Introduction

1. I am a Professor of Distributed Systems at the University of Derby. My research areas include Distributed and Parallel Systems (including High Performance Computing, Grid and Cloud Computing) and scalable methods to mine large and complex datasets. I am currently working on research partnerships with CERN and Roche in the field of high-volume streaming data analytics.

2. The research project with CERN in part focuses on ALICE (A Large Ion Collider Experiment), an ongoing project to investigate the fundamental matter of the universe. The experiments carried out as part of this project generate a very large quantity of data and researchers at the University of Derby are providing expertise in distributed systems, algorithms and artificial intelligence tools to produce new science from this data.

3. Our partnership with Roche is helping with the development of personalised medicines and improving clinicians’ access to medical data. This partnership involves looking at how algorithms can speed up genome analytics, categorise data to give clinicians better access to medical databases, and speed up the process of developing new biomarkers and demonstrating regulatory compliance.

Current and future use of algorithms in decision-making in government and public bodies, businesses and others, and the corresponding risks and opportunities

4. Making effective use of algorithms is currently an expensive process, especially where large quantities of data are involved. First you need to collect and store large quantities of data and then you need a large amount of computational power to process the data. In practice, this means that only wealthy organisations can fully exploit the benefits offered by deep learning algorithms. Companies like Facebook, Google and Amazon have access to huge amounts of user data and, thanks to economies of scale, are able to develop algorithms that create value for the business. Smaller organisations cannot get the same benefit because they do not have access to the same wealth of data and lack the resources to invest in the technology.

5. We live in an age where there is more data available and this could bring significant benefits to government, if handled properly. If more data becomes available to government but the decision-making processes continue to be guided by the same human processes, then all we are doing is increasing the burden of bureaucracy. Effective use of algorithms could expand the capabilities of policy makers and civil servants, so they can analyse data more effectively, make more timely decisions and develop joined-up services.

6. From my work Roche, I believe that algorithms could bring significant benefits to the NHS by increasing efficiency and helping clinicians make better decisions. A recent study found that algorithms were more effective than consultants at detecting cancerous tumours.¹ Obviously, the final oversight and decision-making should rest with the medical practitioners, but new technology can improve their performance. Integrating algorithms into diagnostic processes would increase the capacity of staff to treat patients.

¹ [https://pharmaphorum.com/news/google-ai-algorithm-detects-breast-cancer-better-pathologists/]
Finding ways to bring down the cost of developing algorithms would bring huge productivity benefits to the economy, as smaller organisations adopt new technology. It would also open up more opportunities for innovation in the sector as the barriers to participation are lowered.

One of the ways we can bring the cost down is by decentralising algorithm activity. We need to have algorithms making decisions closer to the data sources, rather than sending all the data off to a central point for processing. If we adopt a distributed system approach then we can reduce the infrastructure requirements and can carry out the activity with less computational power.

However, progress is being held back by a skills gap in this area. We simply do not have enough skilled workers and the expertise required to write a deep learning algorithm goes beyond the level of undergraduate study.

Good practice in algorithmic decision-making

There is a real danger that algorithms could reflect the bias of whoever creates them. To overcome this problem, we need to improve transparency and regulatory oversight. One way that we can improve both security and transparency is through the use of blockchain, the technology underpinning the Bitcoin cryptocurrency. Blockchain is an inherently secure ledger of digital records that would allow decisions taken by an algorithm to be independently audited. This would enable modifications to be made to the algorithm if bias or errors are detected.

For example, we are investigating how blockchain could be used to speed up the process of demonstrating regulatory compliance for new drugs, while also increasing the transparency of the process. Whenever a new drug is produced, the developers are required to send a huge amount of documentation off to the regulator. However, if you integrate blockchain into the development process and give access to the regulator, then they can monitor progress as it unfolds.

Algorithms that have the capacity to self-learn would improve over time, as they are exposed to more data. This kind of incremental learning would help the algorithm to make better decisions over time and it would allow the technology to adapt to changing circumstances in the real world.

Regulatory oversight of algorithmic decision-making

New regulation and enforcement practices will be required to maintain effective oversight of activity involving algorithms. Current regulatory oversight relies too heavily on human processes, which are much slower than the algorithms being inspected. What we need to develop is regulatory algorithms that can assist with – and speed up – the compliance process.

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