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PRECONSTITUTED PANEL: OPTIMIZING OUR NETWORKED LIVES

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“Don’t just live your life, optimize it,” reads the headline of a wry New York Times editorial from February 2020, criticizing the embrace of technology to better manage every waking (and sleeping) moment. Can communication networks deliver a better life? How might network engineering be a form of social engineering? For this year’s special theme on ‘life’ our panel aims to interrogate questions around optimizing life through networked and mediated spaces.

We use the term *networked optimization* to emphasize a sustained but changing set of techniques, technologies, and calculations to decide the best life -- the optimal -- through infrastructures, design, mathematics and engineering. Optimization is a vital concept at a time of critical interest in infrastructural power. Usually defined as doing actions to make the best or most effective use of something, our panel highlights the different uses of the term across the internet. Used as a selling point by many technology companies, optimization means different things to different actors. Perhaps the most important question on this is optimized for who?

Network optimization is a new twist on enduring myths around technology. Technology has always been a tool to optimize different aspects of our lives. As our panelists suggest, today’s enthusiasm for networked optimization draws on myths as old as Carey and Quirk’s electric sublime. Sales pitches for the latest cloud services resemble the promise of what Paul N. Edwards’ *closed world’*, one manageable in real-time and

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sold to the American government. Our panel then draws on a rich theoretical history to describe today's networked optimization.

From Facebook to 5G, our panelists work across technical and theoretical literatures as well as computer science and humanities to identify the social implications of networked optimization. Author #1 examines how Facebook's personalization ideology is engineered into its infrastructure to influence people's behaviors to maximize its advertising value. Author #2 looks to the discourses and infrastructure of Google's cloud computing that promise a form of global social engineering. Author #3 takes these questions out of the cloud and into the next-generation of the Internet, 5G. The promised new wireless infrastructure makes a major shift in the meta-governance of communications and re-consolidates power in network operators. Finally, Author #4 looks for forms of resistance through the development of Protective Optimization Technologies that help people counter efforts to nudge and shape their behaviours.

Each of the panelists responds to one of four critical questions for optimization:

1. What are the myths and discourses that legitimate and programs technologies as forms of social engineering? How do these discourse erase boundaries between humans and A-Life?
2. Who or what decides the optimal? How do infrastructural and institutions changes re-situate calculations of the optimal? How does mathematical states stand in for political ones?
3. How do different companies imagine and construct different ways to optimize life and living on the digital life? What types of tools, measurements and importantly - values do they bake into their design to achieve optimization?
4. How do people understand, negotiate and perform optimization? How do different communities develop tactics to disobey/distort/rebel/protest media corporate strategies of optimization? And especially, how do different groups of people, such as people of color, women, disabled, and older people challenge notions of optimized life?

Optimization has been sold as an ideal way of living. But as societies across the world start to be critical of the benefit of technologies and networked infrastructures, this panel seeks to reveal the politics behind this idea. In a broader sense, the panel aims to question the technological deterministic ideal and asks whether technology is the solution to our everyday life problems, dreams, desires and fears.

PERSONALIZATION AS OPTIMAL (DIGITAL) LIFE: ORDERING PEOPLE'S BEHAVIOR TO CREATE A PERSONAL EXPERIENCE

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"To help personalize content, tailor and measure ads, and provide a safer experience, we use cookies. By clicking or navigating this site, you agree to allow our collection of information on and off Facebook through cookies". If this statement sounds familiar it is because most websites, services and apps have a similar phrasing of this 'agreement'. Presented in small boxes in different parts of your screen, these are in fact contracts whereby people are told that they will be tracked and their data traded because that is what is needed to produce their personalized experience. This personalization, we are told, is how we should experience networked platforms - It is the optimal way of living online.

This paper explores the way 'personalization' is sold to us as the optimized way to experience platforms, and how it is operated according to digital advertising logic. Specifically, the paper examines the way Facebook orders people's experience according to its Ad Auction mechanism running in the back-end to sell the 'real-time' and personal experience in the 'front-end'. The paper argues that using 'personalization' as the preferred interface design and engagement is meant to serve several functions: 1) Create profiles which can be sold as part of the digital advertising market; 2) Try to influence people's tempo-special experience to change their behaviour towards more value.

Facebook's Optimization Machine

To understand the way Facebook optimizes our experiences, this paper analyses the recently leaked documents of Six4Three company vs. Facebook's court case in California (Solon and Farivar, 2019). Throughout the years, researchers have struggled to study the platform with its limited access and even more limited details about the way different mechanisms it operates function. The leaks contain internal communications between different Facebook workers from 2011 to 2015. Analyzing these documents enables us to understand the way the company operates and its rationale, which are usually hidden from most people. Importantly, it enables us to understand the way the company conducts procedures to optimize different components of its platform to produce a specific sociality - personalization - that yield more value.

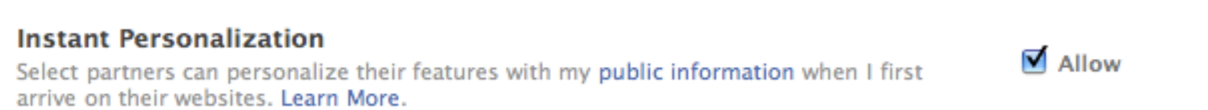
Orchestrating People and Objects with Rhythmedia

To examine the way Facebook optimizes different components of its platform to produce personalization, this paper proposes a media power new framework that instead of using optic concepts such as invisibility and black box, uses sound concepts - *processed listening* and *rhythmedia*. The first concept describes the way media companies “selectively tune into different sources through the media apparatus, by using several tools (which can be automatic or manual), in different temporalities, to produce different kinds of knowledge for various purposes (mostly economic and political)” (Author, 2019). In this way, people are rendered as rhythms (frequencies, durations, pauses and disruptions of behaviors, interactions with others, self-expressions etc.). For example, as the leaked documents show, people’s call rhythms were also listened to and recorded: “Product wants to use call log data (e.g.,duration/frequency/recency of incoming/outgoing calls/texts) to generate PYMK suggestions following contact import”. These data are being monitored, measured, and categorized to turn this knowledge into advertising profiles and audience segments. This knowledge is produced in the ‘back-end’ of platforms’ infrastructures (in this case, as part of Facebook’s Ad Auction) and stored in a dynamic database to then be re-ordered with rhythmedia at the ‘front-end’.

The second concept *rhythmedia* is complementary and Inspired by Raymond Williams’ *planned flow* and Henri Lefebvre’s *rhythmanalysis*. Rhythmedia is about power, space and time and especially intentions behind ordering these elements in a particular way that benefits a specific media company. Talking about the television, Williams’ *planned flow*, is about creating a feeling of natural rather than a planned disruption; to blur the lines between content and advertisements but especially to create an uninterrupted mediated feeling; to tune into the television 24 hours a day. Similarly, Lefebvre argues that the “[p]roducers of the commodity of *information* know empirically how to utilise rhythms. They have cut up time; they have broken it up into *hourly slices*. The output (rhythm) changes according to intention and the hour” (Lefebvre, 2004: 48). Both Williams and Lefebvre, then, were interested in the way media companies orchestrate pieces of data to create a specific output – a desired rhythm - according to intention and timing.

The politics of the personal

As the leaked Facebook documents show, Facebook also wanted to create a premium paid service called “Instant Personalization” which meant that people would experience personalization on other apps, websites and services. This was a default setting which meant that people were presented with this as the preferred way of using these spaces.



The leaked documents reveal that during the D8: All things Digital Conference in 2010, Walt Mossberg asked Zuckerberg “But shouldn’t people make the decision themselves to opt in on it?”. While Mark Zuckerberg’s answer was “No, so, I think that the, you know, making these products that people can share and that people have control, and that are simple to do both, is this balance, right and opt in versus opt out is one part of that balance, right…. Whether it’s through social plug-ins or connect or instant personalization or whatever programs other companies come out with but I just think the world is moving in this direction where links are going to be designed more around people um, and I think that it’s going to be a really power direction”.

This power that Zuckerberg talks about is the ability to make interventions in people’s experiences based on Ad Auction practices of bidding - “optimizing the user experience” as they call it. In their annual report from 2013, Facebook indicated that the value they provide for marketers is to “dynamically determines the best available ad to show each user based on the combination of the user's unique attributes and the real-time comparison of bids from eligible ads”. Bidding on Facebook through Ad Auction is a key element in the way that Facebook’s newsfeed ordering works and it consists of a combination of several factors: advertisers bid, estimated action rates and ad quality and relevance.

As Facebook argues in terms of the technologies they offer “an advanced user action prediction system that weighs many real-time updated features using automated learning techniques. Our technology incorporates the estimated user action rate with both the marketer's bid and a user relevancy signal to select what we believe to be the optimal ads to show”. With the dynamic archive of rhythms created Facebook’s processed listening practices, the company can know what would encourage people to engage more according to their past behaviours. Personalization, then, is a powerful economic model because different people are influenced to engage in different ways - People’s individual and personal past can be turned into a product to influence their future actions.

Conclusion

As this paper shows, personalization is the optimized way to experience Facebook - It shapes people’s experience towards a desired rhythm that yields more value. The company conducts processed listening, measuring their behavior across multiple spaces to produce an archive with their profiles which then inform how they (re)order the platform’s interface. In this way, rather than developing a ‘one-size-fits-all’ type of experience, platforms’ optimization procedures are aimed to create custom and individual experiences that can be monetized by these platforms and the advertising industry that funds them.

References

Author (2019).

Lefebvre, Henri (2004) *Rhythmanalysis: Space, time and everyday life*. A&C Black.

Solon, O., and Farivar, C. (2019). Leaked documents show Facebook leveraged user data to fight rivals and help friends. *NBC News*. Available at: https://www.nbcnews.com/news/all/leaked-documents-show-facebook-leveraged-user-data-fight-rivals-help-n1076986.

Williams, Raymond (1974) *Television: Technology and cultural form*. New York Routledge.

THE INTERNAL CODE IN EVERYTHING: KUBERNETES, OPTIMIZATION AND POWER

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"User data has the capability to survive beyond the limits of our biological selves," concludes a soft-spoken narrator over a tranquil piano score. The quote comes near the end of a 2016 concept video made by Google called the “Selfish Ledger”. Meant as a provocation, the Selfish Ledger speculates that data is a “constantly evolving representation of who we are” that might be enriched and made goal-oriented. Nudges and auto-recommendations could steer individuals and, in doing so, populations toward goals such as environmental sustainability. Eventually, the aggregated knowledge could result in, as the video concludes, a “species-level understanding” allowing “emerging generations” to learn from their ancestors' choices. My presentation reads the Selfish Ledger to describe one form of networked optimization, what I refer to as kubernetics (a spelling of the word borrowed from Google). Kubernetics integrates data, cloud computing and behavioural theory to manage individuals at the scale of populations.

My presentation contextualizes kubernetics part of the study of practices of power (Rose, 1999) involving the Internet. First, I provide a diagrammatics of the Selfish Ledger to highlight key features of kubernetics. Second, I describe how Google is building this Selfish Ledger through a review of its recent developments in infrastructure-as-service and cloud architectures. Finally, I conclude by arguing that kubernetics is an important concept to understand the emerging logistical worlds resulting from the instrastructualization of platforms and helpful in criticizing the type of power constituted by platforms as a political condition.

Part One: The Selfish Ledger

Foucault described the Panopticon as a “diagram of a mechanism of power reduced to its ideal form... it is in fact a figure of political technology that may and must be detached from any specific use” (Foucault quoted in Elmer, 2012). In the same way, Google’s Selfish Ledger offers a diagram of kubernetics reduced to its ideal form. The video begins by juxtaposing biologist Jean-Baptiste Lamarck’s outdated theories of genetics with personal data collected by Google sensors and stored in its cloud, what the video calls a ledger. Like genes, the video suggests, data is the “internal code in every living thing.” The ledger is “a constantly evolving representation” of the individual. Keeping with the biological analogy, the video continues to suggest that every genetics is both individual and collective -- using the evolutionary theorist Bill Hamilton’s idea of the selfish gene to suggest that individual behaviour simultaneously has collective consequences. Indeed, genes succeed even at the expense of the individual. The same applies to data and the ledger when individual choices could be attuned to the common good, which Google keeps vague beyond a short mention of health and climate.

Three qualities of kubernetics may be drawn from my description about:

- The desire to create operating systems at planetary scale composed of the sensors, smartphones and cloud computing as seen in the video's visual reliance on smartphones and data centers;
- Framing this operating system as a problem to be solved through calculation that evaluates every possible action against its optimal choice as when the video discusses how global health could be an end goal;
- Actualizing calculated optimalities through perpetual micro-transactions operating on individuals and on populations at once as in the video's discussion of general system of smart manufacturing to produce goods targeted at individuals.

These are characteristics of a mode of power operating not just in Google, but increasingly in other technology firms that include FAMG (Facebook, Amazon, Microsoft and Google) and BAT (Baidu, Alibaba, and Tencent). Each deploying and manage their operating systems to different ends (Author, 2018).

Part Two: From Borg to Kubernetes

The second part of the presentation explores how kubernetics rebuilds the Internet infrastructure through a close reading of Google's innovations in server operating systems. While Google is best known for its Android, Chrome and experimental Fuchsia operating systems, the company has more quietly invested in major advances in the design of server architecture from its secret Google Borg to its replacement, Kubernetes. Kubernetes, which attributes its name to the same Greek word for helmsman that inspired Norbert Wiener, actualizes the Selfish Ledger discussed above.

Kubernetes, according to Google, is a third iteration of server deployment, replacing traditional server deployment and virtualized deployment. Today, Kubernetes involves:

- The built server infrastructure referred to as clusters of kubernetes nodes;
- Abstracted into a control plane that manages the cluster's net computational capacity all managed by;
- The Kubernetes Engine that includes a Scheduler process making important decisions about the allocation of resources to;
- Containers or individual applications run on behalf of individual users.

Kubernetes is what runs the Google Cloud and actualizes speculative Selfish Ledger. Google's architecture:

- Operates at a global scale due to its novel Kubernetes nodes and clusters architecture;
- Centrally managed through the Kubernetes Engine Scheduler, making calculations of optimal performance;
- Deployed as separate instances of common programs, working at the individual-species level.

Kubernetics, as a mode of power, thus can be understood both as an abstract machine as well as in the built world, the expression of cloud computing today.

Conclusion: Practices of power and kubernetics

My concept of kubernetics contributes to the study of the Internet in relation to modes of power, most recently popularized by the concept of surveillance capitalism (Zuboff, 2019). Zuboff's blockbuster book legitimates long-standing attention to the managerial capacities of the Internet, better understood through the attention to the subjectivation properties of platforms-as-infrastructure (Langlois & Elmer, 2019), the lean platforms (Srnicek, 2017; Steinberg, 2019) as well as the Internet as logistical media (Rossiter, 2017; Sadowski, 2019).

With these contemporary concepts in mind, my presentation concludes by situating kubernetics and optimization within a longer and unfinished genealogy of modes of power. Inquiries into these modes include Foucault's concepts of discipline and governmentality as well as Deleuze's notes on what he called a control society. Their influence is an important part of early Internet studies with Wendy Chun (2006), Phil Agre (1994), Paul Edwards (1996), and Alexander Galloway (2004) being notable examples of theoretical inquiries into the changing possibilities of power through digitally networked technologies.

Kubernetics is an important concept to understanding the logistical worlds now enabled by cloud computing as well as understand the next-generation of infrastructural battles. While kubernetics might be a dominant mode of power today, Google is just one example of a player engaged in competition to expand the scale of its operating systems.

References

Agre, P. E. (1994). Surveillance and capture: Two models of privacy. The Information Society, 10(2), 101–127. https://doi.org/10.1080/01972243.1994.9960162

Author, 2018.

Chun, W. (2006). Control and Freedom: Power and Paranoia in the Age of Fiber Optics. MIT Press.

Edwards, P. N. (1997). *The Closed World: Computers and the Politics of Discourse in Cold War America*. MIT Press.

Elmer, G. (2012). Panopticon—Discipline—Control. In K. Ball, K. Haggerty, & D. Lyon (Eds.), Routledge Handbook of Surveillance Studies (pp. 21–29). Routledge.

Galloway, A. (2004). Protocol: How Control Exists After Decentralization. MIT Press.

Langlois, G., & Elmer, G. (2019). Impersonal subjectivation from platforms to infrastructures. Media, Culture & Society, 41(2), 236–251. https://doi.org/10.1177/0163443718818374

Rose, N. S. (1999). Powers of Freedom: Reframing Political Thought. Cambridge University Press.

Rossiter, N. (2017). Imperial Infrastructures and Asia beyond Asia: Data Centres, State Formation and the Territoriality of Logistical Media. The Fibreculture Journal, 29. https://doi.org/10.15307/fcj.29.220.2017

Sadowski, J. (2019). When data is capital: Datafication, accumulation, and extraction. Big Data & Society, 6(1). https://doi.org/10.1177/2053951718820549

Srnicek, N. (2017). Platform capitalism. Polity.

Steinberg, M. (2019). The platform economy: How Japan transformed the consumer Internet. University of Minnesota Press.

Zuboff, S. (2019). The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. PublicAffairs.

POWER AND OPTIMIZATION IN THE INTERNET ARCHITECTURE: THE PROGRAMMABLE INFRASTRUCTURE OF 5G NETWORKS

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There is a seemingly full consensus among governments, telecommunication providers, and network equipment vendors about the societal progress, innovation, and economic growth that will be achieved through the implementation of 5G networking technology (Selinis et al., 2018). The introduction of 5G will have a significant impact on the information architecture: it will alter the characteristics of how data is send, transported, filtered, and routed, as well as the parties that have access to it. Concerns about 5G have been framed either in the realm of concerns about electromagnetic fields and the warnings from the US government about security risks resulting from implementing Chinese networking equipment (Kaska et al., 2019). In this paper, I explore the power-shifts that come with sociotechnical and sociopolitical reconfiguration of the Internet architecture that happens with the introduction of 5G.

The Internet architecture, with its principal design principles of openness, end-to-end, and permissionless innovation, was developed in response to the centralized control over communication systems by telecommunication providers (Abbate, 1999; Russell, 2014). With the deployment of the new network infrastructure for 5G, which likely will be the main means of network access in urban environments, telecommunication providers are introducing a new architectural paradigm to produce a highly configurable network with less complexity and higher bandwidths. Different from what the name suggests, 5G is not an incremental development of 4G (Andrews et al., 2014), but rather a socio-technical and socio-political paradigm shift. This shift will empower telecommunication providers with significant controls over the network, and thus reinstate a telecommunication regime that bears resemblance to that of the pre-Internet age.

I build on science and technology studies and international relations to foreground how power and control are exercised through and over international information networks. I show how the sociotechnical imaginary of 5G, echoes a ‘rhetoric of the electronic sublime’ (J. W. Carey & Quirk, 1970) and a ‘nostalgia for the future’ (J. Carey, 1989, p. 200) that legitimize the shift from industry self-regulation (Sowell, 2012) towards an intergovernmental telecommunications governance regime (Drake & Wilson, 2008), that is being facilitated by telecommunications operators and equipment vendors. In order to do this, I operationalize my analysis through code ethnography (Rosa, 2019), the qualitative and quantitative document analysis of technical standards, and process tracing of standards development in the 3GPP. I subsequently leverage the theoretical lenses of socio-technical imaginaries (Jasanoff & Kim, 2015) and metagovernance (Torfing, 2016) to uncover ‘the agency of technology designers, policy-makers, and users as those interact in a distributed fashion, with technologies, rules, and regulations, leading to unintended consequences with systemic effects’ (Epstein et al., 2016).

The socio-political reordering of the network through the introduction of 5G finds its origins in institutional design. The current development of Internet protocols happens at the Internet Engineering Taskforce (IETF), where voluntary standards are developed through an open and participatory process. In contrast, telecommunications standards for mobile networks are developed by companies, national, and regional standards bodies that are organized in a membership organization called the 3rd Generation Partnership Project (3GPP). After the standards are developed in 3GPP, they move on for official standardization in the United Nations International Telecommunications Union (ITU). The standards that are sanctioned by the ITU are therefore obligatory standards. Traditionally, the 3GPP provides the standards for the lower layers of communication networks on which the IETF would standardize the Internet Protocol (IP) to produce the network of networks, which we know as the Internet.

With the advent of 5G, member organizations of the 3GPP have made it clear they want to replace IP based networks to reduce complexity, increase control by network operators, and address ‘challenges with end-to-end encrypted content’ (Sutton et al., 2016, p. 8). A shift in authority over Internet standards development would increase the influence by nation-states over information networks since only countries have a vote in the ITU, and ITU standards are binding, not voluntary as the current Internet standards are. This would alter the standards development process from the current participatory consensus process for open standards in the IETF, as well as the design of the Internet. The current Internet architecture is based on principles such as ‘decentralized control, edge user empowerment, and the sharing of resources’ (Alvestrand, 2004), whereas telecom operators aim for less complexity and unified control planes (Sutton et al., 2016).

The socio-technical reconfiguration of the network is the result of the installation of a new dense grid of antennas and routers that are needed to service new frequencies in the radio spectrum. This infrastructure investment brings about a new generation of technologies such as ‘Software Defined Networking’, ‘Network Function Virtualization’, and ‘Information Centric Networking’. The combination of these technologies produces a distributed network with centralized configuration functions that previously could not be implemented due to the reliance on expensive and inflexible hardware, instead of a programmable general-purpose infrastructure. The algorithmic optimization of the network, based on network data, can, for instance, be instrumentalized for the timely caching of content, targeted advertisement provision, as well as individual-level content filtering.

Aside from the shift in control over the standardization process to nation states, algorithmic optimization and the recentralized control over telecommunication networks will negatively impact the transparent, accountable, and configurable workings of the network for end users.

References

Abbate, J. (1999). *Inventing the Internet*. The MIT Press.

Alvestrand, H. T. (2004). *RFC3935—A Mission Statement for the IETF* (RFC-Series). IETF. https://tools.ietf.org/html/rfc3935

Andrews, J. G., Buzzi, S., Choi, W., Hanly, S. V., Lozano, A., Soong, A. C. K., & Zhang, J. C. (2014). What Will 5G Be? *IEEE Journal on Selected Areas in Communications*, *32*(6), 1065–1082. https://doi.org/10.1109/JSAC.2014.2328098

Carey, J. (1989). *Communication as culture: Essays on media and culture*. New York, NY: Unwin Hyman.

Carey, J. W., & Quirk, J. J. (1970). The mythos of the electronic revolution. *The American Scholar*, 395–424.

Drake, W. J., & Wilson, I. I. I. (2008). *Governing global electronic networks: International perspectives on policy and power / ed. by William J. Drake and Ernest J. Wilson, III*. MIT Press.

Epstein, D., Katzenbach, C., & Musiani, F. (2016). Doing internet governance: Practices, controversies, infrastructures, and institutions. *Internet Policy Review*. https://policyreview.info/articles/analysis/doing-internet-governance-practices-controversies-infrastructures-and-0

Jasanoff, S., & Kim, S.-H. (2015). *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*. University of Chicago Press.

Kaska, K., Beckvard, H., & Minárik, T. (2019). Huawei, 5G and China as a security threat. *NATO Cooperative Cyber Defence Center for Excellence (CCDCOE)*, *28*.

Rosa, F. R. (2019). *Global Internet Interconnection Infrastructure: Materiality, Concealment, and Surveillance in Contemporary Communication* [PhD Thesis]. American University.

Russell, A. L. (2014). *Open standards and the digital age*. Cambridge University Press.

Selinis, I., Katsaros, K., Allayioti, M., Vahid, S., & Tafazolli, R. (2018). The Race to 5G Era; LTE and Wi-Fi. *IEEE Access*, *6*, 56598–56636. https://doi.org/10.1109/ACCESS.2018.2867729

Sowell, J. H. (2012). Empirical studies of bottom-up Internet governance. *Proc. TPRC*.

Sutton, A., Li, R., Pillay Esnault, P., Foster, G., Han, L., Grasa Gras, E., Shepher, M., Sheng, J., Makhijani, K., Grant, J., Mohajer, M., Lopez, D., Day, J., Chenhao, Y., & Yinyue, M. (2016). *Next Generation Protocols – Market Drivers and Key Scenarios*. ETSI. https://www.etsi.org/technologies/next-generation-protocols

Torfing, J. (2016). Metagovernance. In *Handbook on theories of governance*. Edward Elgar Publishing.

Protective Optimization Technologies (POTs)

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As software engineering shifted in the 2000s from packaged software and PCs to services and clouds, enabling distributed architectures that incorporate real-time feedback from users [Kaldrack and Leeker, 2015], digital systems became layers of technologies, metricized under the authority of objective functions. These functions define the optimization objectives of, among others, the selection of software features, the orchestration of cloud usage, and the design of user interaction and growth planning [Author #4]. In contrast to traditional information systems, which treat the world as a static place to be known and focus on storage, processing, transport, and organizing information, systems produced under these logic of optimization consider the world as a place to sense and co-create. They seek maximum extraction of economic value by optimizing the capture and manipulation of people's activities and environments [Agre 1994; Curry and Phillips, 2003].

Optimization systems apply a logic of operational control that focuses on outcomes rather than the process [Poon, 2016]. While this introduces efficiency and allows systems to scale, they also pose social risks and harms such as social sorting, mass manipulation, majority dominance, and minority erasure. In the vocabulary of optimization, these systems create substantial externalities that arise due to the inadequacy of their objective functions to address the world.

Moreover, optimization systems hold great potential to shift power. The fast pace at which they manipulate users and environments obscures their effect, making it difficult to devise strategies to contest them. Optimization also often leads to asymmetrical concentration of resources in the hands of a few companies which can collect large scale data and muster the computational power to process these in the pursuit of financial gain [Hwang 2018, Poon 2016]. This centralizes governance and reconfigures market structures, creating an imbalance of power that benefits a select portion of society.

In response to the externalities and centralizing gist of optimization systems, we introduce Protective Optimization Technologies (POTs) which enable those affected by optimization systems to influence, alter, and contest these systems from the outside. POTs build on the idea that optimization systems infer, induce and shape events in the real world to fulfill objective functions. POTs analyze how events (or lack thereof) affect users and environments, then reconfigure these events to influence system outcomes, e.g., by altering the optimization constraints or poisoning the system inputs. We specifically conceive POTs to address the negative externalities of optimization.

Externalities of Optimization Systems

Optimization systems capture and manipulate user behavior and environments under the logic of optimization. For instance, ride sharing applications such as Uber, which rely on optimization to decide on the pricing of rides; navigation applications such as Waze, which rely on optimization to propose best alternative routes to beat traffic congestion; and advertising networks, which rely on optimization to decide what is the best advertisement to show to a user.

Optimization systems result in the common negative outcomes that usually surface during deployment —that are typically (dis)regarded as 'externalities'. Externalities refer to situations when the actions of a group of agents, e.g., consumption, production and investment decisions, have "significant repercussions on agents outside of the group" [Starrett, 2011]. The following are some of the common externalities intrinsic to optimization systems:

Disregard for non-users and environments. Optimizing the service for targeted users results in costs to non-users and environments affected by the system. Traffic and navigation services only consider ways to optimize the travel time of their users, exposing non-users to more congestion [Lopez, 2018].

Disregard for certain users. Many optimization systems provide the most benefit to "high-value" population segments. For instance, in the popular augmented reality mobile game Pokémon Go the placement of Pokémon and in-game resource stations rely on maps that heavily benefit players in urban areas, leaving players in rural areas and underserved neighborhoods starved of Pokémon resources [Huffaker, 2016].

Externalization of exploration risks to users and environments. Optimization systems benefit from exploration and experimentation to reduce risks associated with environmental unknowns. However, exploration often means that risks stemming from unknowns are pushed to users and their surroundings [Bird et al. 2016].

Distributional shift. Optimization systems built on data from a particular area or "domain" may underperform or downright flounder when deployed in a different environment [Sugiyama and Lawrence, 2017], e.g., a voice recognition algorithm that is only trained on men's voices fails to recognize women's voices [Rodgerand and Pendharkar, 2004].

Unfair distribution of errors. Optimization algorithms may learn to maximize success by favoring the most likely option [Hardt, 2014]. As a result, for example, minorities underrepresented in training may not perform well under deployment as in the case of facial recognition algorithms that misclassify faces of black women [Buolamwini and T. Gebru, 2018].

Promotion of unintended actions to fulfill intended outcomes. Systems may find shortcuts to their optimization goals, also known as "reward hacking" [Amodei et al., 2016], e.g., electricity grid manager choosing to cause a blackout in order to save energy [Simonite, 2018].

Mass data collection. Many optimization systems need massive amounts of data to function. The concentration of resources and power in data holders may enable more accurate inferences about populations. However, it exposes the individuals whose data is input to optimization systems to greater privacy risks.

Enter POTs

In response to these externalities, we introduce POTs, technologies conceived to address the negative externalities of optimization when all other attempts to internalize the externalities of optimization systems fail. The externalities of optimizations could be better addressed using socio-legal means, however, we focus on technological approaches that can kick in when these alternatives return no results. POTs are designed to be deployed by actors affected by the optimization system. As these actors directly experience the externalities, they have intimate knowledge of the system's negative effects; they are in position to have a better view of their social utility than a system provider can model—because it is their own utility. Lastly, POTs do not rely on the incentives of the provider. POTs are intended to eliminate the harms induced by the optimization system, or at least expose them.

For example, Uber optimizes the prices offered to riders and the wages offered to drivers. Uber uses from both riders and drivers, as well as data from other sources such as online service providers, e.g., Google for maps and data that they might collect using cookies. Uber also receives offine data from parties like municipalities interested in promoting the use of Uber to reduce costs of public transport. Lastly, Uber uses inputs from the market and regulators to evaluate the economic context in order to adjust wages and ride prices.

Uber ultimately uses these inputs and all the political and economic context in a combination of managerial and mathematical optimization to deliver outcomes to the environment: match riders to drivers and set ride prices. Reports and studies demonstrate that these outcomes cause externalities: Uber's activity increases congestion and misuse of bike lanes, increases pollution, and decreases public support for transit.

In the Uber scenario, POTs can be deployed by users and non-users with the goal of changing the phenomena captured by Uber. These can come in different forms: by changing the inputs of the users to the system (e.g. drivers can simultaneously turn off the app to induce surge pricing) or by changing the online or offline signals gathered by Uber (e.g., mayors changing the city urban planning), and could be further reinforced by affecting the market (e.g., by changing regulations or mandating salary increases).

References

I. Kaldrack and M. Leeker. There is no software, there are just services: Introduction. There Is No Software, There Are Just Services, 2015.

Author #4

P. E. Agre. Surveillance and capture: Two models of privacy. The Information Society, 1994.

M. R. Curry and D. Phillips. Surveillance as social sorting: Privacy, risk, and automated discrimination. In Privacy and the phenetic urge: geodemographics and the changing spatiality of local practice, 2003.

M. Poon. Corporate capitalism and the growing power of big data: Review essay, 2016.

T. Hwang. Computational power and the social impact of artificial intelligence. arXiv preprint arXiv:1803.08971, 2018.

D. A. Starrett. Economic Externalities. EOLSS, 2011.

S. Lopez. On one of L.A.'s steepest streets, an app-driven frenzy of spinouts, confusion and crashes. Los Angeles Times, April 2018.

C. Huffaker. There are fewer Pokémon Go locations in black neighborhoods, but why? The Miami Herald, July 2016.

S. Bird, S. Barocas, K. Crawford, and H. Wallach. Exploring or exploiting? social and ethical implications of autonomous experimentation in AI. In FAT, 2016.

M. Sugiyama, N. D. Lawrence, A. Schwaighofer, et al. Dataset shift in machine learning. The MIT Press, 2017.

J.A.Rodgerand, P.C.Pendharkar. A field study of the impact of gender and user's technical experience on the performance of voice-activated medical tracking application. International Journal of Human-Computer Studies, 2004.

M. Hardt. How big data is unfair? Medium, September 2014.

J. Buolamwini and T. Gebru. Gender shades: Intersectional accuracy disparities in commercial gender classification. In Conference on Fairness, Accountability and Transparency, 2018.

D. Amodei, C. Olah, J. Steinhardt, P. F. Christiano, J. Schulman, and D. Mané. Concrete problems in AI safety. CoRR, abs/1606.06565, 2016.

T. Simonite. When bots teach themselves to cheat. Wired, August 2018