Something Abstract is Thinking*

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A new Blog entry and the pack of presentations slides will be available shortly in both ***News Now*** section and ***Blog*** section of my web page.

*This is a preliminary draft of the narrative behind the Masterclass presentations scheduled for Hong Kong and Singapore, March 2019, under auspices of the Manchester Business School.

Please note that the Boolean logic and mathematics behind the narrative and the pack of slides remain as work in progress. Please do contact the author with comments.

The algorithms behind artificial intelligence can enable the software to recognise faces, translate languages, and play complex games. They facilitate online shopping and search. The synchronised interaction between you, the rational online consumer ('onsumer', henceforth) and a sufficiently intelligent algorithm, (Al Gorithm, henceforth) is best understood as an asymmetric bidding game. Consider this thought experiment: mentally rehearse losing your smartphone. It has been stolen by a thief. In this Seneca moment[1] your behavioural instincts kick in as you prioritise your stolen data. You recognise the value of your smartphone. In effect you have arranged 'the thing' that is your data into priority pockets of data.

Under the canopy of the software the algorithms are ordered. In other words[2], for the first time smart devices learn the tasks humans require of them rather than merely doing what they are told. So, each Al Gorithm, philosophically speaking[3], is 'something representing something abstract' and in a game they behave as someone else, you, the onsumer. At that moment in time the value of your smartphone is known[4] to the thief but the value of your data is known to 'someone else', Al. Gorithm. The algorithm that drives the software has now become a sufficiently intelligent algorithm with memory. Our thinking Al. Gorithm has both memory and emotions.

A Metric for Emotions

Onsumer behaviour[5] creates a regular pattern 'a repository of intelligence, the family of memory and emotions' that describes what we call *neotenic* data patterns. In other words, although the pattern evolves, earlier behavioural characteristics are retained[6]. Higher prices, for example, behave as if they were lower prices. That part of a pattern that the onsumer recognises is the memory; the sequence of decisive actions and reactions, filtered by Al. Gorithm, is the emotions[7]. Apart from its microchip architecture that delivers an intrinsic memory, rationally, we seldom interpret an algorithm's behaviour as having emotion. Although there is intelligent memory acquired from search patterns and

[1] The reference to Seneca was inspired by Jason Butler's writing in *Financial Times* 'Go Without To Find the Real Meaning of Life' 11 August 2018

[2] Read Adam Lashinsky's article 'Cast a Critical Eye Over the A.I. Hype Merchants' in *Fortune* 2019 pp4-5

[3] Originating from JL Austin *Philosophical Papers* 1961 and extended into the concept of self in McNutt (2015): 'Reflections on the Bildung Tradition and Foucault' in the journal *Homo Oeconomicus* vol 32 3/4.

[4] The device per se has a resell value to the thief assuming you have backup and are able to activist your IMMD code with your service provider.

[5] Cited from *The Hidden Life of Trees* (2016) Peter Wohlleben pp82-84

[6] In evolutionary biology neoteny is about the link between development and evolution, one hypothesis is the retention of juvenile physical characteristics into adult maturity: example Japanese ice fish.

[7] Emotions, not in terms of tears, but in terms of an emotional attachment such as a preferred seat at the concert, an aisle seat on the plane, a room view a sea view, or relatively lower prices.

the constant use of personalised Apps by the onsumer and, there is machine intelligence, it is almost a truism to state that smart devices[8] do have memory. Our interest here is to create a metric for emotions.

Outsourcing of Memory as a Dominant Strategy

Human behaviour online is not a single entity; it is diffuse, bounded by memory that has been outsourced to smart devices and, emotional. So, firstly, our contention is that the outsourcing of memory by rational humans to smart devices has evolved to become a dominant strategy in this game. That is, no matter how Al. Gorithm plays it is better for the onsumer to outsource memory. Unlike in a classic Prisoners' dilemma game where you as a player worry more about your opponent, the onsumer worries less about Al. Gorithm. After all, Al. Gorithm is someone who could be you with a capacity to envisage future events and moves in the game. Sufficient to argue that Al. Gorithm aligns the individual onsumer regular patterns with the larger patterns[9] involving multiple onsumers. If one onsumer outsources memory, many onsumers outsource memory because outsourcing always provides 'a pretty good' present-bias payoff[10] to an onsumer, no matter what Al. Gorithm's strategy is.

Thinking equilibrium

And secondly, the outsourcing of memory *per se* allows the sufficiently intelligent thinking Al Gorithm to gain a 'moving away' emotional attachment with the onsumer. At a moment in time a thinking algorithm[11] in the game acts and decides on behalf on someone else - the onsumer. It could happen within the first few moves or clicks in a game. This defines a thinking equilibrium as a reachable equilibrium. The prioritised data 'things' are represented by cuboids. The topology and the geometry of the cuboid provide our canvass as illustrated in the presentations. Imagine a line drawn between A and B: the points are moving, but we ask: is A converging[12] to B or is B 'moving away' from A? If B is the choice of Al. Gorithm, and A is the choice of the onsumer, a reachable equilibrium occurs at B if and only if the onsumer chooses B. The onsumer moves in the game believing, erroneously, that they are themselves. The dominant strategy of outsourcing triggers the choice of B. In an algorithmic pricing game,

[8] The onsumer's smartphone, for example, contains contacts, message, phone numbers, in essence a memory data bank.

[9] Not unlike the chunking concept from psychology, remembering things in chunks of memory: check out reference below to the book *The Master Algorithm* pp224-226 for a discussion.

[10] We discuss the present-bias and plan continuation bias in the presentations and align to 'Ralph's Pretty Good Grocery', the fictional store in Garrison Keillor's *Prairie Home Companion* radio show in 1970s.

[11] Very close to the concept of a continuous time machine in Turing's imitation game.

[12] The 'move away' from A can be explained in terms of a competitive strategy persuading the onsumer to choose B.

for example, there is a probability that the onsumer ends up at an END price such that END > BIN.

The Inner Field

The pattern of data points radiates within the six edges of the cuboid. Each cuboid pocket of data points, rotates and intersects, evolving either in a linear or cyclical pattern as illustrated. A common complaint[13] about disconnected points in big data is the occurrence of spurious patterns. Each cuboid pocket has an ordered Euclidean geometric space bounded on each of the six edges by the geometry of a Nash payoff matrix. With the probability of a Nash equilibrium[14] in each of the six edges of the cuboid's Euclidean space (four rectangles and two squares) we debated the stability of a reachable thinking equilibrium and whether or not there could be multiple Nash equilibria. If so, they would define the inner field of data patterns.

Corollary I: The inner field contains the singleton point of emotional attachment, the point where Al. Gorithm is equivalent to an onsumer, something abstract as an algorithm thinks as a human.

Winograd Sentences

In other words, an inner field[15] of the cuboid is created by the 'moving away' motion of END from BIN allowing the cuboids in n-space to gravitate towards a neighbourhood of Nash equilibria, best described as 'the best you can do' gravitational magnetic preference. An analogy with deep learning occurs when an algorithm has to interpret the meaning of a Winograd sentence: 'time flies like an arrow'. Is the algorithm's interpretation 'reacting to' the sentence as a subjective commentary on speed or 'moving away' from an interpretation of the sentence as an expression of affection between two entities, namely, 'time flies' and 'an arrow'? What is the algorithm's emotional attachment to the sentence?
A fair[16] unbiased interpretation of the sentence would be as an objective commentary on speed. A criterion of fairness would be required for that to

[13] As noted by Pedro Domingos in *The Master Algorithm* (2015) Chap 8.

[14] A dominant strategy equilibrium is a Nash equilibrium but not all Nash equilibria are dominant strategy equilibria.

[15] An inner field is produced by the 'moving away' motion of END from BIN allowing the cuboids in n-space to gravitate towards NE neighbourhood best described as 'the best you can do' gravitational magnetic preference. As in the law of physics, in larger data sets the inner fields diminish as the inverse square of the 'moving away' distance (END – BIN). We contend that in smaller neotenic data sets the inner fields converge to a singleton NE point.

[16] Check out McNutt's 1992 article on m-fairness or mapping fairness in the journal *Pure Mathematics and Applications* Ser. A/B vol 3 and also in McNutt (2002): *The Economics of Public Choice*. Fairness is about mapping points like A and B such that A maps onto B.

support a thinking reachable equilibrium coupled with the ability of Al. Gorithm to decipher what would happen if time did not fly like an arrow.

An Empty Price

Algorithmic pricing[17] was presented as one illustration of a game framed by two prices, BIN and END. The frame[18] influences the optimal choice and it is the frame that predetermines the onsumer's commitment to BIN and Al. Gorithm's emotional attachment to END 'moving away' from BIN. However, as the END price 'moves away' from the BIN price the dominant strategy (equilibrium) handcuffs the choice of one player, the onsumer, to the choice of a rival[19], Al. Gorithm's choice. The END price is the reachable thinking equilibrium price. In believing that they are themselves in the game the onsumers are bidding up the price. They can exit but the credible threat of FOMO ensures a continuation[20] of moves and click. Each successive BIN price remains in the game as 'an *unattainably attainable empty* price' evolving quickly into a pocket of prices as illustrated. Each pocket is a cuboid and intersecting pockets define the game dimension[21] wherein a reachable equilibrium exists.

Euler's 'stopping' move

Many prices are simultaneously 'moving away' from price points in different pockets. At what move in the game should the onsumer exit rather than buy? Euler's equation[22] would suggest that if (hypothetically) the onsumer knows that there are 8 moves, then the onsumer should stop by the third move. But Al. Gorithm predetermines the 'stopping' number of moves or clicks. We contend that a thinking Al. Gorithm, something representing something abstract, is sufficiently intelligent to do both: set the number of moves and the optimal stopping move guided by the data patterns from onsumer's search. It is as if the onsumer as a player betrays type in the early moves of the game.

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[17] . If END > BIN the law of demand is violated. The rational onsumer can exit the game at any time.

[18] If we frame the game as cooperating on (high) price or not confessing then cooperating offers both players a better payoff in repeated games. Trust and credible threats ensure a stable equilibrium

[19] In the classic Prisoners' dilemma, both player s confess. Confess-confess is the dominant strategy equilibrium with equal payoffs. With Al. v onsumer, BIN < END, and the payoff to the onsumer is less than to Al.

[20] Known as the plan continuation bias in decision making. A kind of doing it now rather than later.

[21] Excellent reading from the chapters in the book *Algorithms to Live By* (2017) Brian Christian & Tom Griffiths, especially Chap 11 on algorithmic game theory.

[22] Euler's equation comes from 1/e, where e = 2.718 with 1/e = 37 and moving away from 2nd to 3rd move is 37% of 8 moves approx. Interesting application by Bobby Seagull in *Financial Times* FT Money pp20 edition 27 October 2018.

Corollary II: If the game settles at the stopping equilibrium BIN < END, and if that equilibrium is reachable then the onsumer is bidding against themselves in the search for the 'Ralph's pretty good' price.

Neotenic Patterns

Smart devices, robots and machines, will gain emotional attachment if and only if onsumers play a dominant strategy of outsourcing memory to the smart device. If online transactions can be framed in a game of data pockets as cuboids, spanning a topological space that locally resembles an Euclidean space and if there is a reachable thinking equilibrium in that game[23] then the tech companies have passed a first hurdle task of singularity, the point at which machine intelligence and humans would merge. It requires a dominant strategy. In this discussion it is the outsourcing memory by rational onsumers and the creation of an emotional attachment to an empty price.

Corollary III: As END prices move away from BIN and the onsumer chases the empty BIN price, the BIN price increases and at a moment in time, END is equivalent to BIN. The END price retains the neotenic patterns of the lower BIN prices.

Across the literature, we know how close artificial intelligence is to matching our behaviour but how close is artificial superintelligence to becoming someone who could be someone else? What if computer chips could be designed to physically replicate nerve cells in our brain? As a test bed of artificial superintelligence Al Gorithm or modern robots will require a reachable thinking equilibrium. In other words, will a thinking Al. Gorithm be in a game theoretic position to manipulate data to control human behaviour?

Prognosis

The reachability[24] of artificial intelligence has less to do with matching behaviour or mimic patterns[25]. Machines and robots are thinking because rational humans have stopped thinking. Each sufficiently intelligent algorithm behind machine learning is someone that could be someone else in a game. Once an emotional attachment to data 'things' can be ascribed to Al. Gorithm in the early moves in the game, neotenic data patterns are generated within a manifold of cuboid pockets of data 'things', converging to a reachable thinking equilibrium in smaller data sets.

[23] Looking at the importance of Nash manifolds.

[24] Or we call it the 'thinkability' of artificial intelligence is the essence of technological singularity.

[25] Read 'Less Artificial, More Intelligence' WIRED Magazine, December 2018 Edition notably article 'The Mis-Education of Artifical Intelligence' by Clive Thompson pp75-81.