variously been described in terms of a kind of 'immanent domain'

(Cuff, 2002), 'ubiquitous computing' (Hunter, 2002), an 'invisible city' (Latour and Hermand, 1998), a 'surveillant assemblage' (Haggerty and Ericson, 2000), or a proliferating array of 'Automated Socio-Technical Environments' (Lianos and Douglas, 2000). However one describes them, code-based technologised environments continuously and invisibly classify, standardise, and demarcate rights, privileges, inclusions, exclusions, mobilities and normative social judgements across vast, distanciated, domains (Graham and Wood, 2003, Bowler and Star, 1999, Thrift and French, 2002).

Given all this, it is curious that remarkably little attention had been paid to "the millions of lines of code that have come to run cities as computing power has increased and as many former bodily practices have been written into code" (Amin and Thrift, 2002, 125). What Nigel Thrift and Shaun French (2002, 309) term the *automatic production of space*, through the simultaneous enaction of multiple, interacting worlds of computer software, remains largely ignored in human geography and social science more generally. Sunk in the taken for granted background of everyday life, these worlds of code exert their power over the geographies and lifeworlds of capitalism continuously and powerfully, but with scarcely any analytical or day-to-day scrutiny. This invisibility contrasts markedly with the burgeoning library of volumes which now exist which address the connections between new technologies and urban life more generally (Graham, 2004a). Thus, it seems, "code is in some sense invisible compared with its computer carapace" (Amin and Thrift, 2003, 125).

As the opaque and esoteric worlds of code operate to directly shape the practices and possibilities of everyday life in ever extending ways, so the analytical challenge is thus to excavate the worlds of code as critical political, social and geographical sites requiring urgent understanding, regulation and intervention. "Software challenges us to understand new forms of technologies politics and new practices of political invention, legibility and intervention that we are only beginning to comprehend as political at all" (Thrift an French, 2002, 331). Encouragingly, a range of recent work in geography, sociology, technology studies and allied disciplines, is starting to make real progress in unearthing the ways in which contemporary capitalist societies are continuously brought into being through code. Such work reflects a broad shift in social scientific analyses of new media and information technologies. Such work has turned away from discussions suggesting that such technologies offer access to some 'virtual' domain which is somehow distinct and separable, in some binary way, from the 'real' spaces and places of cities and material urban life (Woolgar, 2002). In their place, much more nuanced and sophisticated approaches are emerging. These stress that new technologies are intimately involved in the fine-grained and subtle transformations, or 'remediations', of place-and space-based social worlds (Bolter and Grusin, 2000, Graham, 2004a,b, Haythornwaite and Wellman, 2002). Far from being separated domains, then, such perspectives underline that the coded worlds of the 'virtual' actually work to continually constitute, structure, and facilitate the place-based practices of the material world (Dodge and Kitchen, 2004, 198).   Castells (1996, 373) calls this the shift from 'virtual reality' to 'real virtuality' (see Dodge and Kitchin, 2004).

The purpose of this paper is to provide a critical review of emerging work on the relationships between the worlds of code and human geography. This is undertaken as a means of taking stock of this emerging body of work and to suggest directions for future research. The specific focus here is on the ways in which software code actively shapes and structures social and geographical inequalities within and between places in a wide variety of ways. In what follows, I review emerging research which addresses three particularly important domains where social and economic inequalities within and between places are directly mediated, and shaped, by hidden worlds of code. These address, in turn: spaces of physical and electronic mobility, the production and consumption of urban neighbourhoods via online Geographical Information Systems (or GISs), and the growth of facial-recognition based Closed Circuit Television (or CCTV) covering city streets. Before reviewing these three bodies of work, however, it is necessary to place coded geographies of inclusion and exclusion within their wider political economic contexts.

II 'One Person's Infrastructure is Another's Difficulty':
Software Sorting and Political Economies of 'Unbundling'

To capture the ways in which software code mediates contemporary social worlds automatically (i.e. with little immediate human supervision), with very little delay (i.e. in real time), and continuously, I coin the term 'software-sorting' (Graham, 2004c). Software-sorting is a critical landscape of power within what Jeremy Rifkin (2001) has termed the 'age of access'. Rifkin uses this term to describe the way in which individual and collective life chances are shaped increasingly by their treatment within computer-controlled, customised, service domains. These, Rifkin argues, are

incraesingly orchestrated through technological networks which are rigidly structured using consumerist criteria. Such systems enrol selected, privileged users whilst precisely controlling access for those deemed unprofitable, risky, or deviant.

Software-sorting is the means through such selective access is organised (Graham and Wood, 2003). Such processes operate through a vast universe of what Michel Callon (1986) has termed 'obligatory passage points'. These are particular topological spaces within socio-technical systems through which actors have to 'pass' in order that the system actually functions in the way that dominant actors desire. The obligatory passage points within software-sorting systems involve a burgeoning array of subscriptions, passwords, service entitlements, physical and virtual access control points, electronically surveilled passage-points and transaction systems, automated, biometric judgements, and normative databases -- all of which are enacted and sustained through code and computerised systems (see Lyon, 2003a).

Software-sorting captures the crucial and often ignored role of code in directly, automatically, and continuously allocating social or geographical access to all sorts of critical goods, services, life chances, or mobility opportunities to certain social groups or geographical areas, at the direct expense of others (Lyon, 2003b). Such an emphasis is made more important by the ways in which software-sorting techniques are currently being overwhelmingly mobilised to help restructure and recommodify many previously 'public' domains of everyday life within western capitalist nations, as part of the elaboration of neoliberal models of state construction and service provision (Graham and Marvin, 2001). Of course, this is far from being

some simple, deterministic, or one-dimensional technological shift. But without software sorting techniques, many major infrastructural and material transformations, based on the application of neoliberal political paradigms to a wide range of social and economic contexts, would be all but impossible. Examples include electronic road pricing, 'bypass' immigration based on biometric IDs, 'virtual' and competitive electricity markets, internet systems where the 'packets' of data are individually prioritised, geodemographic consumption systems, facial recognition closed circuit television on city streets, and electronic tagging systems for low-level offenders. The widening application of software-sorting techniques thus needs to be seen as a crucial, facilitating dimension in the broad shift from Keynesian welfare states and public domains to 'splintered', post-Keynesian regimes of infrastructure, service, and space production and consumption (Graham and Marvin, 2001, Brenner, 2004).

Lianos (2003, 424) argues that this transition involves a broad process of *desocialisation*. In this, discourses or paradigms emphasising universal or quasi-universal rights of access or consumption, based on Keynesian ideas of citizenship, cross-subsidy, monopolistic control, universal service, and electromechanical or bureaucratic technologies, are being replaced -- or at least complemented – by new software-sorted modalities of power.   Often intensely individualised and commodified, the immense transactional flexibility and surveillance power of software-sorting means that the essential infrastructures, spaces and services of everyday can thus undergo a process of 'mass-customisation' (Andrejevic, 2003) or 'unbundling' (Graham and Marvin, 2001).

In essence, then, software-sorting is being overwhelmingly used to undermine the classic characteristics of urban public goods,[1] allowing these limits to recommodification to be swept away (Pinch, 1985). Packaged, delivered through consumerist markets, sorted through the endless distinctions of geodemographic profiles, and linked closely to the surveillance of actual consume behaviours and desires, fully unbundled service and access packages thus become possible. Under pressure to maintain of increase profits, within the context of widespread privatisation and liberalisation, service packages geared towards more lucrative market niches can thus to be customised and 'splintered' from the wider societal fabric though software-sorting techniques (Graham and Marvin, 2001, Andrejevic, 2003). At the same time, less lucrative users of streets, mobility systems, services, electronic communications grids, and places can be electronically (and/or physically) pushed away and marginalised, again through software-sorting and machinations of code.

Such unbundling can allow privileged users to enjoy enhanced mobility, reliability, service quality, quality of life, or (real or perceived) freedom from risk, crime, congestion, or contact with (sometimes demonised or humiliated) Others (Young, 1999). "The mobility of some can", in short, "immobilise others" (Cresswell, 2000, 21). "One person's infrastructure" becomes "another's difficulty" (Leigh-Star, 1999, 390). Crucially, however, because most processes of software sorting are actually

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[1] [1]These are, first, the concept of 'joint-supply' (or non-rivalness) meaning that if a service, such as the national defense or legal system, is supplied to one person, it can also be supplied to all other persons at no extra cost. The second concept, 'non-excludability', means that once a supply has been built a user can not be prevented from consuming the service (e.g. traditional city streets), including infrastructure such as rural roads. Third, there is 'non-rejectability'. This means that once a service is supplied it must be equally consumed by all, even those who do not wish to consume it (e.g. traffic control systems) (Pinch, 1985)

invisible from the point of the users, these prioritisations are often not evident to either the favoured groups or places, or the marginalised ones.

It is crucial to stress, then, that the 'mobile publics' inhabiting the extending neoliberal geographies of flow and access that are the focus of so much recent work in geography, anthropology, and sociology (Lyon, 2003b, Sheller, 2004, Cresswell, 2001), are publics that are often prioritised, enacted, and kept apart, by hidden worlds of software-sorting. Certain caveats must be raised here, however. Such attempts at separation or secession are never simple, 'top-down' and dualistic. Transgressions of categories are almost always possible; asserted boundaries are almost always porous to some extent (see, for example, Bloomfield, 2001). The transitions surrounding software-sorting are also not simple, deterministic results of the powers of these techniques. It is important to remember that complex inequalities were always a feature of Keynesian or monopolistic service regimes and that the discursive egalitarianism that characterised such regimes often tended to contrast sharply with their highly unequal material effects 'in the ground' (Graham and Marvin, 2001). So we should be careful not to romanticise or over-emphasise the egalitarian achievements of modern, Keynesian models of service and infrastructure provision.

Notwithstanding such caveats, however, it is clear that the proliferation of social and geographical boundaries where discipline and division are at least *attempted* through the application of software-sorting techniques is a central, and poorly researched, feature of the contemporary social world (Garland, 2001, Jones, 2002).

III Code Space: Software-Sorted Mobilities

With these points in mind we can turn to our three reviews of particular software-sorted geographies. Our first – that of software-sorted physical and electronic mobility systems -- remains perhaps the least understood and researched. Considerable work has been undertaken exploring the ways in which complex assemblages of new technologies facilitate and mediate a whole range of mobilities (Urry, 2000). The blurring of new media into car systems (Sheller and Urry, 2000, Thrift, 2004b), logistics systems (Meyer, 2001), airport systems (Aday, 2004 a,b, Dodge and Kitcin, 2004), and street spaces (Andrejevic, 2003) has been increasingly reported. However, the specific roles of software-sorting systems in shaping social and geographical inequalities in physical and electronic mobility systems and spaces remain only poorly understood.

It is clear that physical mobility systems increasingly utilise powerful software-sorting techniques to address imperatives of profit maximisation, social control, or perceived risk minimisation. Emerging research by Aday (2004a,b) and Dodge and Kitchen (2004), for example, has successfully revealed the ways in which key physical mobility spaces such as airports can only sustain the astonishing transactional complexity now expected of them because they are saturated with, and, indeed, constituted through, complex sets of software-sorting and coding systems. Importantly, Dodge and Kitchin (2004a, 198) argue that the relationship between code and electronic and physical mobility systems like airports is qualitatively different from the relationship between code and other types of built of technosocial environment. In mobility systems they write that "the relationship between code and

space is *dyadic* – code and space are mutually constituted, wherein how the space is produced and used is predominantly mediated by code" (original emphasis). Dodge and Kitchin use the term 'code/space' to describe such environments. This they distinguish from 'coded spaces' like CCTV-surveilled streets, where code remains, thus far, more peripheral to the constitution of the built environment (ibid.).

1 Software-Sorted Airline Mobilities

Taking airports as paradigmatic 'code/spaces' and sites of ubiquitous tracking, it is now clear that "the control of international mobilities that cross *through* airports and border zones are effectively managed, filtered and screened *within* these sites" (Aday, 2004a, 1365, original emphasis). This work demonstrates that, traditionally, the use of machine-readable tags and tickets allowed all human, cargo, baggage and worker flows in and around airport spaces, and, indeed, airline systems, to be surveilled, tracked, and socially controlled with a high degree of precision. As computerisation of the multiple logistical and transactional systems involved has proceded, so an extending universe of software and code has started to orchestrate the burgeoning flows associated with the global airline system.

Importantly, from the point of view of software-sorting and social inequality, Aday (2004a) shows that such systems are being augmented by software-sorting systems where the identifier of a person is actually biometric – that is, a supposedly unique signifier scanned directly from part of the human body (usually a finger, face or iris scan). Initially – as at Schipol airport's 'Privium' system -- biometrics have been used to allow premium, business travellers to bypass conventional border controls.

Aday argues that the practices and framings of biometric approaches to software-sorted mobilities are deeply shaped by neoliberal ideologies. In particular, a politics of differential speed is established. Biometric techniques are used to "facilitate the ease of speed for trusted, 'good' and economically sound business travellers and yet impede the flow of 'bad guys' or secondary processing – where officers 'really don't care how long it takes' to process their entry".(Aday, 2004, 1370).

However, as biometrics shift from elite to mass usage, the prospects of travellers who can't display their body signature – 'illegal' migrants or asylum seekers, for example – worsen considerably. This is because the identification and tracking of such people will become much easier simply because they are subjects who attempting to travel around the world's airline system *without* their associated biometric tag moving through the parallel coded system.

Compounding the routine racial profiling or air travellers, which has deepened significantly since 9-11, biometric software-sorting techniques necessitate a massive global extension of interconnected databases, in order to match the deep association of bodies, flows and information at transnational scales. The diffusion of such techniques underline the fact that, as Aday concludes, "the airport is now a surveillance machine— an assemblage where webs of technology and information combine. Movement, and, increasingly, the body, identity, and objects are made legible, momentarily fusing with technology and virtual realism" (2004, 1375).

2 Unbundling Highway Spaces and the Quest for 'Real-Time' Road Pricing

Highway and urban transport systems are facing similar transformations (Graham and Marvin, 2001). In a detailed case study of the construction of the world's largest privatised, electronically-charged highway systems – the CityLink in Melbourne -- for example, David Holmes (2000) has underlined how scarce urban road space can become a priced commodity allocated to those who can afford it through software-sorting techniques. Whilst, like the central London congestion charge, access here is controlled through a fixed tariff, in some premium highways in California – for example I-15 highway in San Diego – software-sorting can actually display variable pricing in real time (Graham and Marvin, 2001, 253). This is based on algorithms which estimate exactly the level of price per journey that is likely to deter enough drivers to guarantee free-flowing traffic -- no matter how bad the congestion is on the surrounding public highway system.

Here we confront software-sorting to guarantee speed, and time saving, to affluent elites through a kind of neoliberal, technoscientific, urban bypass. Such techniques herald new urban geographies of differential mobility. In these software-sorting techniques can differentiate between various users based on their willingness, or ability, to pay for newly commodified road space. If EU proposals for satellite-based charging of all road users, based on assessments of their environmental impact, are ever implemented, similar technbiques could conceivably be used to force drivers to pay charges based on assessments of the environmental externalities of their vehicles.

3 The Internet: From 'Best Effort' to 'Squelching the Scavenger Class'

Remarkably similar techniques are also being mobilised, much more discretely, to sort people's access to a whole suite of electronic mobility, communications, and service systems (Winseck, 2002). The Internet, for example, was originally developed to accord all the 'packets' of information that flowed within it equal status. This was the so-called 'best effort' model of 'packet switching' where equal efforts were made to allow all packets to flow to desired destinations at all times. Now, however, the entire Internet is being reengineered into a corporately controlled system of systems dominated by a vast range of commercial services. As Dwayne Winseck notes, the technological architectures of the Internet are thus being reconfigured:

"by designing networks that put intelligence, resources, and capabilities back in the network[…]. Consequently, open network architectures are yielding to network designs that enhance network providers' ability to allocate resources, bandwidth, and speed to varying types of information and services. This is based on their relation to the network owner, revenue potential, class of user served, and judgements regarding the quality fo content" (2002, 182).

In the process, complex software-sorting techniques are now being enrolled, by the transnational media firms who run the Internet, to actually sift and prioritise each of the billions of data packets that flow over the 'Net at any one time. Whilst this will allow a guaranteed quality of service to premium users and prioritised services, even at times of major internet congestion, those packets deemed unprofitable will actually be deliberately 'dropped', leading to a dramatic deterioration in the electronic

mobilities of marginalised users (Graham, 2004c). Such strategies are closely linked

to the growing corporate control of domestic and mobile internet use, where 'home

portals' and coded cookies establish an increasingly commodified regime through

which multimedia conglomerates capture personal identities, enrolling them into

coded geographies of marketing and exchange, often without users' knowledge

(Luke, 2002).

Take, for example, the strategy of the most important manufacturer of Internet

routers, Cisco (2002). They have produced a telling document outlining the centrality

of software-sorting to the new Internet architectures that they are establishing.

Describing how premium internet services can now be offered to what they call the

"transactional/interactive data class" of users, the document also outlines how the

electronic mobilities of what they term the "scavenger class" will now be actively

impeded based on software-sorting of every single Internet packet. "The Scavenger

class [categorisation] is intended to provide differential services, or 'less-than-Best-

Effort"' services, to certain applications", the document suggests. "Applications

assigned to this class have little or no contribution to the organizational objectives of

the enterprize […]. Assigning a minimal bandwidth queue to Scavenger traffic forces

it to be squelched to virtually nothing during periods of congestion" (Cisco, 2002).

Such potent 'netscapes of power,' as Winseck (2002) terms them, are completely at

odds with the widespread surviving perception that the Internet somehow

intrinsically embodies deeply egalitarian exchange. "Far from being transparent

means of channelling information from one point to another," writes Winseck, the

emerging software-sorted Internet networks "are technologies of discrimination that

regulate information flows according to fine-grained criteria set by network owners. In essence gatekeeping functions have been hardwired into network architectures as part of the communication industries' strategies to cultivate and control markets" (2002, 1820).

Similar software-sorting techniques have also been shown to shape the results produced by supposedly unbiased search engines in ways that favour the affiliates of the transnational media conglomerates who own search engine companies (Introna and Nissenbaum, 2000). Moreover, as mobile phones emerge as peripatetic appliances mediating user's relationships with geographic and city spaces and services, so they, too, are opening up whole new realms of software-sorting (Andrejevic, 2003). Here, such techniques promise to customise 'mobile commerce' services to an individual's own consumption and mobility habits, targeting advertising spam for goods and services that are geographically and geodemeographically appropriate, as the user moves around the city. Individually tailored city maps will be directly customised to software records of users' consumption habits. Andrejevic points out that "time-space paths will be used as a strategy for customisation. Advertising and marketing appeals will be directed to consumers based on where they are in time and space." This, he believes, will usher in "a radical departure from the productive disciplinary surveillance associated with the institution of mass society (2003, 134).

4 Call Centres; The Politics of Differential Queuing

In our final example of software-sorted electronic mobilities, it is becoming apparent that even call centre telephone queues are now being differentially sorted based on value judgements about callers' economic value as customers (Graham, 2004c). Because call centres can detect the telephone numbers of incoming calls, and instantly check these against customer and geodemographic databases, they can use software-sorting techniques to queue 'good customers' for much shorter times than 'bad' customers.

"One of your best customers dials the national customer service number for your company", gushes the scenario in a marketing brochure from the Avaya Corporation (2000). "The ANI [Automatic Number Identification] database reveals the customer to be among the top 5% of your customers. [Our system] routes the customer at high priority. When the agent picks up the call, he hears a whispered announcement that this caller is 'Top 5'" (2000, 3)(sic.).

IV Code Place: Software-Sorted Cities

A substantial body of research has revealed the importance of geographical information and geodemographic systems (GIS's and GDIS's) in shaping the production and consumption of contemporary urban spaces (Goss, 1995, Curry, 1998, Phillips and Curry, 2002). With their tendency to exaggerate and reify homogeneously constructed 'ideal type' neighbourhoods profiles, and so to ossify spatial and social classifications, such techniques have been widely shown to underpin redlining and socially regressive location decision making and service planning (Pickles, 1995).

1 Geographic Information Systems as Urban Surveillant-Simulations

GIS's and GDIS's do indeed provide powerful urban software-sorting devices. Here code both surveils the social geographies of cities and provides the means to construct powerful, and highly biased, simulations and visualisations of those geographies (Graham, 1998). Unlike software-sorting in mobility systems just discussed -- and those operating public streets, as we shall shortly see-- geodemographic systems do not, yet, offer real-time mediations of cities and urban life. Rather, they are systems of surveillance and simulation that rely on what Phillips and Curry have called a "phenetic fix.' Linked to locational referencing, postcode data bases, mobile and electronic commerce systems, and geopositioning networks, this palimpsest of code is increasingly determinate in support self-reinforcing spatial categorisations. In the process, "databases become increasingly determinate: you become where you live" (Amin and Thrift, 2002, 45).

Thus the city thus itself becomes a software-based simulation, a fine-grained dynamic map of consumption and spending potential, as the large geodemographic bureaux now attempt to capture more and more direct consumption information into GIS-based 'data warehouses' from store credit cards, credit bureaux, direct marketing campaigns, Internet responses and the like (Graham, 1998). Goss (1995) outlines how such GIS-based systems become transformed from partial representations and simulations of some putative 'reality,' to effectively operate as *reality itself,* the basis for precise locational decision making and profit-driven targeting within large retailers :

"the GDIS (Geo-Demograpic Information Systems) is literally

represented as a construction, a "built environment" consistent, of

course, with the architectonic metaphors so pervasive in the discourse

on information technology. This architectonic metaphor effectively

gives substance to a language, reifying the binary code that

represents information as an alternate world, literally a data 'structure'

[...] The abstract data structure is then anchored to a direct

representation of reality, which leads to the conceit that the world of

the GDIS is itself another reality [...].A representation of the 'exteriority'

of the world is interiorized on the computer" (Goss, 1995; 143-4)

2 On-Line GIS, Software-Sorting, and the Remediation of Neighbourhoods

Crucially, however, Roger Burrows and Nick Ellison (2004) have demonstrated that

the reach and power of GDISs is now extending to directly shape the consumption of

neighbourhoods, the processes of individual and collective identity formation, and

the dynamics of housing markets and educational systems in extremely powerful

ways. Increasingly, GDIS and GIS-based representations of city spaces are directly

mediating the consumption of place through software-sorting systems that can be

accessed directly by consumers. Burrows and Ellison (2004, 326) argue that "the

informatization of neighbourhood consumption that online GIS websites of various

sorts makes available the informational resources by which strategically inclined

social groups are able to find 'their' place within complex and dynamic urban spaces"

(2004, 326).

As GISs emerge to dramatically remediate the consumption of housing, education and all manner of geographically specific services and attributes (at least for such 'strategically inclined' groups), so the processes of neighbourhood informatization take a crucial new turn. Comprehensive national web sites like upmystreet.com in the UK provide powerful postcode based searching devices through which coded algorithms deliver multidimensional analyses of everything from crime rates, school performance, house prices, environmental quality and hazards, pollution, and access to services. Customised maps and aerial photographs can be accessed, and virtual communities of 'like minded' people living in the neighbourhood can be accessed. In the USA such processes have gone even further. Using web sites like homestore.com, people considering moves can automatically sort through metropolitan social geographies to find neighbourhoods with the social and demographic attributes that most closely 'match' those of heir current location.

The current saturation of urban environments with a vast universe of tracking systems means that, very soon, dynamic and real-time geographical simulations of urban places will be accessible over the Internet. These attempt to match the social and demographic fluctuations of real places over various temporal scales (Burrows and Ellison, 2004, 329). Once such 'tracking' – of people, vehicles, consumption habits, and digital interactions – becomes routine, software-sorting techniques will move beyond crude, generalised, and 'lumpy' simulations of places accessible over PCs to offer real-time and fluctuating simulations to mobile and hand-held computers based on the real time-space flux of urban mobilities. Such systems will allow individuals to be "aggregated with that of other proximate mobile individuals in

order to construct fleeting geodemographic characterizations of any particular configuration of people in any particular place" (Burrows and Ellison, 2004, 329).

As a result of such applications it is now clear that the social politics of place, and the geographies on urban inequality, are being directly mediated by the sorting and simulation capabilities of online geodemographic software. The individual and collective preferences, and identities, of subjects are starting to impact upon the geographies of inequality through their active engagement with software-sorting systems. Through such systems "privileged social actors increasingly affect the social and political patterning and characteristics – and social politics – of their chosen neighbourhoods" (Burrows and Ellison, 2004, 334). Online GISs are being used to negotiate the social geography of cities. Such systems:

> "strategically, substitut[e] online search capacity for what was hitherto
> intuition […]. The use of information for ostensibly consumption and
> lifestyle goals will transform the contours of social citizenship.
> Essentially, individuals who are privileged in this way can be expected
> to separate themselves increasingly from a dependence of goods and
> services produced for collective ends – and, by extension, from the
> responsibilities that accompany these forks of collective consumption""
> (330).

Thus, as online GISs support a consumerisation of the consumption and production of urban social geographies, the real concern is that such processes will further support an unbundling of notions of universal urban citizenship that elsewhere, in my book with Simon Marvin, I have termed a process of splintering urbanism (Graham

and Marvin, 2001). Individualised, online-GIS based decisions and behaviour, based on self identities and reflective, lifestyle choices, are likely to allow socially powerful groups to further their secession from the wider space-times of the city, as they seek to locate in, and consume, the privileged, best serviced and highest amenity neighbourhoods. The algorithms that support such choices, simulations, orderings, and classifications – the very guts of online GIS systems – meanwhile remain completely opaque and utterly unscrutinised. Moreover, "aside from the initial programming of these systems and the naming of the classifications they use, there is little human agency at play in their day-to-day operation" (Burrows and Gane, 2004, 29)

When added to the proliferation of privatised mobility infrastructures and defensive, gated, private communities in many cities, the predominant use of online GISs by relatively affluent, powerful and technologically literate groups seem likely to provide new 'secessionary networked spaces' (Graham and Marvin, 2001). These seem likely to work to further undermine concepts of universalised, redistributive politics based on integrative and public notions of city governance operating to ameliorate social inequalities across metropolitan scales. This is particularly so as marginalised subjects and communities in cities often remain largely unable to engage in the online GISs that are so rapidly remediating the production and consumption of urban places for more affluent. groups "Lacking the requisite virtual and material resources, these groups are less able to shape forms of social politics capable of protecting, let alone extending, the public services and accompanying collectivist ideologies n which they continue to depend" (Burrow and Ellison, 204, 335). Such conclusions, however, must remain speculative because very little research has actually yet been

done on the ways in which online GIS systems are influencing the production, consumption and experience of geographies of urban inequality.

V Code Face: Software-Sorted Streets

Our final exploration of the extension of software-sorting techniques addresses the proliferation of 'algorithmic' closed circuit television systems, covering city streets and public places, which attempt to automatically recognise peoples' faces using inputted image databases. Building on the massive and rapid diffusion of analogue CCTV, which relies on the (expensive) 'MK1 eyeball' of human operators scanning monitors and recording footage using banks of domestic-style video recorders, a major effort is now being made to install much cheaper, automated, facial-recognition, or 'event-driven' CCTV in the place of such systems (Norris and Armstrong, 1999). Often such systems take advantage of the installation of broadband and internet infrastructures with their ready multimedia capabilities. The 'surveillance surge' that has followed the 9/11 attacks, as a vast 'security-industrial complex' has attempted to sell 'silver bullet,' technologised solutions to the perceived fears of 'terrorism,' has added further momentum to the digitisation of CCTV (Zureik, 2004, Lyon, 2004, Gray, 2003).

1 The Face as Bar-Code: Face-Recognition CCTV and the Automation of Street Surveillance

In digital, facial recognition CCTV, the software-sorting process involves the inputting of the facial, biometric imagery of a 'target' population which computer algorithms

then actively seek out. Crucially, this inputting tends to go on without the subject's consent: "unlike other biometrics [facial recognition CCTV] can operate anonymously in the background" (Koskela, 2003, 2). The code within the facial recognition system becomes a key political site because its operation automatically stipulate the subjects, locations or behaviours that are deemed by the operators to be 'abnormal', 'threatening' and worthy of further scrutiny or tracking.

As well as stipulating the digitised signatures of 'target' faces, software-based CCTV can also be programmed to search for the signature walking styles that are deemed to be most often used by those committing criminal acts, for the number plates of suspect cars, even, when linked with microphones or smelling sensors, for stipulate suspect sounds or smells (Hook, 2001). One report on the growth of such automated, 'intelligent', detection systems, from a leading CCTV industry representative, explains the process through which software is designed to 'target' apparently abnormal behaviours, presences, and people, bluntly. "Recognising aberrant behaviour", it writes, "is for a scientist a matter of grouping expected behaviour and writing an algorithm that recognises any deviation from the 'normal'" (Hook, 2001, 20).

The social politics of software sorting is rarely described so succinctly. The report continues to describe how pattern -recognition and neural software could be embedded within facial recognition CCTV to support a much wider automatic search for the supposed signifiers of social pathology. "If the sensors were to 'see' a leg moving back and forward but the torso remaining still," it continues, "that might suggest that someone was kicking something rather than just walking along. Equally,

a milling crowd where none was expected or rapid movements of an arm might also trigger an alarm in the system" (Hook, 2001, 20).

The fact that coded algorithms can automatically monitor vastly larger domains of time and space and vastly larger CCTV camera networks than human operators adds to the sense that it represents a step-change in the power of CCTV (Graham and Wood, 2003). There are very real risks that the multiple 'islands' of private and public CCTV systems, each monitored by its own human operators, could quickly merge into much more massive and geographically-stretched facial recognition CCTV systems. Potentially, these could operate to exploit transnational divisions of labour, with operators, and their software-sorting systems, on the other side of the world from the CCTV 'eyes' themselves . Software sorting techniques provide scope to realise the clear economies of scale and scope that the obvious limits of human operation have, thus far, made impossible (Graham, 2002).

The proliferation of such systems raises a host of crucial political, social and ethical questions. The possible connections between facial recognition CCTV and the geographies of inequality are particularly worrying. What happens, asks Phil Agre (2003), when a person's face becomes a sort of 'bar-code' that is captured without their permission, and integrated into vast data bases allowing extending and interconnecting facial-recognition systems, potential, to track their movements continuously? "As the technology advances", writes Mitchell Gray (2003, 216), the clear risk is that "the software will effortlessly track individuals moving through urban space, public and private. Any appearance of a person deemed threatening can be

set to trigger an alarm, assuming that that person's face has been recorded in a linked database".

However, such fears must be balanced by the real problems involved in making face-recognition CCTV work on city streets even at a very local scale. Most trials of facial recognition CCTV have tended to operate within the narrow obligatory passage points of airport security checks and access control systems. Translating such systems to the open and extremely porous domains of city street systems, with people's facial images complicated by multiple angles, weather conditions, levels of light and appearances, is a major headache for digital CCTV operators. Early evidence from one of the first facial recognition CCTV systems in the world, the 'Facit' system at Newham in East London, certainly suggests that early generations of the technology, at least, rarely identify stipulated individuals effectively in open street situations (Meek, 2002). However, since this system was installed, major technological progress has ensured, although, as of 2003 "the ability to match a face in a crows [was] still elusive" (Norris, 2003, 271).

2 "A Biology of Culpability" : Embedding Prejudice into Code?

Importantly, the potential for effective recognition also varies heavily between different social or ethnic groups. An analysis by Lucas Introna of one trial of various facial recognition CCTV systems concludes, for example, that "for the top systems […] identification rates for males were 6% to 9% points higher than for females[…]. Recognition rates for older people were higher than for younger people" (2003, 20). Moreover, Introna quotes the official document which confirms that "Asians are

easier [to recognise] than whites, African-Americans are easier than whites, [and] other race members are easier than whites" (FRVT, 2002, 8)(sic.). Incorporated in to complex, ongoing software-sorting CCTV systems, the potential for such discrepancies to be translated into major geographical and social inequalities is clearly immense.

Three prime concerns arise here. First, there is the question of the invisibility of operation and design of such systems. Introna and Wood (2004) argue that the apparently mundane design decisions that go into facial recognition CCTV systems, and the code embedded in them, need to be opened up to scrutiny. They argue that the 'silent', passive and utterly invisible code within face recognition CCTV systems -- where even the location of the software-sorting process may be far from the gaze of the cameras – must be made visible if the configurations and implications of such software-sorting processes are to be exposed. This is a prerequisite, they argue, if any hope can be sustained that such systems can be brought under any form of democratic scrutiny and regulation (Introna and Wood, 2004, 195). The great fear, Introna and Wood argue, is that the racial, social or gender biases reported amongst operators of manual CCTV systems (see Norris and Armstrong, 1999), may be directly translated into the very facial recognition algorithms that are the basis for the software sorting process.

Second, Mitchell Gray (2003) argues that facial recognition CCTV systems decontextualise the behaviour of human subjects from their observation or detection. They remove the contingency of discretion and local knowledge that once characterised the way human law enforcement personnel decided whether to use

sanctions of force (Koskela, 2003, Norris, 2003). And they threaten to open the door to a widening universe of algorithmically policed systems which detect the supposed biometric or digital signifiers of social or individual pathology at a more or less considerable distance, as defined by a highly dubious set of 'scientific' sub-disciplines who have much to gain from the ubiquitous application of these technologies. Nikolas Rose (2000), referring to the emerging biocriminology which links code, surveillance, and genetic or biometric detection, calls this an emerging "biology of culpability." Here Gray (2003, 325) notes that micro-expression detectors are already being developed within the US military to detect 'unusual expressions' not supposedly associated with their location of behaviour.

Finally, there are grave dangers that algorithmically controlled CCTV systems might work to deepen already establish ecologies of normalization, and demonization, within neoliberal urban landscapes of power. Exaggerating logics of exclusion against 'failed consumers,' the young, refugees/asylum seekers, or other demonised minorities, within the increasingly polarised landscapes of contemporary cities, these very logics could, conceivably, be embedded in biases within the very code that makes facial recognition CCTV systems work (see Reeve, 1996). Indeed, it is conceivable that such biometric and individualised systems could destroy the anonymised interactions that have long been central characteristics of city spaces. A new ontology of the body could be ushered in which uses software-sorting techniques to continuously police and stipulate notions of the purported value, fitness, riskiness, worth and legality of subjects, based on the continuous scanning of a whole suite of biometric signatures, as people move within and between city spaces (Van der Ploeg, 1999).

To Phil Agre (2001), such a shift would could usher in a "tremendous change in our society's conception of the human person. People would find strangers addressing them by name" in previously anonymised encounters in city streets and commercial spaces. More worrying still, normalised, commercial judgements, based on continuous connections to credit registers and the like, could cement the processes of consumer marginalisation to this new logic of personalised monitoring and (Agre, 2001, 3).

VI Conclusions: Towards a Spatial Politics of Code

This paper has sought to underline the centrality of software-sorting in structuring contemporary social and geographical inequalities. It has also attempted to illustrate the need to maintain a broad, multisectoral perspective which can capture how different software-sorting techniques are encroaching across different dimensions of contemporary societies. Given the limited space available here, I would like to finish by briefly underlining four central questions raised by this discussion.

First, it is very clear from this discussion that software-sorting must be at the centre of any attempt to conceptualise the formation, maintenance and experience of social and geographical inequalities within contemporary capitalist societies. A pressing imperative for human geography, in particular, is to fully address, and excavate, the power of code and software-sorting techniques in continually orchestrating the geographies of contemporary inequality. Software-sorting techniques are diffusing rapidly to mediate the production, consumption ad

experience of physical and electronic mobility systems and spaces, urban neighbourhoods, a whole plethora of service, finance, and communication systems, and even city streets. So powerful and invisible have such domains of technosocial power become that geographers and other social scientists addressing social inequality will surely face nothing short of a paradigm crisis of irrelevance if they do not address them with much more sophistication, energy and urgency than they have done hitherto. As Amin and Thrift suggest, software-sorting techniques "are becoming one of the chief ways of animating the city. They must not be allowed to take us unaware" (Amin and Thrift, 2002, 128).

It is therefore time for a concerted, multidisciplinary effort to try and open up the 'black boxes' that trap software-sorting, and the cultural and spatial politics of code, within their esoteric, largely unknown, and almost completely opaque, technocratic worlds (Eischen, 2003). For, crucially, software-sorting practices "must become transparent if we are to evaluate critically the politics of mobility," as well as those of inequality, citizenship, the city, and the body, more generally (Aday, 2004a, 1377).

This paper has begun to demonstrate how, through the application of software-sorting techniques, whole swathes of the urban public realm and the essential private and pubic services of advanced industrial nations are being 'mass customised', unbundled, commodified, individualised, and co-ordinated through networked technologies linking scales from the globe to the body. This is being accomplished based on combinations of neoliberal, consumeristic principles of governance, new technological assemblages, and intensifying surveillance capabilities. In post Keynesian, neoliberal contexts, it is clear that software-sorting

techniques provide critical political sites. This is especially so as, currently, they are being overwhelmingly implemented to address perceived imperatives amongst service providers of offering favoured groups and places enhanced services, rights and mobilities, whilst directly working to undermine the prospects of marginalised groups and communities.

Second, whilst the vague contours of software-sorted geographies outlined here are, indeed, now starting to become apparent, a whole range of vitally important research questions remain virtually unaddressed. In what ways, for example, do the inequalities that are constantly and automatically produced through software-sorting map on to the more familiar geographies and spatialities of inequality within and between contemporary cities? How do multiple systems of software-sorting interact and combine together? Do their redistributive effects multiply through positive feedback loops to favour and disfavour broadly the same individuals, groups and places? Do such compound effects reinforce broader trends that have been identified towards the 'splintering' of the sociotechnical and geographical fabric of contemporary cities (Graham and Marvin, 2001). If so, might this herald the onset, as Lieven de Cauter (2004) has termed it, of a sort of "capsular civilisation" dominated by the cultures and biopolitics of (attempted) separation, a vast infrastructure of continuous, digital filtering, and the cultural politics of fear? Or do these effects work in more complex and contraditory ways, as they interact with the more subtly biased practices that, I would argue, have tended to mark the service cultures of Keynesian and electromechanical service regimes?

A second group of key research questions surround the subjectivities of service use and mobility within software-sorted domains. How, for example, do such techniques influence the identities, experiences, emotions and perceptions of those on the receiving end of software sorting? Does the varying level of (in)visibility amongst such techniques -- for example between relatively invisible electronic mobility systems and relatively visible city street and physical transport systems -- affect such subjectivities and experiences?

A final group of research questions emerge when we consider the linkages between the widespread implementation of software-sorting systems and the extending spatial divisions of labour and mobility within neoliberal capitalism more broadly. What, for example, are the geographies of production, diffusion and operation of the vast universe of software-sorting systems now being implemented? How are they enmeshed within broader transnational divisions of labour within information and data processing industries and how are their 'front' and 'back-office' elements, linking the points of data capture to the moments of algorithmic judgement, geographically structured? Finally how do the social and normative judgements, and inclusions, that form the heart of these systems diffuse between different geographical, social and sectoral sites and contexts?

Our third critical conclusion concerns the practicalities and epistemologies of social research on software-sorting. How, for example, can social and geographical research aimed at excavating the social and spatial politics of code, and the impacts of software-sorting techniques on the production and experience of inequality, best progress? Given the opaque, fast-moving and deeply arcane nature of this crucial

new realm of produced inequalities, how can social and geographical research hope to genuinely address this challenge? Given the inevitably confidential, proprietary and highly technical nature of the core algorithms that now socially-sort so many key social domains, what research techniques and paradigms can offer any genuine assistance here? Clearly, the research challenges here are truly immense. This is especially so given that, from the point of view of social geographic research, the worlds of software-sorting tend not to be amenable in any meaningful way to traditional geographical or social scientific research techniques and conceptualisations (Thrift and French, 2002).

This paper's final conclusion raises the question of appropriate political responses to the spatial politics of software-sorting. How can regulation, policy and resistance address the rapid and multi-scaled diffusion of automated software-sorting techniques across contemporary societies? When such techniques tend to rely on their true opacity and topological configuration to elude any real attempts at public regulation from polities which are necessarily jurisdictionally-embedded, how can states and policy makers begin to respond? In what ways can policy makers, in the diverse reams now affected, truly gain knowledge of, and leverage over, the software-sorting techniques that are embedded at the heart of the emerging inequalities? What policy instruments might best address these fast-moving domains, bringing standards, transparency, and democratic oversight where at present there exists a universe of unfettered, 'frontier' technoscience? Can such policy makers avoid the ever-deepening encroachment of software-sorted techniques, and the resulting emergence of societies where a universe of electronic code continually works to imprint neoliberal and consumerist logics-- with virtual

invisibility -- on to a growing proportion of social and economic exchanges? And what scope is there for creative resistance through which social movements, activists, and participatory technological spaces, can work to infiltrate and expose the inequities that are being digitally encoded into such routine, but essential, transactions?

In addressing this wide research, policy and activist agenda, the challenge is to maintain a critical and informed position without falling foul of dystopian and absolutist scenarios suggesting that software-sorting techniques are somehow limitless and all-powerful. As Koskella (2003) suggests, "urban space will always remain less knowable and, thus, less controllable than the restricted panoptic space". Spaces which escape the reach of software-sorting systems do and will remain. A politics of transgressing, resisting, and even dismantling software sorting systems is possible. And, crucially, as Ash Amin and Nigel Thrift put it, the:

> "networks of control that snake their way through cities are necessarily
> oligoptic, not panoptic: they do not fit together. They will produce
> various spaces and times, but they cannot fill out the whole space of the
> city – in part because they cannot reach everywhere, in part because
> they therefore cannot know all spaces and times, and in part because
> many new spaces and times remain to be invented" (2002, 128).

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Acknowledgements