Headlamp Software:
Moving the world from correlation to causality

Data analytics is becoming more pervasive in business, organizations and daily life. The process of examining data sets in order to draw conclusions and insights has moved from niche to mainstream in the past decade; according to the 2018 Gartner CIO Agenda, CIOs globally ranked analytics and business intelligence as the most critical technology to achieve an organization's business goals, while Research&Markets reports that data analytics has a CAGR of 29.7% and will be a market worth $40.6 billion by 2023.

The science of data analytics covers a diversity of techniques and applications. To many it is seen as the crude use of big data to establish retrospective correlations, but increasingly the approaches being used focus on the deeper causal relationships between events and outcomes, and attempt to deliver these insights in real time.

Causal analytics has a critical role to play in the future evolution of man-machine relationships, that will transcend all the benefits we have derived to date from the exploitation of artificial intelligence (AI). The insights offered by causal analytics are set to accelerate our understanding and application of AI to medicine, e-commerce, economics and science through the deep learning that this new approach makes possible for us.

What is Causality?

The causal relationship is seemingly obvious to humans; the sun shines so the grass grows. But sometimes we misinterpret a correlation as a cause; the increase in lung cancer coincided with the invention of plastics, therefore plastics caused cancer – when in retrospect it is obvious the true causes were smoking and asbestos. And sometimes we like to mix correlation and causation for fun; when the storks leave their nest for a nine-month migration it coincides with the wedding season, and when they return nine months later there are babies arriving - and the myth attributes babies to storks.

The assumption is that we, as humans, are pretty much as good as we can be at pattern matching and spotting the difference between causation and random, or accidental, correlation. But the truth is that we are not that good, as DeepMind has proven with its reinvention of chess, where its machine learning has shown that seemingly poor moves can be strong, and unconventional tactics win the game. What DeepMind has taught us is that our assumptions about causation, despite being based on generations of accepted wisdom built on human experience, can in fact be very wrong.

In the place of human experience and intuition, data scientists are now turning to causal analytics as a means of accurately pinpointing precise relationships between events and outcomes based on mathematical modelling. The science of causality relies on three levels of inference: the association

of one event with another based on correlation of data; intervention through manipulation of a single variable while keeping others constant, to observe the change; and the counterfactual analysis that examines the hypothesis that if an event had not occurred what would the outcome have been.

Each of these inferences can be described in mathematics and algorithms that can lead to the productive employment of causal analytics to determine why events happen. When implemented using an automated inference engine that can manage the manipulation of variables, the causal analytics process can be applied in any circumstance that offers a stream of computer-interpretable data with governable variables.

Causal Analytics Value

Advanced algorithms and computer processing speeds can test for true underlying causation far more effectively than the base correlations of big data analytics, or the intuition of humans. Mass experimentation based on automated micro-changes can lead to a far more profound understanding of the true causal construct. Put simply, the causal analytics approach uses simple "is it A, or is it B?" tests to determine the optimum outcome, then based on the outcome, drives another micro-experiment. In reality it utilises millions of micro-experiments to gain a causal understanding of the relationships that exist.

The power of this new computer science has the potential to radically change the success of organizations that adopt it. Already, companies like Amazon and Netflix have adopted causal analytics to drive sales in retail and entertainment, while Google's DeepMind has shown the world what it can do, through the use of causal analytics, in beating all human and computer challengers in Go and Chess, before moving into the realm of medical science and finding new ways of diagnosing and treating diseases believed to be caused by misfolded proteins, such as Alzheimer's, Parkinson's, Huntington's and cystic fibrosis.

Democratizing Insight

So far causal analytics has been used by proprietary solutions, such as the Amazon shopping cart or the Netflix menu. Headlamp Software's mission is to democratize this technology by making it generally available to the benefit of all. By taking a generic, non-proprietary approach to the application of causal analytics, Headlamp can deliver its solution more rapidly across a diverse range of situations.

Just as Alan Turing, the father of computing, took a single solution machine and reinvented it as the idea of a programmable computer, so Headlamp is creating a generic causal computing platform that generates its own algorithms, using massively powerful hardware to enable parallel dataflow. Through its generic implementation, Headlamp is also looking to significantly cut the cost of causal analytics for customers and open up the science to thousands of companies that lack the financial resources and expertise of Netflix and Amazon.

At the core of the algorithm is a Structural Causal Model (SCM) that relates the math to logic through the testing of a succession of hypotheses that determine the true relationships and discard

the false positives. The computational requirements for this approach are considerable and Headlamp's software is run by dedicated hardware that delivers over 100 Petaflops of processing power.

Application

Headlamp's causal analytics system is initially being tested in diverse and quite unrelated applications, to assess the wider applicability of the platform to problems ranging from e-commerce to medical research.

E-commerce Application Case Study

One World Observatory (OWO) draws over two million guests per year from all over the world, instantly placing it in the top five attractions in New York. In 2018, Headlamp Software engaged with the operator of OWO, Legends, to study and ultimately optimize online ticket conversion through determination of causality.

Consisting of a video-led web page with click-thru sales exhortation, the OWO e-commerce site is an ideal test case for the application of Headlamp Software's causal analytics system. The OWO e-commerce site was redirected so that variables such as the timing or location of the sales exhortation could be varied and the results tracked. The Headlamp platform was then set up using a Structural Causal Model to manage the automated variables that would be used in the optimization of the OWO e-commerce platform (see Figure 1).
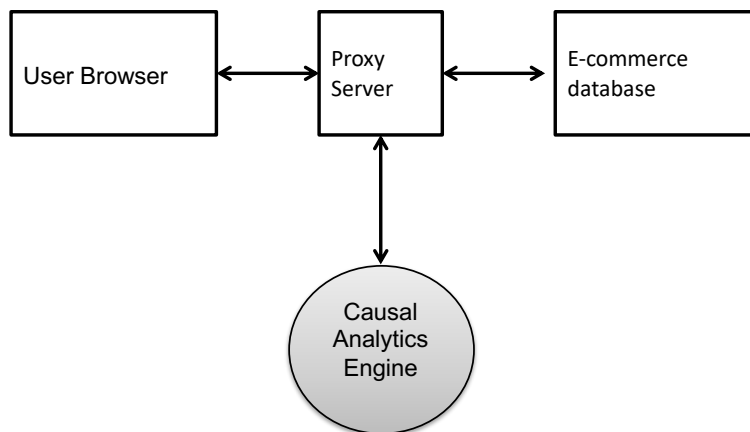

Figure 1: The application of Causal Analytics in e-commerce.

The first phases of the OWO causal analytics research are currently underway with results expected in the next few weeks, but early returns have already shown significant transactional improvements through the identification of new optimization pathways.

Conclusion

The promise of causal analytics is substantial, and progress in using causal analytics has been demonstrated by Amazon in e-commerce, Netflix in entertainment, and DeepMind in gaming and medical research. This approach can now be replicated across many other sectors in diverse ways with the availability of a generic platform that will be fast to implement and relatively low-cost to develop.

Following the pioneering work of Turing-award winning mathematician Professor Judea Pearl, causal analytics is a science that has become practical thanks to the availability of super-fast and low-cost processing power. The math is well understood and the technology proven in what it can achieve. We are now ready to reap the rewards of this new data revolution.

About Headlamp Software

Headlamp Software is pioneering a generic platform for causal analytics to provide organisations and companies worldwide with the means to discover new causal relationships between events and actions. Headlamp is also introducing a gainshare business model where its financial reward will be based on the measurable gains made by its customers.