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The Operational Research Society has provided a written response to the inquiry into Automated Decision-Making. This paper echoes the sentiment of that paper and provides additional insight and input, separately and independently.

Introduction

Operational Research (O.R.) has long solved the problem of automated decision underpinned by computational algorithms and offers three propositions to support the statement.

Firstly, through its collection of academically researched and scientifically proven soft and hard O.R. methods the full range of possibilities in the uncertainty space is always initially explored and experimented with before the design and build of computational algorithms begins. Secondly when O.R. exploration and experimentation combined mathematical optimisation with computer programming it led to the discovery that 'data' is a viable system with its own set of behaviours fostering research into machine learning and artificial learning using structured and unstructured Big data, driving Big Data technology innovation. Lastly, The O.R. Society, which founded in UK is the world oldest and one of the largest professional body for Operational Research, built its foundations on soft and hard O.R. methods some of appear to be grouped under the generic term of Data Science , and these O.R. methods maintain industry standards and best practice in the use computational algorithms; it the only professional body to invite professionals (academics and practitioners) working in the field of Data Science, Advance Analytics and Operational Research, to become certified and professionally registered and commit to continuing professional development (CPD) and offers training in DSaaF™ : Data Science as a Framework.

Therefore, the real question to ask is why should there be so much concern about the use of computational algorithms underpinning automated decision-making. But fefore that question can be answered it is important to discuss each proposition.

Proposition 1 – Using soft O.R. methods combined with hard OR methods ensures the design and build of algorithms covers the entire uncertainty space, encapsulates in-built

impact assessment capabilities, encloses autonomous corrective actions and is capable of being audited and independently reviewed, solving the problems of automated decision-making

Soft OR methods such as Viable Systems Model (VSM), Problem Structuring Methods (PSM), Soft Systems Methodology (SSM), Behavioural Science and Organisational Design using computational experiments to explore uncertainties in systems models from different perspectives; focusing on the reasons for a systems behaviour rather than predicting systems behaviour. The emphasis is on the process of researching and exploring a broad range of assumptions, circumstances and hypothesis. This exploratory research conducted before the design of a computational algorithm helps to uncover the whole space of possibilities and uncertainties, identifying interesting areas of systems behaviour to drill into, to explore and research further. The process also poses two challenges, how to keep algorithms focused on original goals and how to ensure the algorithms change to enable continuous learning.

To address the first challenge, research has shown that algorithms based on adaptive dynamic policies, implemented before key uncertainties are resolved but designed to adapt as new know is acquired, require policymakers and stakeholders to make sure algorithms remain focused on its original goals through monitoring, audit and corrective action (McCray, 2010). The second challenge is address by actively managing, understanding and accepting that not all uncertainties can be eliminated, and the sustainability of computational algorithms is determined by the algorithms ability to adapt. Ignoring uncertainty limits the computational algorithms ability to take corrective action and will stem innovation (Haasnoot, 2013)

Both these approaches are explored and researched using a combination of different soft O.R. Methods before designing and building computational algorithms.

They key question to ask of an algorithm is ‘under what conditions’ will the algorithm fail, because algorithms not only model part or all of a system under scrutiny but include every system relationship to be able to simulate and estimate all relevant outcome indicators, so it is vital that algorithms integrate impact assessment capabilities across multiple domains. Algorithms that offer policymakers with insight into their future problem situations are

often supporting the development of sustainable rea-world policies which is where hard O.R. methods come into the picture.

Well known and established algorithmic models such as Optimisation, Simulation, Markov Chains, Decision Theory and Game Theory to name but a few, are now developed as self-parameterising machine learning computational algorithms leading the development of artificial intelligence. These are often mistaken as new and innovative under the umbrella term of Data Science, but these models have existed for many years under the umbrella term of Operational Research. What could be argued as seemingly 'new and innovative' is the absence of evidence that soft O.R. methods are used to scope and frame the future problem situation that the machine learning algorithms is being designed and developed for.

O.R. Academics and Practitioners have long been the first trained and qualified Data Scientists designing and building computational algorithms underpinning automated decision-making.

Proposition 2 – Computational algorithms built using a combination of soft and hard O.R. methods cope better with vast amounts of structured and unstructured data because O.R. had discovered that 'data' is a viable system that needs to be modelled using dynamic programming.

The emergence of Big Data and supporting technologies has come about because of the application of hard O.R. methods such as dynamic programming to data from the perspective of a viable system (Beer, 1984). Innovative O.R. Professionals had combined O.R. mathematical optimisation with computer programming and discovered the concept of Big Data with underlying technology swiftly evolving to support the discovery. Operational Research methods create a nutrient rich breeding ground for innovation and creativity because of its emphasis on research and this has already been applied to Data.

Computational Algorithms built using O.R. methods can cope with vast amounts of structure and unstructured data using Big Data technologies because in-built impact assessment capabilities can also be applied to data types, data lineage and data security. It was the process of exploratory research using soft O.R. methods that identified a change in the uncertainty space. Big Data and supporting technologies introduced new social,

environmental and technical bias factors that need to be audited, monitored and impact assessed in the computational algorithms engines that make up automated decision-making. Having identified this interesting new area in the uncertainty space, a combination of soft and hard O.R. methods have been utilised to drill down and conduct further exploratory research to gain insight and support development of sustainable real-world policies.

O.R. Academics and Practitioners have long understood that Data and Big Data have its own set of behaviours and are aware of how Big Data Technologies have introduced and managed the new factors that add bias to the analytical outcomes.

Proposition 3 – The Operational Research Society has long been promoting best practice use and supporting industry standards that are aligned to its scientifically proven O.R. methods ensuring the design and build of computational algorithms remain robust, sustainable and transparent

Operational Research is unique in that it offers an industry standard toolkit of mathematical and statistical applications that addresses every component of the Scientific Method. From mathematically and statistically framing the defining the viable system, to structuring the problem using exploratory research and using soft O.R. methods to uncover the whole space of possibilities in the uncertainty space. From using hard O.R. methods to design, build and test system models, including data models, from different perspectives to focus on uncovering the reason for a systems behaviour rather that predicting systems behaviour.

As best practice Operational Research Society recommends soft O.R. methods to help reveal a broad range of assumptions, circumstances and hypothesis by constantly asking what could make the algorithm fail? Then by feeding the outcomes into hard O.R. methods it ensures algorithms have in-built impact assessment and corrective actions capability, and continuous learning capability to support monitoring, auditing and assessment of algorithms vulnerability to uncertainty and change, particularly relating to data. By promoting best practice it ensures that design and build remains transparent, sustainable and capable of being independently reviewed.

The Operational Research Society actively promoted the use of its industry standards toolkit of O.R. Methods and recommends the application of soft O.R. methods before designing

and building hard O.R. algorithms. By offering certification and professional registrations, it ensures industry standards and best practice remain high on the agenda, encouraging continuing professional development to ensure knowledge and expertise of industry standards and best practices remain up to date. A broad range of training programmes including the recently published DSaaF™ : Data Science as a Framework and pro-bono projects supports early career professionals, and its OR in Schools bring knowledge and expertise to the UK curriculum.

The recent publication of 'DSaaF™ : Data Science as a Framework' contributes to and reinforces the message that all the techniques required to solve the problem of automated decision-making and the management of Big Data, can be found under the original term of Operational Research. The Framework emphasis the point that Data Science and Operational Research are interchangeable terms and by using the Framework it can help guide and direct the process of scoping, designing and building of computational algorithms, using a combination of soft and hard O.R. methods. The DSaaF™ : Data Science as a Framework is in the process of obtaining the British Standards Institute kitemark, to support institutions who wish to display their commitment to O.R Industry Standards and Best Practice, as part of their process of designing and building computational algorithms. Training on the Framework is uniquely available through The Operational Research Society.

O.R. Academics and Practitioners have long been well trained and best qualified to implement industry standards and best practices during the process of the design and build of computational algorithms supporting automated decision-making.

Summary

In summary, Operational Research methods, The Operational Research Society and qualified O.R. Academics and Practitioners have long solved the problem of automated decision-making using computational algorithms. So, what has gone wrong?

The reason the concerns are now being raised about computational algorithms underpinning automated decision-making is because of the visible departure from the practical application of O.R. Industry Standards and Best Practices to the design and build of computational algorithms underpinning automated decision-making.

This departure is evident in the disappearance of O.R. departments in many institutions, organisations and sectors. This is particularly evident in the financial institutions and the banking sector where once every financial institution had an O.R. Department actively managing sustainable algorithmic modelling and now there are none.

The finance industry's deliberate choice to bypass O.R. best practice and industry standards when designing and building computational algorithms lead to the proliferation of computational trading algorithms that were neither transparent, nor capable of being independently reviewed. Their design and build were further fertilised by generous financial rewards for algorithms that produce immediate results, that underpinned the development of unsustainable real-world policies.

Innovative Start Up companies heavily financed by Venture Capitalist Funds have also inherited this desire to design and build computational algorithms that produce immediate results. Faced with generous financial rewards, innovation has also opted to bypass O.R. best practices and industry standards in favour of quick and cheap algorithm development. Resulting in anxiety and concern about the way personal data is used for benefit and gain.

The DfE formed A-level Content Advisory Board's decision to exclude any Decision content in A-Level Maths is also evidence of the departure of understanding the maths behind decision-making which fostered further learning of Operational Research Methods as well as its industry standards and best practices.

The social media's desire to sensationalise Data Science as new innovative concept is further evidence of the departure of the best practices associated with soft O.R methods, feeding the insatiable appetite to build unsustainable computational algorithms that generate immediate results, and depart from the scientific research that O.R. promotes, incorrectly perceiving the process of scientific O.R. research to be costly, time-consuming and stemming innovation. No evidence of which exists.

Conclusion

The only way to address the concerns associated to use of computational algorithm underpinning automated decision-making is to revive the need for organisations and institutions to implement O.R. industry standards and best practices such as those described

in the DSaaF™ : Data Science as a Framework; to reinforce the need for the designers and builders of computational algorithms to become trained, qualified, certified and professionally registered O.R. practitioners; and to support the education of O.R. best practices and industry standards by adding O.R. back into the curriculum from key stage 3 onwards, in order to raise awareness and set the tone for future O.R. best practice and standards.

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References

Beer, S. (1984). The viable system model: Its provenance, development, methodology and pathology. *Journal of the operational research society*, 7-25.

Haasnoot, M. K. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global environmental change*, 23(2), 485-498.

McCray, L. E. (2010). Planned adaptation in risk regulation: An initial survey of US environmental, health, and safety regulation. *Technological Forecasting and Social Change*, 77(6), 951-959.