

Introduction: The Economy of Algorithms Is Here

‘Fuck the algorithm!’

In the heart of London, right behind Westminster Abbey, and just as close to the famous Big Ben, there is a short, narrow street called Great Smith Street. It runs parallel to the Thames. And, just like the river, the street has seen its share of the city’s history – including the history of information technology. The world’s first computer programmer, Ada Lovelace, was born just a few minutes away in December 1815. And one of the founders of modern computer science, Alan Turing, known for breaking Enigma ciphers in World War II, began his life a couple of miles away, a century later, in June 1912. Lovelace and Turing saw beauty in algorithms and their potential to make the world a better place. Quite possibly, they each used to stroll along the quiet street while pondering their work.

But on Sunday, 16 August 2020, the street was far from quiet. It was louder and angrier than Lovelace and Turing would ever have experienced it.

‘Fuck the algorithm!’ The chants intensified.

Hundreds of students were gathered in front of the Department for Education at 20 Great Smith Street, voicing their frustration. The students were the victims of an algorithm that had been allowed to decide their future, and they were not having it.

What is an *algorithm*? Essentially, an algorithm is a step-by-step procedure for solving a problem or performing a computation. If I were to avoid formal definitions here, I would say that an algorithm is

like a recipe that a computer follows. Computers are useless without algorithms. They calculate, predict, optimise and do all sorts of other things that make our human lives easier. Some of them are very simple, others so complex that people cannot comprehend them.

‘Fuck the algorithm!’

Ah, right. Let’s get back to the Great Smith Street commotion.

In 2020, students in the United Kingdom couldn’t sit their final-year exams due to the pandemic. These exams are critical for high-school leavers: university offers are conditional on the results. If a student’s grade is too low, they won’t get into their preferred university.

To get around this issue in England, the Office of Qualifications and Examinations Regulation (Ofqual) introduced an algorithm to calculate the missing exam grades. First, teacher-predicted grades for each student, ranking them within their school, were fed into the algorithm. Then, the historical grade distributions of schools from three prior years were entered. Finally, previous exam results, per subject, were added. Well, that’s how the algorithm worked for students at larger schools. For smaller schools, if fifteen or fewer students were enrolled in a particular subject, only teacher predictions were considered.

What resulted sparked the student protests. Students at smaller – typically private – schools, benefited from teacher optimism, or so-called ‘grade inflation’: the algorithm reflected teachers’ predictions and scored them high. But everyone else fell into a ‘destiny trap’: teacher-predicted grades were ignored if there were more than fifteen students enrolled in a particular subject, and if a school had done poorly in the past, its students’ grades reflected that, no matter how hard they had worked. The algorithm was designed to make grade distribution look the same as it had in previous years. If there had been no A students at a certain school in the three years prior, the algorithm would not allow any students to graduate from the school with an A in 2020. When Ofqual announced its results, nearly 36 per cent were a grade lower than teachers’ predictions, and 3 per cent were two grades lower. Some fifteen thousand students were rejected by their first-choice university. Many of them went out on the streets to express their anger.

The students achieved their goal. On 17 August, a day after the protests, Ofqual accepted that all students should be awarded the grade predicted by their teachers, not the one the algorithm had produced. Just imagine how the life trajectories of countless students changed with that one decision.

There are many organisations like Ofqual – small businesses, multinational corporations, government departments – that try to use algorithms to improve what they do. But often they don't know how. The pattern they follow is usually similar: they put too much power in the virtual hands of an imperfect algorithm.

Could Lovelace or Turing have predicted that in the twenty-first century people would congregate to protest against the inhumanity of an algorithm? Being the visionaries they were, perhaps they could have.

While I was watching the protests unfold, something dawned on me: algorithms are no longer just sets of instructions that guide computer behaviour. Sure, technically speaking, that's what they do, but their impact is far greater than that. Algorithms now shape the way we live, work and think. Sometimes they fail miserably, making us go out and rebel against them. Sometimes they help us. And often they impact our lives in ways we do not comprehend. We live in the economy of algorithms.

As I finish writing this book in early 2023, society is trying to understand the impact of GPT-4, another algorithm, which has turned out to be unexpectedly capable. The algorithm, powering an application called ChatGPT, can confidently converse with humans, write poetry, solve logical puzzles, explain complex concepts and even play chess. The release of ChatGPT in late 2022 was met with excitement but also concern: several education departments decided to ban its use at schools, universities moved to paper-only exams and even conferences on artificial intelligence asked academics to refrain from using it or similar algorithms.

I allowed an algorithm to write a small section – just a paragraph or two – of this book, an option that was unimaginable until very recently. It is a sign of the times. We are allowing technology to make decisions and act on our behalf in many more ways than we used to. In short, we are giving more agency to technology.

But here's the catch: we are not used to thinking of technology as having agency. Our species did not evolve alongside autonomous tools. Have you ever seen a self-chopping pickaxe? If you did, you would likely assign it some divine, if not devilish, attributes. Surprising as it may be, we might be subconsciously doing the same with algorithms.

The world seems easier to comprehend if we think of technologies as tools, not agents. For instance, when we use software to help us file our taxes, we use it as a *tool* – we don't expect it to file our tax return without our direct involvement, the way a tax *agent* would. But then we do give a lot of agency to other technologies. Take one of the most advanced robots in the solar system, NASA's Mars 2020 *Perseverance Rover*, which explores the red planet, looking for signs of past life, collecting rock and soil samples, and preparing them for the return to Earth. It is equipped with autonomous systems to function without human help. *Perseverance* is an *agent* acting on our behalf on the planet Mars. Yes, it regularly receives directions from Earth, but it also makes its own decisions – and this level of independence makes it an agent.

As technologies advance, many are becoming capable of acting in their environment without supervision. With this advancement comes increasing complexity. Some technologies are becoming too complicated for ordinary humans to comprehend.

Suppose you have a smart assistant – Amazon's Alexa, Apple's Siri or Google Assistant – and you let it make decisions for you without supervision. For instance, you may ask it to play music that you and your friends will enjoy during dinner. It can do this using a so-called 'recommender system'; video-streaming and social-media applications also use such technology. Can you say with confidence, 'Oh, I know which songs it will play, and I can explain why it will play each of them'? Probably not – at least, I can't, and I spent many years researching and building recommender systems. In most cases, smart assistants will take multiple factors into account: the music you have played in the past, your current preferences and trending music. Perhaps it will make some random selections to experiment with new content too.

Likewise, if you are the lucky owner of a car with a 'self-driving' mode, you will find it hard to explain, in every instance, why your car switches lanes or decides to slow down.¹ And if you have a

smartphone, you may ask, *Why does my phone recognise my face in the middle of the day but never just after I wake up?*

See? Explaining how technology works is often harder than it initially seems. Arthur C. Clarke, an English science-fiction writer, who will appear again later in this book, said that ‘any sufficiently advanced technology is indistinguishable from magic’.² Much like a self-chopping pickaxe.

When we work with technology we do not fully comprehend, it occasionally affects us in unpredictable ways. Does that mean we should all simply give up on understanding the algorithms we use and hope for the best? I guess you know what my take on this is, and I think I know yours, since you are reading this book.

As algorithms gain agency, we need to ensure we do not lose ours. And the only way to retain our agency is to embark on a journey of understanding this newly forming world around us: the economy of algorithms. This is the world we will explore together in this book.

We will learn how algorithmic agents beat world champions at complex games and decide who goes to jail and who goes free. We will meet people who have been hired and fired by algorithms, and others who – thanks to algorithms and robots – can now do work that was previously inaccessible to them. We will examine how algorithms have invested our money only to lose it – in unbelievable quantities – due to simple programming errors. And we will explore how algorithms dream up and design new products ... and keep our fridges full.

Some of the stories in this book are uplifting and optimistic: algorithms have created opportunities for inclusiveness, organised support for communities affected by war and inspired us. Others are more cautionary and even scary: algorithms have tried to break up marriages, denied social-security payments to innocent citizens and been used as a weapon to destabilise entire political systems. But don’t expect this book to be prejudiced in either direction. I am not a tech evangelist, although I once worked in the tech sector in Silicon Valley. Nor am I a tech alarmist, though I’ve seen my share of highly problematic tech. My goal is to show you a balanced picture, recognising that my perception of what is ‘balanced’ might be different from yours.

Whatever your opinion on the positive and negative potentials of technology, there is no denying that algorithms have an outsized

impact on our lives. We need to understand that impact and learn what we can, and should, do in response.

As a professor of the digital economy who worked with the world's tech leaders for two decades and once collaborated closely with the most cutting-edge digital innovators of Silicon Valley, I am frequently asked to speak about the economy of algorithms.

Throughout my career, I've witnessed how algorithms have changed the way we live and do business, profoundly affecting both individuals and corporations in the process. With a deeper understanding of these complex tools, we can use their power more effectively and for the greater good. Some of us are actively involved in creating algorithms, but for those of us who aren't, our choices – as users, customers and conscientious citizens – still have an impact as well.

In the chapters to come, we will explore real scenarios – derived from my own experience working with countless businesses, government departments and other organisations – that reveal how algorithms can either facilitate or hinder our progress. These scenarios represent the most compelling and relevant algorithm-related issues we face today. Some of the stories might sound as though they're straight out of a science-fiction novel, but they're not. They're happening right now. We need to understand the ways these incredible tools are rapidly reshaping our world.

Just as I've helped my clients – from small businesses to global corporations – to understand and benefit from algorithms, I can help you. In this book, I share the information, tools and insight needed to successfully navigate our ever-evolving digital landscape and harness the power of algorithms to create a better future. Whether you're a business leader or a forward-thinking professional, or you simply want to better understand the increasingly pervasive role of algorithms in our lives, I wrote this book for you.

Shall we?