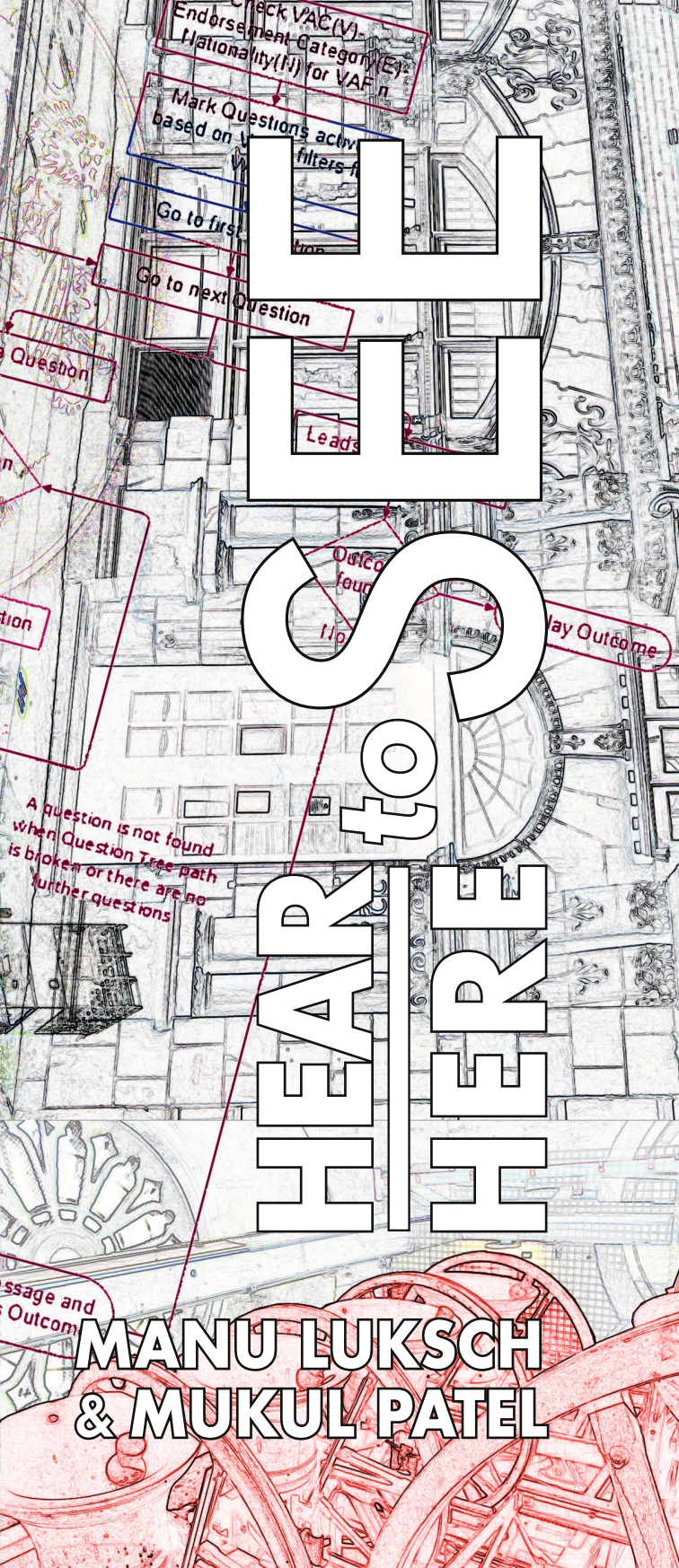


SEE SO HEAR TO HERE

MANU LUKSCH
& MUKUL PATEL

HEAR/HERE TO SEE: ALGORITHMS OF WESTMINSTER

is a journey through the political heart of London that reveals the new forms of algorithmic governance and decision-making at work behind historical façades of power.

Guided by the conversations of three teenagers, Eliza, Ruby and Io, the walk begins in sight of iconic seats of legislative, judicial and ecclesiastical authority.

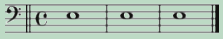
Along the route, the teenagers encounter increasingly prevalent, but far less apparent, modes of management and control made possible by ubiquitous networked computing.

Their exploration of these new mechanisms and associated issues begins with an account of what exactly an algorithm is, informed by the methods of church bell-ringing.

SCAN TO DOWNLOAD THE APP

PARLIAMENT SQUARE

E 
… what comes next?

R  *… Big Ben!*

E *Someone's ringing those bells every 15 minutes? Are they in the tower all day?*

R *No, Big Ben is played by a machine. But the bells in Westminster Abbey are rung by hand – ten different bells, ten bellringers. Each of them pulls a rope to swing their bell. Then they wait for it to swing back before they can ring it again.*

BELLRINGING METHODS

'Change ringing' – playing a sequence of 'changes' (patterns) on a set of tuned bells in a precisely controlled way – originated in English churches. Church bells are massive, swinging objects with lots of inertia, so there are severe physical constraints to performance. Change ringing is circumscribed by conventions that make interesting music possible within these constraints – e.g., every bell sounds exactly once in each change, changes are not repeated, and each bell moves at most one position between consecutive changes. Despite these limitations, many thousands of different 'methods' (performances) are possible – some involving a very large number of changes. An 'extent' or 'full peal' is a method in which every possible permutation of the the bells is heard exactly once. An extent on four bells has 4×3×2×1 = 24 permutations; an extent on ten bells has over 3.6 million, and would take three months to play.

E *No-one could remember that.*

R *They don't have to – they just need to know the first change, then they use an algorithm to work out the next change. An algorithm, you know? It's a set of rules or instructions, like computers use. And computers are everywhere – so algorithms are everywhere too.*

To make them humanly playable, methods are constructed in a logical manner out of a small set of simple rules. For example, in the method called 'Plain Bob Hunting' on four bells, the treble (bell #1) moves one position later in each change before reversing course:
1 2 3 4 ⟶ 2 1 4 3 ⟶ 2 4 1 3 ⟶ 4 2 3 1…
while the other bells follow similar routes through the permutations. Each bellringer only needs to memorise a simple rule that produces successive changes.[1]

MACHINE ALGORITHMS

A bellringing method is an example of an algorithm, which can be defined as a computational procedure that produces unambiguous output from given input. More generally, an algorithm is a well-defined process for solving a specific problem. Powerful processors allow computers to run complex algorithms on large datasets at high speed.One type of algorithmic system consists of a (possibly very long) sequence of preprogrammed steps that reproduces human reasoning at speed and scale.[2] More advanced algorithmic systems involve an aspect of 'learning', where machines 'discover' the rules that best connect some input to an output by testing many different rules on large sets of training data. In supervised learning, the training data is structured (pre-interpreted) by humans, while in unsupervised learning, the system itself discovers categories and structure in the data.[3]

WESTMINSTER ABBEY

R *Computers are everywhere – so algorithms are everywhere too.*

E *What, even in those traffic lights?*

R *The algorithm gets data from sensors in the road, and if it calculates that there's going to be a traffic jam, it adjusts the timing of the traffic lights.*

E *So the algorithm sees into the future...!*

R *It guesses the future, more like, by seeing into the past.*

A rule that strongly links inputs to outputs can be regarded as 'predicting' the output. This 'machine learning' (ML) approach can handle broad problems and is extraordinarily powerful at tasks such as medical diagnosis and language translation. ML algorithms are embedded in Automated Decision Making (ADM) systems across sectors from energy and finance to traffic management, education, and criminal justice.

BLIND JUSTICE

In the criminal justice system, algorithms are used for tasks including risk assessment of individuals, predictive crime mapping, and verification of evidence. Automated risk profiling systems such as Durham Constabulary's HART (Harm Assessment Risk Tool), or the commercial COMPAS (Correctional Offender Management Profiling for Alternative Sanction) software widely used in American courts,are marketed as more accurate, consistent, impartial and efficient than humans.[4] System designers claim that by correctly identifying offenders at low risk of recidivism and keeping them out of prison, they prevent further criminalisation of these individuals and reduce the burden on the state.

THE SUPREME COURT

R *You know my aunt's a judge in a court like that? She thinks that an algorithm could do her job! In the US, they use algorithms to decide if someone should get bail, or even how long a jail sentence should be.*

E *Why would an algorithm be better than a person at that?*

R *A judge might be prejudiced by the way a defendant speaks or looks, but an algorithm wouldn't be. It would make decisions by looking into the past to see how similar people behaved.*

E *But how is that fair? Just because someone's similar to me doesn't mean I'll do what they did. And anyway, how does an algorithm know that we're similar?!*

However well-intentioned system designers might be, researchers have found grave problems with their implementation. Although neither HART nor COMPAS use the protected characteristic of ethnicity as a factor in assessing risk, they do use address data, which in segregated urban districts is an excellent proxy for ethnicity. HART has also been criticised for using data of unknown quality purchased from credit reference agencies. And a 2016 investigation into COMPAS by ProPublica found that not only was the algorithm poor at predicting recidivism, but also that it consistently underestimated this rate for white defendants, and overestimated it for black ones.[5]

R *It's not so easy to design fair algorithms. My aunt told me about a police algorithm that ended up making prejudices worse!*

E *How?*

R *It searched arrest records for patterns and used those used to predict where crimes might happen. But the police in the area were really racist. They'd cruise around black neighbourhoods arresting people for minor offences, and ignore similar crimes in white neighbourhoods. So the records made it look like black neighbourhoods were full of crime, and the algorithm would send more patrols there.*

E *Oh, so they'd arrest even more black people for minor crimes...?*

R *Exactly, and this algorithm – PredPol, it was called, 'Predictive Policing' – would see these new arrests and send even more police there, making a bad situation even worse!*

PREDPOL: FEEDING BACK BIAS

Some states are deploying anticipatory models of policing in the hope of transforming outcomes in the same way that preventitive medicine has revolutionised healthcare. Various 'predictive policing' systems, designed to identify where and when to send police patrols, have been deployed in the UK and US. Some early systems attempted to predict future crimes based on a theoretical (causal) model of why and where repeat offences occur, but most current systems, such as the American PredPol, use a machine learning approach to correlate crime occurrences with any other data available. Independent assessments of these systems have found major issues in the training data. Firstly, convictions or arrests are used as a proxy for actual crimes. Secondly, since training data is derived from historical records, past discrimination skews the output and can cause positive feedback loops – a neighbourhood that has historically been over-policed (because of racial prejudice, say) would show many arrests per capita, and the system would direct more resources there, further entrenching discriminatory practices.[6] Moreover, because of their power and speed, ADM systems rapidly amplify even small biases. As in the case of sentencing algorithms, current implementations of predictive policing algorithms have systemic lacunæ that must be addressed before the harder tests of social appropriateness and constitutional legitimacy can be applied.

E *But can't we just check the algorithm to make sure it's fair?*

R *The company that made it keeps it secret, to stop others from copying it. It's called a 'black box' algorithm – you input some data into it, and it outputs an answer, but you can't look inside it to see how it got the answer.*

E *That's really shady. At least a person could tell you how they made a decision.*

The lack of transparency and accountability is a basic problem of algorithms such as COMPAS and PredPol. Being proprietary, details are not available for public scrutiny, and – in common with many ADM systems – there are no robust mechanisms for individual appeals. Predictive policing algorithms are so problematic that in 2020, nearly 2,000 mathematicians addressed a letter to the American Mathematical Society urging their colleagues to boycott collaboration with the police. Even the U.S. Department of Justice has pointed to possible constitutional issues around due process with COMPAS.[7]

DEPT. OF BUSINESS, ENERGY & INDUSTRIAL STRATEGY

E *Do you think that CCTV camera knows who we are?*

R *Well, if it's using a facial recognition*

algorithm, and is connected to a database with everyone's faces, then yes! There's no law against it here. Some places like San Francisco have banned facial recognition algorithms in public, because they're just not accurate.

E *We should ban them here too then!*

R *Too right! The worst thing is that HikVision has been building a mass surveillance system for the Chinese government to help them keep track of every citizen. It's even supposed to be able to identify Uyghurs.*

E *You mean the people that China's imprisoning in camps? But then why is the UK buying Hikvision cameras – and putting them around Parliament?*

BIOMETRIC SURVEILLANCE

There are at least 400 million surveillance cameras installed in China[8], many of which are networked with a biometric database to allow the state to identify and track citizens by their faces. This country-wide facial recognition system provides data to the national social credit system. It also serves as a platform for running 'minority analytics' – in 2018, the state-controlled company Hikvision inadvertently revealed the existence of a tool for identifying ethnic groups such as the Uyghurs using facial recognition algorithms.[9] In July 2019, the Parliamentary Foreign Affairs Committee reported that Hikvision is the primary technology provider at Uyghur internment camps. Concurrently, Hikvision was contracted to supply cameras to the Parliamentary Estate – an arrangement that not only lacks any probity, but also credibly threatens national security.[10]

Technology companies constantly oversell, however, as the measured performance of facial recognition algorithms in the field shows. Between 2014 and 2019, several UK police forces conducted public trials of facial recognition cameras linked to the National Police Database and obtained poor results, with the rate of false positive identifications particularly high.[11] But the issues of privacy, dignity and due process that arise with biometric surveillance are only compounded by such inaccuracies.

DEPT. OF EDUCATION

E *What are you protesting about?*

A *We couldn't sit exams because of the pandemic, so our teachers graded us, and the Department of Education used an algorithm to check the grades. But it's totally biased!*

B *My school gave me all 'A's and then this stupid algorithm lowered them all to 'B's, just because last year no-one in my school got all 'A's. And now I've lost my college place – how is that fair?*

C *And for a kid in a top school, it didn't matter if they worked or not – the teacher might give them a 'D', but if everyone scored higher than a 'D' the previous year, the algorithm would automatically boost the grade!*

E *Those algorithm designers need to go back to school!*

BACK TO SCHOOL

In August 2020, the Department of Education on Great Smith Street witnessed a remarkable public demonstration – perhaps the first anywhere to specifically protest an algorithm.[12] The Covid-19 pandemic had disrupted

school-leaving exams that were pivotal to the university admissions process. In lieu of exams, students were graded by an algorithm that took teachers' evaluations, which tended to be inflationary, and moderated them using the particular school's historical performance.[13] However, the algorithm was poorly conceived. By forcing a grade distribution onto teachers' rankings, many students found their grades significantly – and unfairly – deflated. A student evaluated with a high absolute grade, but ranked lowest in a class, might see their grade reduced to the absolute lowest grade achieved in the previous year. To make matters worse, teachers' rankings were more strongly weighted for smaller cohorts, typically associated with independent (fee-paying) schools. Consequently, students at independent schools – already bastions of privilege – saw greater grade inflation.[14] As is typical, the appeals process was totally inadequate. Students took to the streets, and legal action was mounted by digital rights initiative Foxglove. Facing a judicial review, the government retracted the algorithm and grades were reverted to teachers' evaluations.[15]

ADAM SMITH INSTITUTE

Of course we don't know what the AI algorithms do, that's the point of using them.[16]

E *Who's that?*

R *That was Tim Worstall from the Adam Smith Institute. It's a think tank that advises politicians and businesses.*

E *Wait – is he saying that it's a good thing that I don't understand how algorithms work? But if an algorithm's going to change my grades or send me to jail, I'd want to know exactly why!*

AI'S MYSTERIOUS WAYS

Complex, successful algorithms and ADM systems are often described as exhibiting 'artificial intelligence' (AI). Most current AI algorithms use a type of ML called 'deep learning', in which computation is carried out by a neural net. A neural net is an array of processing nodes whose interconnections are modelled on the way neurons connect in the brain; 'deep' refers to the large number of layers of nodes between input and output. Google DeepMind's human-conquering chess and Go game engines and their protein-folding algorithm use this approach. Deep learning systems achieve striking successes without needing to be explicitly given any concepts or structure. On the other hand, the reasoning by which they produce particular outputs is usually opaque, even to their designers.[17]

E *But then whose fault is it if the algorithm makes a mistake?*

While not having explanations for a strategy or gameplay doesn't undermine the entire culture of chess or Go, an inability to justify decisions that more viscerally impact human lives – through financial trading, or healthcare provision, or autonomous weapons systems – has a devastating effect on individuals and society.

THE HOME OFFICE

E *That huge building with the coloured glass – looks like a fancy hotel.*

R *You're kidding – that's the Home Office. They're in charge of the police and prisons, they give out passports and visas. And guess what they've been using to decide who deserves a visa?*

E *Don't tell me – an algorithm.*

GCHQ National Technical Assistance Centre

Supermarket

Home Office

Adam Smith Institute

Department of Education

Department of Business, Energy & Industrial Strategy

Supreme Court

Westminster Abbey

Parliament Square

R *A secret one, naturally, which was actually designed to discriminate against people because of their nationality. It was totally racist – people from African countries found it really hard to get visas. But campaigners took the Home Office to court and proved that the algorithm was illegal, so they've had to stop using it for now.*

SECRET STREAMING

In June 2019, the *Financial Times* revealed that the Home Office had been using a secret algorithm to process visa applications for several years.[18] The Chief Inspector for Borders and Immigration had earlier criticised the algorithm for having the potential to become a de facto decision-making tool, and encouraging confirmation bias in visa caseworkers. The algorithm assigned a risk rating to applicants on the basis of nationality, and contained a vicious feedback loop. After increasing numbers of otherwise eligible African academics and artists were denied visas, the Joint Council on the Welfare of Immigrants worked with Foxglove to bring a legal challenge against the government. The Home Office withdrew the algorithm in 2020.[19]

E *So we can defend ourselves against unfair algorithms!*

R *Sometimes!*

SUPERMARKET

E *Sainsbury's Bank? I thought it was a supermarket!*

R *It is a supermarket – and a bank. They sell pretty much everything you could want. Their website even kind of knows what you want...*

E *They read your mind – with an algorithm?*

R *You'd be amazed what they know about you...*

OMNICHANNEL RETAIL

Multi-brand retailers such as Sainsbury's pool data from across their operations to gain competitive advantage. The efficiencies and insights gained through patching together internal silos of data, for example from different points of the supply chain, are uncontroversial. What should be disturbing is how data harvested across different brands is pooled to build a multidimensional portrait of the customer – as someone who is no longer merely contracting for goods and services, but whose behaviour must be understood, predicted and nudged. The chief data and analytics office of Sainsbury's, Helen Hunter, wants 'to stitch together what Nectar understands about how customers travel from the Nectar travel partners, how the bank can understand who's using travel money, how Argos can understand who's buying luggage, and how Sainsbury's food can understand who's buying a load of sun cream.'[20]

Multiply this approach to business by the dozens of large retailers in the marketplace, and you, the customer, should perhaps be beginning to feel a little uneasy about just how interesting you appear. Not only must you navigate among multiple brands that may or may not be faces of the same corporation, but you are also courted on every platform and in every medium in a calculated manner. How does the retailer make their offer irresistible? – through an omnichannel strategy. Add something to an online shopping basket, and you might be sent coupons via social media. Forget to check out, and the next day you might be served ads on Youtube. A week later and still no purchase, and you might find physical marketing material in your mailbox

promoting an ancillary product. Return to the online store, and a deeper discount awaits. Upon purchase, the retailer expresses their gratitude by emailing an invitation to review the product for future discounts. If the email does not work, a last message over social media offers discounts for your friends. And after a respectful silence, a new campaign starts via ads on the game you just downloaded. Do you understand your place in all this now? [21]

MILLBANK HOUSE

R *There's an office here called NTAC – National Technical Assistance Centre – which can listen to your phone conversations, read your emails, and see where you go on the Internet. All of that information is supposed to be private… it's encrypted. But NTAC can crack that encryption – using algorithms. I heard that they're even using a chess algorithm designed by Google DeepMind – not to play chess, but to intercept data on the Internet.*

CHECKMATE

Of the millions of different algorithms that inhabit the software and processes of modern life – from mobile telephony and GPS navigation to keeping your utilities on and your fridge stocked – relatively few were crafted originally for their current applications. Abstraction is a feature of modern algorithms – and particularly of ML systems. It gives them their power, also their portability. A 2019 *Financial Times* feature on GCHQ, the UK's largest intelligence service, briefly mentioned a novel repurposing of Google DeepMind's open-source chess-playing algorithm.[22] Instead of hunting for plays to win, this derived code hunts for the best points on the Internet at which to eavesdrop on traffic. The office in which this technique was developed, NTAC in Millbank House, marks the end of this wander through the algorithms that infuse Westminster.

E *There are algorithms everywhere!*

R *They're part of our daily lives, so it's important to know something about them, like what exactly they're designed to and how well they do that, how fair and reliable they are, how their decisions can be challenged – and whether they should used for certain purposes at all.*[23]

OMNICHANNEL STRATEGY

Bank with us
trade with us
fly with us
play with us
Eat with us
work with us
buy with us
sell with us

The things that you want
the things that you want
the things that you need

Keystroke logger
IP logger
GPS logger
Searching
searching
surfing
What're you searching?

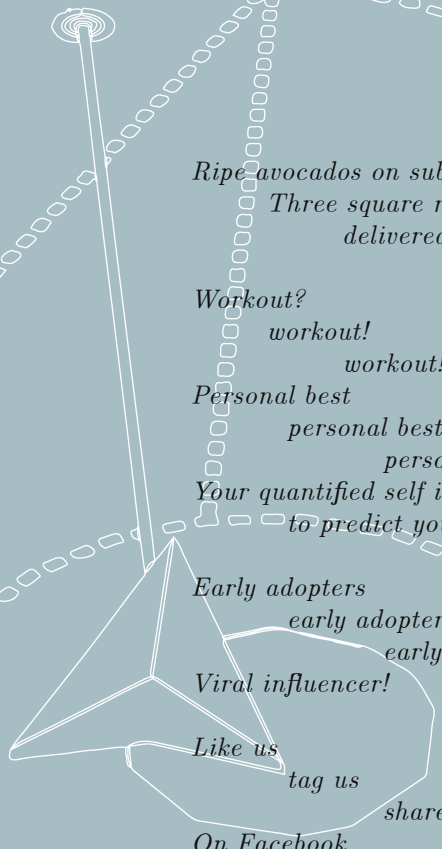
Beach holidays
Embarrassing problems
Age-related intermittent
back pain
Hair loss?
Anxious?
Overweight?
YouTube ads
YouTube ads
YouTube ads

Have you considered –
our wellness cure?

The things that you want
the things that you want
the things that you need

The voice of your choice
to keep you warm at night

Got a vet for your pet?
We Insure your dog!
Not protected by God?



Ripe avocados on subscription
Three square meals a day
delivered to your door

Workout?
workout!
workout!
Personal best
personal best
personal best
Your quantified self is what we want
to predict your future health

Early adopters
early adopters
early adopters
Viral influencer!

Like us
tag us
share us on Facebook
On Facebook
on Google
on Instagram
For an unmissable offer!

And if you like the sound of that
you're gonna love what's coming next!

24–7–365
Door to door
Artificially Intelligent
With a voice of your choice

Our friendly digital assistant
is the only service
you will ever need

Join our club!
join our club!
join our club!

(The free trial giveth
and the terms and conditions
taketh away)

Notes

[1] See Sarah Hart, 'The Mathematics of Bell Ringing', transcript of lecture at Gresham College (5 January 2021). https://s3-eu-west-1.amazonaws.com/content.gresham.ac.uk/data/binary/3459/2021-01-05-1300_HART_Bells_T.pdf
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[2] For a non-technical introduction to some fundamental algorithms used in computers, see especially pp. 59–83 of Brian Christian & Tom Griffith, *Algorithms to Live By* (London: Collins, 2016). For a full treatment, see Donald Knuth, *The Art of Computer Programming, Vol 1: Fundamental Algorithms*, 3rd ed. (Boston: Addison-Wesley, 1997).

[3] For a succinct overview of machine learning, see the GCHQ report *Pioneering a New National Security. The Ethics of Artifical Intelligence* (GCHQ, 25 February 2021), 11–13. https://www.gchq.gov.uk/files/GCHQAIPaper.pdf
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[4] For HART, see Michael Veale et al, *Algorithms in the Criminal Justice System* (The Law Society of England & Wales, 2019), 45–46. https://www.lawsociety.org.uk/en/topics/research/algorithm-use-in-the-criminal-justice-system-report
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[5] Julia Angwin et al, *op. cit.*

[6] Kristian Lum & William Isaac, 'To predict and serve?', *Significance*, 13 no. 5 (2016): 14–19. https://doi.org/10.1111/j.1740-9713.2016.00960.x

[7] For the letter to the AMS, see *Notices of the American Mathematical Society* 67, no. 9 (October 2020): 1293. https://www.ams.org/journals/notices/202009/rnoti-p1293.pdf
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See also Charles Rollet, 'Hikvision Markets Uyghur Ethnicity Analytics, Now Covers Up' (IPVM, 11 November 2019). https://ipvm.com/reports/hikvision-uyghur

[10] See Ryan Gallagher, 'Cameras linked to Chinese government stir alarm in U.K. parliament' (The Intercept, 9 April 2019). https://theintercept.com/2019/04/09/hikvision-cameras-uk-parliament
A comprehensive report, *Who's Watching You? The dominance of Chinese-state owned CCTV in the UK* was published by Big Brother Watch in February 2022. https://bigbrotherwatch.org.uk/wp-content/uploads/2022/02/Whos-Watching-You_The-dominance-of-Chinese-state-owned-CCTV-in-the-UK.pdf
See also the UK Parliament's Foreign Affairs Committee own report *Never Again: The UK's Responsibility to Act on Atrocities in Xinjiang and Beyond* (8 July 2021). https://publications.parliament.uk/pa/cm5802/cmselect/cmfaff/198/19802.htm

[11] Michael Veale et al, *op. cit.*, 36–38. Extravagant claims for facial profiling continue to be made in the corporate and academic sectors. For example, Israeli company Faceception claims to be able to classify people by IQ, profession, and criminal propensity. https://www.faception.com
Academics at elite institutions also peddle the new phrenology: see Michael Kosinski, 'Facial recognition technology can expose political orientation from naturalistic facial images', *Scientific Reports* 11 no. 1 (2021). For compelling rebuttals, see Tristan Greene, 'Stanford team behind BS gaydar AI says facial recognition can expose political orientation' (The Next Web, 14 January 2021) https://thenextweb.com/news/opinion-the-stanford-gaydar-ai-is-hogwash and Kyle Wiggers, 'Outlandish

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[12] https://twitter.com/huckmagazine/status/1294985562106015750

[13] For a summary of the algorithm as described in Ofqual's technical report, see Jeni Tennison, 'How does Ofqual's grading algorithm work?' (RPubs, 16 August 2020). https://rpubs.com/JeniT/ofqual-algorithm

[14] See Will Bedingfield, 'Everything that went wrong with the botched A-levels algorithm', *Wired,* 19 August 2020. https://www.wired.co.uk/article/alevel-exam-algorithm
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[15] 'We put a stop to the A Level grading algorithm' (Foxglove, 17 August 2020). https://www.foxglove.org.uk/2020/08/17/we-put-a-stop-to-the-a-level-grading-algorithm

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[18] Helen Warrell, 'Home Office under fire for using secretive visa algorithm', *Financial Times*, 3 June 2019. https://www.ft.com/content/0206dd56-87b0-11e9-a028-86cea8523dc2

[19] 'Home Office says it will abandon its racist visa algorithm – after we sued them' (Foxglove, 4 August 2020). https://www.foxglove.org.uk/2020/08/04/home-office-says-it-will-abandon-its-racist-visa-algorithm-after-we-sued-them

[20] Ellen Hammett, 'Why Sainsbury's isn't waiting for "big silver bullets" to drive business transformation' (Marketing Week, 13 December 2018). https://www.marketingweek.com/sainsburys-transforming-business-data

[21] See for example the case study by Nick Winkler, 'Omnichannel vs Multichannel: What is the Difference and Why Does It Matter?' (Shopify, 13 August 2019). https://www.shopify.com/enterprise/omni-channel-vs-multi-channel

[22] David Bond, 'Inside GCHQ: the art of spying in the digital age', *Financial Times*, 23 May 2019. https://www.ft.com/content/ccc68ffc-7c1e-11e9-81d2-f785092ab560

[23] AlgorithmWatch https://algorithmwatch.org/en and The Ada Lovelace Institute https://www.adalovelaceinstitute.org and are two exemplary publishers of research into these and other ethical and political questions arising in AI and ADM.

HEAR/HERE to SEE: Algorithms of Westminster
by Manu Luksch & Mukul Patel

Featuring the voices of
Robyn Anika Buus Phillipps, Elektra Chandranandini Luksch, Indigo Luksch, Jemimah May, Mathilda May, Liesel May

Commissioned for
City Songlines, a project created and curated by Grad London from an original idea by Katya Sivers.

Project Manager Timothy Maxymenko

iOS Developer Ilia Batii (baitcode)

Special thanks Elena Sudakowa

Supported by Bundesministerium Kunst, Kultur, öffentlicher Dienst und Sport, Austria and Arts Council, England. Research supported in part by the Open Society Foundations.

Opinions expressed herein are the authors' own and do not necessarily represent the views of the supporters.

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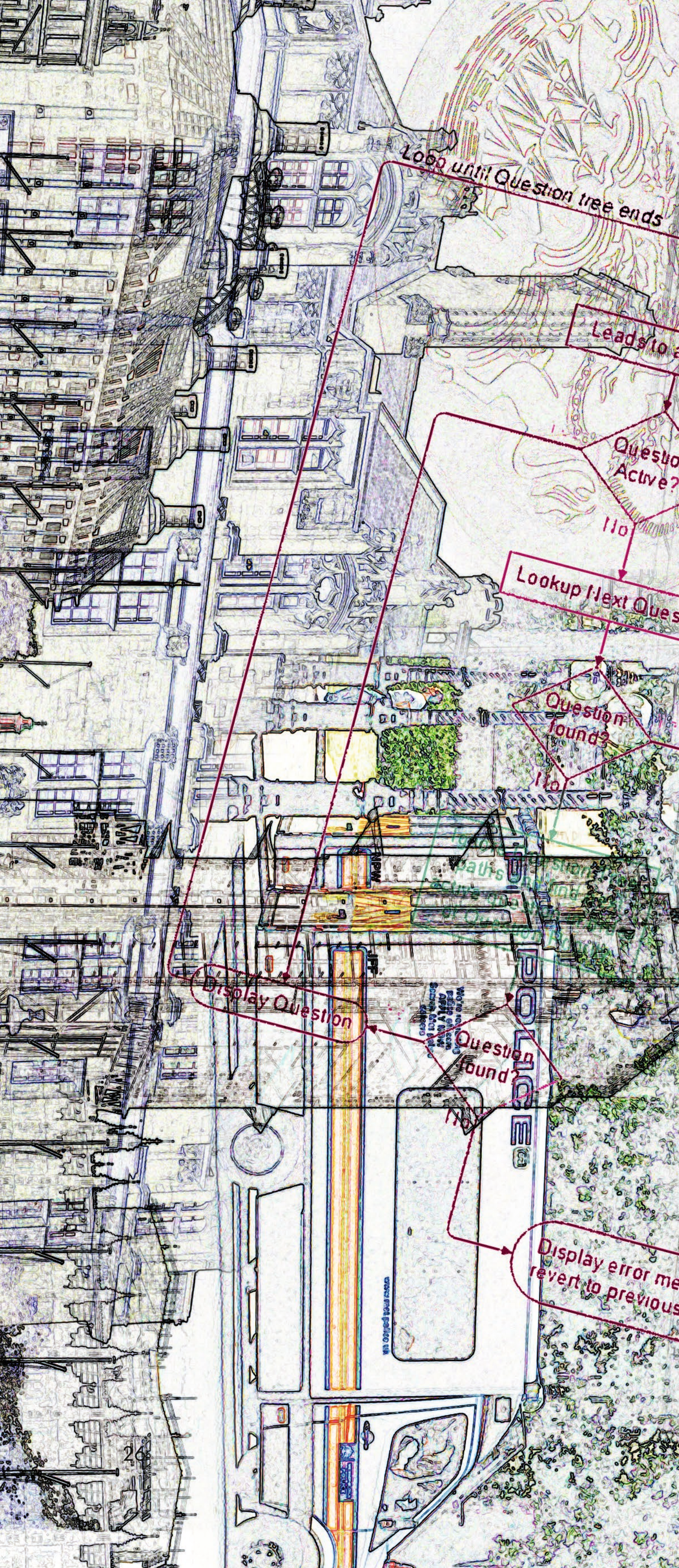
Loop until Question tree ends
Leads to a
Questio
Active?
No
Lookup Next Ques
Question
found?
No
Display Question
Question
found?
No
Display error me
revert to previous