The Oxford-Man Institute, Man AHL and the Direction of Machine Learning

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Artificial Intelligence ('AI') is advancing rapidly. From driverless cars through to virtual assistants, from smart heating systems to Amazon drones, innovation seems to be everywhere. The field of finance is no different and Machine Learning ('ML') techniques – a branch of AI – are increasingly being applied to investment analysis.

Simply put, we define ML as any computerised system which can use algorithms to identify and act on repeatable patterns learned from data, without being explicitly guided as to what patterns to look for.

The University of Oxford and Man AHL are at the forefront of quantitative techniques, as academics and practitioners, respectively. We both see ML as being an increasingly important part of our research areas. Since our joint decision in 2016 that the Oxford-Man Institute ('OMI') would concentrate on ML in quantitative finance, the OMI has added 19 new researchers who specialize in this area. A research community of this scale makes the OMI one of the most significant research groups within the University.

Common perceptions are often a hindrance to a proper understanding of the subject. In 'The Hitchhiker's Guide to the Galaxy', the super-computer Deep Thought takes 7.5 million years to determine that the 'answer to the ultimate question of life, the universe, and everything' is 42. A similar picture is often conjured when people talk about ML – throwing enormous processing power at a massive dataset until some golden insight is found that can unlock the secrets of the universe.

In fact, the aim is often simply to combine a variety of weak information sources into a whole which has greater signalling power than any of the individual inputs in isolation.

In investment specifically, we think that a world of unbridled AI with people rendered redundant is some way off. We do, however, think that machines will continue to enable investors to benefit from areas that the human brain struggles to reach. Homo sapiens have strong pattern recognition ability over small homogenous datasets, but they struggle as the information set becomes larger and more varied. This is undoubtedly the case for financial information, which is not only burgeoning in size – Man AHL alone receives around 1.25 billion unique data ticks every day – but is also very diverse, consisting of the obvious numbers and text, but also more unusual information sources.

For example, in the case of energy and crop markets, meteorological diagrams and satellite images (both visible light and synthetic-aperture radar) are becoming crucial to our understanding of both crop conditions and inventories. ML techniques allow us to combine numerous and varied data sources to give insights that human intelligence might miss.

Expectations of imminent ML domination in finance have been encouraged by a series of computer victories in ever more complex board games. In 2016, we saw Google's AlphaGo beat South Korean Lee Sedol, one of the world's most decorated Go players, by four games to one (Go is a board game played largely in East Asia). AlphaGo was then itself beaten by AlphaGo Zero in October 2017, by 100 games to zero. The new development was significant in that AlphaGo Zero taught itself to play Go in three days, using a neural network which originally knew nothing about the game. Instead of studying thousands of human games, AlphaGo Zero simply played against itself, starting from random play. The game of Go is reported to have more possible board configurations than there are atoms in the universe.

Given this, some media commentators have asked why the same computational fire-power could not be recalibrated to tackle the 'game' of finance. The reality, however, is unlikely to be straightforward. Go has total observability – the board design and the number and colour of the stones are all set in advance and cannot change. With investment, although there are certain constants – such as the amount of money you have to invest – most of the factors and the 'rules of the game' are more nebulous, and the regulatory, economic or demographic environments can, of course, change significantly over time. Trying to navigate the correct path through this amorphous landscape requires the core human skill of contextualisation – making a qualitative judgement about how processing power should be best applied.

In addition, the unchanging rules of Go, combined with the computer's ability to explore alternative moves through replay, enabled AlphaGo Zero to evolve its game strategy through billions of rounds of self-play.

A machine trying to do the same thing in financial markets faces a far greater challenge. This is not only because the number of permutations inherent in financial markets is massive – even relative to Go – and that the nature of the 'game' changes through time, but also because real-life financial markets only get played out once. This significantly limits the scope for financial strategy development through self-play.

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Having said all this, we do see significant future potential in ML as a technique for assimilating information from ever larger and more varied data streams. We think that ML naturally extends existing systematic data modelling approaches which already successfully provide robust rational alternatives to human behavioural biases.

However, the challenge remains significant because, as we have discussed, finance is an order of magnitude more complex, and statistically noisy, than many of the arenas where ML has so far reported its greatest successes. Accordingly, for the foreseeable future, we believe that the relationship between man and machine will remain collaborative rather than adversarial.

The OMI is at the forefront of ML. We believe it is ideally placed, through its co-location with Man AHL's Oxford research laboratory, to contribute to the science that underpins Man AHL's investment research, whilst also making a broader academic contribution to ML and its application across different disciplines. Indeed, we increasingly find that solutions in one domain can resonate in others, including finance and investment.

One such example is the Galaxy Zoo Supernovae project[1]. This is an online initiative which presents volunteer users with images of deep space and asks them to classify what they see based on each image's features. The answers from many such volunteers are then aggregated to determine which images contain supernovae.

Collaboration between the OMI and Man AHL enabled the ML methodology for solving this astronomy problem to be applied to the task of seeking to extract useful predictive signals from broker recommendations in the world of finance. Both cases involve classification decisions based on a variety of potentially conflicting evidence, where learning is undertaken by processing the track records of individual astronomers or analysts. As ML matures, we expect to find similar examples of techniques which are transferable across disciplines.

When asked how he would spend a trillion dollars to solve global warming, the late Professor Sir David MacKay gave a somewhat surprising answer – data analytics. The implicit suggestion was that academics and practitioners alike are not currently extracting information from data to its full potential. We believe that organisations such as the OMI, which bring together researchers and practitioners from widely varied backgrounds, can be part of the solution. We think this could greatly accelerate progress, giving heightened insight into the investment world, and beyond.

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1. See https://www.galaxyzoo.org/