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TOWARDS A CRITIQUE OF ALGORITHMIC REASON

TERESA NUMERICO[*]

Abstract: Datification and predictions based on correlations suggest that data–driven procedures in social sciences are interested mainly in tracing the appearances. Big Data science seems to rely on predicting the appearance without taking into account the explanation and the existence of the phenomena.
Following Husserl, Arendt and Stiegler it is legitimate to build abstraction criteria to extract data from the phenomena in order to make sense of them. However, it is necessary to be in control of what we are doing, and we need to check models against the effectiveness of the results in understanding phenomena.
What happens when the process of abstraction happens in ways and with tools that nobody can check from outside? What happens when the results of the abstraction/technicization process have normative effects on its research objects, imposing expectations and predictions of people's behaviour according to predictive analytics? Is data science moving beyond Modern Science as we know it?
If phenomena under observation rely on uncertain circumstances, there is no way to make predictions that are completely trustworthy. But if the predictions have normative effects, we have to pay attention to the uncontrolled consequences of such a vicious circle.

Keywords: Data Science, Predictions, Abstraction, Technicization, Edmund Husserl, Hannah Arendt.

(*) teresa.numerico@uniroma3.it.

1. The epistemology of data driven science

There are many algorithmic procedures that involve citizens' rights, based on the datification of people's preferences and characteristics. Their aim is the classification, and anticipation of the behaviour, of human beings' behaviours in many sensitive contexts, such as: risk assessment evaluation in repeat criminal offending, credit scoring, insurance premium quantification, shortlisting candidates for jobs offers, student access to university, etc.

However, data is always built; there is no such thing as raw data[1]. Data is always "cooked" in some way and extracted out of a process of definitions and interests. Data can be defined as relational, and its relevance is produced by the intricacy of its connections with other variables and other databases[2].

There are many authoritative voices starting from the famous paper by Anderson[3] on *data deluge* who claimed that theory is no longer needed, because there is so much data that explanation can be replaced by correlation. This hypothesis is based on the assumption that data and theory are different epistemic entities. However, by paying more attention to the complex ontological and epistemic assumptions that underlie this hypothesis, the validity of this distinction can be easily challenged.

If we agree that raw data is impossible to achieve, we must raise questions about how we "cook" data and how we prepare it for algorithms that correlate and interpret it. As suggested by Gillespie, we need a deep investigation on the interpretative nature of algorithmic interpretations and the data preparation that precedes them[4]. Bernard Stiegler sustained that human beings have always been defined by their use of tools, and in particular by devices for the externalization of memory, and these devices have inherent policies[5]. What needs to be understood are the policies of this computational representation of knowledge, and the methodology of their creation.

(1) See Gitelman L. (ed.), *"Raw Data" Is an Oxymoron*, MIT Press, Cambridge 2013.

(2) See on this issue Leonelli S., *Data–Centric Biology: A Philosophical Study*, Chicago University Press, Chicago 2016.

(3) Anderson C., *The End of Theory: The Data Deluge Makes the Scientific Method Obsolete*, "Wired", 23/6/2008, https://www.wired.com/2008/06/pb-theory/.

(4) See Gillespie T., *The relevance of algorithms*, in Gillespie T., Boczkowski P., Foot K. (eds.) *Media Technologies: Essays on Communication, Materiality, and Society*, MIT Press, Cambridge 2014, pp. 167–94.

(5) See Stiegler B., *La société automatique. 1 l'avenir du travail*, Librairie Arthème Fayard, Paris 2015; eng. tr. *The automatic Society*, Polity Press, London 2016.

Evelyn Fox Keller argued that, once a methodology is adopted within a scientific discipline, it transforms the object under observation[6]. And the chosen methodology arises from a pre–scientific decision–making context. This means that the method is often chosen without any clear epistemic strategy. However, once chosen, the method changes the way we observe the object of the research. Applying this epistemological perspective to the choice of interfaces, computational infrastructures and algorithms, the consequences of these choices can only be vaguely foreseen and have not been agreed in advance. The selection of methods and devices can definitively influence an earlier object of research by imposing on it a new interface design and model to filter, translate and understand it. This transformative effect is a matter of policy and ethical positioning of the scholars carrying out the research. Freedom of experimentation is of course necessary, but the meaning and the effect of the technical devices chosen to represent the objects under investigation must also be taken into account.

Wiener[7] and Licklider[8] (1960) shared with many other scholars of cybernetics the idea that the computer, a digital stored–program machine, would be able to support some human tasks by externalizing the functions of human intelligence, especially with regard to memory. The availability of a quick, basic way to manipulate information, combined with a huge amount of data would transform the communication and acquisition of knowledge.

This conception of the characteristics of digitization and communication technologies, which underlaid cybernetics was founded on the implicit belief that it was possible to capture human intellectual/cognitive capabilities, substituting intuitive and responsible human decision making, by a quick sequential processing of a massive amount of data. However, we have to point out that Wiener himself was rather scared of the social and political consequences of this new transdisciplinary approach to knowledge that he called cybernetics. In the next section I will discuss the effect of the cybernetics' approach on the project of the complete externalization of memory within communication and control phenomena under the investigation of Licklider,

(6) See. Keller Fox E., *Conversazioni con Evelyn Fox Keller*, Elèuthera, Milano 1991.

(7) See Wiener N. (1948/1961), C*ybernetics: or control and communication in the animal and the machine*, MIT Press, Cambridge 1961[2] and Wiener N., *The Human Use of Human Beings*, Houghton Mifflin, Boston 1954[2].

(8) See Licklider J.C.R., *Man–Computer Symbiosis*, «IRE Transactions on Human Factors in Electronics», vol. HFE–1, 1960, pp. 4–11 (http://groups.csail.mit.edu/medg/people/psz/Licklider.html); Licklider J.C.R., Taylor R.W., *The computer as a communication device*, «Science and Technology: For the Technical Men in Management», n. 76, April, 1968, pp. 21–31 (http://memex.org/licklider.pdf).

whose project was the complete digitization of human knowledge. We can consider his approach as the missing link between the scientific proposal of cybernetics and the birth of data driven science.

2. A genealogy of data science: replacing human memory according to Licklider

The idea of accessing an entire corpus of texts related to an object of study was originally conceived in connection with the development of digital technology in the 1960s. Joseph Licklider published a book on the future of libraries where he discussed in detail a project of how to interact directly with the "fund of knowledge"(9). He is one of the pioneers of the network project, although he was not directly involved in the first practical steps of the creation of Arpanet, the network that started in 1969 and that is the ancestor of the Internet. Licklider was also influenced by cybernetics. He participated in one of the Macy's conferences, and in the Cybernetics dinners organized at the end of the 1940s by Wiener(10). In his book on *The libraries of the future*, Licklider introduced the possibility of managing the "fund of knowledge" as a unique object of study that could be consulted in its entirety, even remotely. He hypothesized that the digital reorganization of libraries might be the vehicle that would facilitate a transformation in knowledge organization and hence in knowledge acquisition.

Licklider suggested that computer communication technologies would enable a direct interface between the "fund of knowledge" and a researcher's experimental results. He had in mind the classical scientific experiment, but the idea of Big Data was already present and could be applied to social and political research as well as to research in physics and biology. It was based on the ingenuous representation of digitization as a form of disintermediation. Licklider believed that in his time the boundaries between the library where books and information were kept, and the experimenter's laboratory forced the researcher into a cognitive mediation between the result of the experiment and already acquired knowledge. He characterized digitization as a method that would avoid the intervention of the scientist's own cognitive process to

(9) Licklider J.C.R., *Libraries of the future*, MIT Press, Cambridge 1965.

(10) It is impossible to get into more details about the influence of cybernetics on the birth of Arpanet. For further information see Numerico T., *Alle origini di Arpanet. Il contributo cognitivo di Norbert Wiener*, «Sistemi Intelligenti», vol. 21, 2010, pp. 533–42.

correctly interpret experimental results. He was convinced that the mediation of human cognitive capabilities was a limit to the effectiveness of the scientific effort, introducing potential mistakes in interpreting the outputs of experiments.

Licklider's belief was that the cognitive frame used by the scholar to make sense of experimental data would not be needed if the library could be merged with the laboratory. This transfer of the library into the laboratory was exactly his futuristic project — strongly pursued — from October 1962 when he became head of the IPTO[11], an office of the ARPA Defence Agency.

> In organizing knowledge, just as in acquiring knowledge, it would seem desirable to bring to bear upon the task the whole corpus, all at one time — or at any rate larger parts of it than fall within the bounds of any one man's understanding. This aim seems to call for direct interactions among the various parts of the body of knowledge.[12]

According to Licklider, then, it was necessary to obtain "direct interactions" between all parts of knowledge, and he was aware that, for a single human being, it was impossible to manage the necessary amount of information. The machine should, then, act as a sort of expert colleague capable of giving the right advice to the scientist, and knowledge should be managed without the direct intervention of the human being. The conclusion of this hypothesis seemed to be clearly formulated by Licklider himself when he affirmed that:

> It no longer seems likely that we can organize or distil or exploit the corpus by passing large parts of it through human brains. It is both our hypothesis and our conviction that people can handle the major part of their interaction with the fund of knowledge better by controlling and monitoring the processing of information than by handling all the detail directly themselves.[13]

Another interesting consideration he suggested was that the human being might not be the unique and the major agent in the process of acquiring knowledge, acting rather as a kind of supervisor or coordinator of the

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(11) The meaning of the IPTO is Information Processing Technology Office. This office was one of the sections of the ARPA, later called DARPA: Defense Advanced Research Projects Agency.

(12) Licklider J.C.R., *Libraries of the future*, cit., p. 25.

(13) *Ibidem.*

machine's procedures. This approach is relative to a big picture in the future of knowledge, more than only a discussion on the perspectives for the future of libraries. The machine was the only agent able to interact directly with what he called "the fund of knowledge":

> He [the human being] will still read and think and, hopefully, have insights and make discoveries, but he will not have to do all the searching himself nor all the transforming, nor all the testing for matching or compatibility that is involved in creative use of knowledge.(14)

The most interesting element here is that he was not completely convinced that there would still be a creative contribution by the human agent in the production of knowledge. He suggested it by using the expression «he will [...] hopefully have insight and make discoveries», admitting that he was not sure that human insight and ingenuity would still be important or deeply relevant to the creative processing of information. If it was necessary to deal each time with the entire fund of knowledge in order to make new discoveries, it was clear that no human being would be able to do it without the central role of a machine tasked with handling the data, employing adequate procedures and programmed with the most effective methods. Cybernetics opened the possibility of considering living beings (including human beings) comparable to machines in terms of their communication capabilities. Licklider went a step further in asserting that, in this respect, machines were better than human beings, because they were the best managers of the huge amount of available data. Machines could use well–established procedures (algorithms) to sort through all relevant information, using the correlations between the data. Human beings could not make sense of data (finding the correct correlations) because they are not able to follow stringently the required instructions; only programmed algorithms, expressly designed, could produce the desired output.

The idea suggested here had a profound influence on the Big Data approach because it insinuated that it is better to deal with all the data potentially available, than to sort out the relevant portions of that data. His hypothesis was that the human activity of selecting and sorting out an initial subset of the data, which would be crucial for the later intuitions or creative use was not important, because it was more effective to access all the data, subsuming it under a unique management procedure, to find the potential correlations using the brute force of an exhaustive search.

(14) Ivi, p. 32.

Viewed in this perspective, the conclusion that Licklider obtained in 1965 seemed very similar to the objectives of the Big Data projects that started in the decade beginning in 2000. It could be considered as the ancestor of the ideological stance taken in the present technological design. The Big Data hype appears to be one of the concrete achievements proclaimed by Licklider in his seminal book on the future of libraries. It is possible to conclude that he suggested in the mid 1960s a change of infrastructure, as defined in a broader sense by group of researchers of Bowker:

> Here we take infrastructure as a broad category referring to pervasive enabling resources in network form, and we argue that a theoretical understanding of infrastructure is crucial to its design, use, and maintenance.(15)

Changing the infrastructure of science means not only transforming what can be discovered and the methods of discovery but also a social renewal that deeply impacts the organization of work and redesigns memory practices that support knowledge acquisition. According to Bowker information and communication technologies produce a new social dimension of science that deals with how knowledge is acquired and disseminated(16). The infrastructures create new "social, ethical and political values", and produce "new information technologies, modes of representation, and the accompanying shifts in work practice and systems for the accreditation of knowledge"(17). The next section will investigate in more detail one of the major changes created by the introduction of the new infrastructure: the revolution of memory practices suggested by cybernetics.

3. The Destruction of memory by Cybernetics and Big Data

According to Geoffrey Bowker one of the consequences of the adoption of cybernetics was the destruction of memory. «Cyberneticians have frequently announced the dawning of a new age, with its new classificatory principles»(18).

(15) See Bowker G.C., Baker K., Millerand F., Ribes D., *Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment*, in Hunsinger J. *et al.* (eds.), *International* Handbook *of Internet Research*, Springer Science, Amsterdam 2010, pp. 97–117, p. 98.

(16) See Bowker G.C., Baker K., Millerand F., Ribes D., *Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment*, cit, *passim*.

(17) Ivi, p. 105.

(18) See Bowker G.C., *Memory practices in the sciences*, MIT Press, Cambridge 2008, p. 99.

According to Ross Ashby, memory was considered «just a metaphor needed by a "handicapped" observer for his inability to observe»[19]. Memory was necessary but was completely exhausted by a correct and complete explanation of present events. Bowker considered that what was impossible in this context was the idea of duration, due to the synchronic nature of cybernetics insight and also because the differences between human and non–human actors were ignored. Following this interpretation, feedback implied the past could not be retained, considering the applicability of feedback to both the organic and inorganic environments. Ashby further suggested that a feedback system could be totally and simultaneously automatic as well as actively goal–seeking.

In Bowker's opinion:

> There is a triple destruction of memory […] first past disciplines are destroyed: they need to be created anew from first principles. Second, an individual experimenter must destroy his or her knowledge of previous experiments. Third, one result of this double destruction will be the discovery by cybernetics that memory itself is epiphenomenal. […] In cybernetics memory is destroyed so that history can be unified; in classical physics nonreversible time is destroyed so that history can be ignored.[20]

The suggestion of Bowker's interpretation, therefore, was that: «the destruction of memory is the temporal extension of the central notion of feedback». The algorithm that is used to represent knowledge in the printing press, a linear–time narrative in coordinated space, will not work in cybernetics: «you need a principle for enfolding knowledge into itself. This enfolding is a very powerful tool»[21]. In Cybernetics there are three things working together: ways of writing histories of disciplines and of the cosmos itself, meditation on infrastructural technology, and mythically charged discourse[22].

When a new perspective on memory is built, it necessarily includes a reorganization of the past, a new perspective on technical tools and a new mythical discourse about how these new stories are organized and what they mean. For Cybernetics these connections were completely respected. The new vision of memory implied a new device to store information and the invention of data–driven science, for both the natural and social sciences. The idea that

(19) Ashby W.R., *An Introduction to Cybernetics*, Chapman & Hall, London 1956, p. 115.
(20) See Bowker G.C., *Memory practices in the sciences*, cit., p. 101.
(21) Ivi, p. 102.
(22) Ivi, p. 104.

laboratory and library could merge together played a crucial role in shaping our imagination and discourse as regards Big Data, algorithms and data–driven science. The destruction of memory involves the rebuilding of all connections with the past and the recollection of past souvenirs as a perfectly stored list of information, inside a huge and infallible repository, typically enabled by the use of digital memory in computers[23].

We cannot forget, however, that the machine is a number–crunching device, that can deal only with numbers and instructions that are very clearly stated: they must be formalized in a language that can be compiled or interpreted in machine code. The abstract model of the machine was invented to demonstrate a limitation of the system of calculation within mathematical logic: the *halting* problem[24]. It is impossible to know when and if a program will stop once we launch it, and there is no way to know the response in advance. The practical machine, moreover, also has other limits; it can deal only with finite mathematics or with problems that can be completely formalized. All the rhetoric of artificial intelligence, deep learning, or machine learning algorithms cannot take the machine outside of these limitations.

According to Wiener, for example, Cybernetics, though considered a transdisciplinary field, could not give interesting results when applied to society because «For a good statistic of society, we need long runs *under essentially constant conditions* […]. Thus, the human sciences are very poor testing–grounds for a new mathematical technique»[25]. He was skeptical about the claim that mathematical measurements of feedback effects could produce interesting results because the fluctuations of variables that influence the phenomena under investigation were too hard to identify or specify in a mathematically rigorous way. It was better to deploy methods in the fields that allowed a clearer formal description of the relevant model of the phenomena.

Data science is instead mainly interested in social sciences. The aim of the science is the anticipation and prediction of human social behaviors in terms of preferences, attitudes, desires, habits and needs. The approach towards the object of research is not the explanation of the meanings and the reasons of such behaviors and orientations, but the algorithmic predictability of future

(23) See Numerico T., *La memoria e la rete*, in Bertollini A., Finelli R. (eds.), *Soglie del linguaggio. Corpo, mondi, società*, RomaTre University Press, Roma 2017, pp. 81–102.

(24) See Turing A.M., *On Computable numbers with an application to the Entscheidungsproblem*, «Proc. London Mathematical Society», (2) 42, 1937, pp. 230–265; reprinted in Copeland B.J. (ed.), *The essential Turing*, Clarendon Press, Oxford 2004, pp. 58–90.

(25) Wiener N., C*ybernetics: or control and communication in the animal and the machine*, cit., p. 25.

events based on knowledge of the recording of past activities, which needed to be quantified and datified according to precise rules of interpretation. The rules and the procedures by which the system pretends to be able to anticipate the future are organized according to the vision of the algorithmic reason.

Memory is rearranged in order to consent to the algorithmic interpretation to cluster the objects and organize the events along a line that let the past speaks for the future in probabilistic terms.

The probabilistic results of algorithmic reason can never be false because of their mechanism of classification. If we presume that someone is 80% inadequate for being recruited for a specific job opportunity the assertion is never false because it means that there is a 20% probability that he or she is adequate for the position. The reorganization of memory also produces a rearrangement of the relationships between the decision–making processes and the external world, which need to be interpreted according to the method that the algorithmic reason uses to anticipate the future.

In the second part of the paper, we will offer a critical interpretation of the epistemological structure adopted for interpreting future events and for arranging agents in clusters in data driven science, as well as in some of the areas of artificial intelligence. In order to achieve this goal, we will discuss Husserl and Arendt's critical stances about the technization of science. After that, we argue that, though the method of modern science implied the technization of knowledge creation, data science is proposing a complete subversion of the principle of experiment replicability and methodical doubt that was at the core of the scientific revolution that produced the origin of modern science. Technization, for Galileo and Descartes, was the result of the search to increase the precision of perception in order to avoid the instability effect of subjectivity while interpreting phenomena. The objective of modern science was to save phenomena from appearances, whilst the project of data driven science is somehow to record the output of phenomena appearances in order to predict the future behavior of the variables under observation without searching for their explanations or for the meaning of the obtained output.

4. Husserl's critique of unaware technization in science

The critical issues about data–driven science are not only related to the difficulties in giving a meaning to the great amount of data, which is not always coherent and whose error rate cannot be easily detected. The automation of memory also implies some epistemological implicit premises that need to be discussed because they impose a sort of formalization of scientific theorization that is not always clearly stated. The borders and the basis of the formalization that is needed in order to rely on data–driven science are not explicitly stated. An algorithmic science of data, guided by artificial intelligence, that can make direct sense of phenomena, the object of the investigation, presupposes that we can assume that there is a unique and clear correspondence between data and phenomena, which should be demonstrable. This new empiricist hypothesis is assumed without further discussion in the rhetorical domain of Big Data about the scientific validity of its results in the field.

According to Husserl:

> the process whereby material mathematics is put into formal–logical form, where expanded formal logic is made self–sufficient as pure analysis or theory of manifolds, is perfectly legitimate, indeed necessary; the same is true of the technization which from time to time completely loses itself in merely technical thinking. But all this can and must be a method which is understood and practiced in a fully conscious way. It can be this, however, only if care is taken to avoid dangerous shifts of meaning by keeping always immediately in mind the original bestowal of meaning [Sinngebung] upon the method, through which it has the sense of achieving knowledge about the world.(26)

Husserl claimed that it was Leibniz who was the first to understand the power of a universalistic attitude toward an algebraic thought.

> Leibniz, though far ahead of his time, first caught sight of the universal, self–enclosed idea of a highest form of algebraic thinking, a mathesis universalis, as he called it, and recognized it as a task for the future. Only in our time has it even come close to a systematic development. In its full and complete sense, it is nothing other than a formal logic carried out universally (or rather to be carried out in infinitum in its own essential totality), a science of the forms of meaning of the «something–in–general which can be constructed in pure thought and in empty, formal generality».(27)

The thesis that Husserl elaborated in the final part of his work about the evolution of science suggested his concern for the risk of excessive formalization

(26) Husserl E., *The Crisis of European Sciences and Transcendental Phenomenology*, Northwestern University Press, Evanston 1970³, p. 45.

(27) *Ibidem*.

in knowledge. The objective of abstraction and extraction of a universal categorization, which would allow the production of all the outcomes of the automatic organization of the external world, could cause errors and misunderstanding in the cognitive process on which the science was based. He considered that the transformation of mathematics in terms of its own logical formalization was legitimate and useful, even necessary, as long as the method was practiced knowingly. He argued that, in order to avoid dangerous shifts of meaning, we should use abstraction and formalization without forgetting that knowledge of the world is an externality that cannot be completely exhausted by any formal method.

Husserl's critique was concentrated on the tendency to empty natural mathematical science of its own meaning and to consider that this inadequate step was due to the so–called "technicization" process. The algebraic formalized arithmetic was used in all the scientific developments, including within mathematics itself. Husserl was discussing, in particular, the techniques adopted in logic applied to mathematics that — during the 1930s — pressed for a complete formalization of mathematics. He was critical of the excessive formalistic reductionism that was used in the Hilbert programme, even though between the two scholars there was reciprocal esteem and a deep respect, as testified by the academic support that Hilbert gave to Husserl, while he was in Göttingen[(28)].

The theory of computability was one of the areas in which formal logic studies were more successful. Turing himself invented the abstract concept of the Turing Machine while demonstrating one of the meta–theorems of computability theory, the negative result of the decision problem. This abstract Machine is considered the theoretical counterpart of the modern computer. It was Turing again that, during the early 1950s, introduced the concept of Machine Intelligence which later took the more famous name of Artificial Intelligence. In this technical research field, it was established that it was possible to reproduce intelligence using a set of algorithmic–computational procedures that needed only to be discovered and implemented in the electronic calculator, the first examples of which were built during the same years[(29)].

(28) For more information on relationships between Hilbert e Husserl, see Hartimo M., *Husserl and Hilbert*, in Centrone S. (ed.), *Essays on Husserl's Logic and Philosophy of Mathematics*, "Synthese Library (Studies in Epistemology, Logic, Methodology, and Philosophy of Science)", vol. 384, Springer, Dordrecht 2017, chap. 11 e Mancosu P., *The Adventure of Reason. Interplay between Philosophy of Mathematics and Mathematical Logic 1900–1940*, Oxford University Press, Oxford 2010.

(29) This is not the place where we can deepen on the birth of artificial intelligence and automatic algorithmic procedures for the development of intelligent activities in machines, for more details see

If we want to transpose Husserl's critique of technization of scientific research and apply it to the present faith in algorithmic reason we have to take some strategic steps. The first step is related to the reductionistic attitude of data–driven science in terms of the possibility of representing phenomena as completely quantifiable and easily measurable, without considering the interpretational layer that is necessary in order to obtain the quantitative reproduction of the events under observation. This attitude is also applied without any constraint to social phenomena that are at the centre of the interest of Big Data Science as a fashionable label. This unwavering faith in the quantification of phenomena is the sign of what we can call the ultra–empiricist approach in Data Science: models or theories are not necessary to understand phenomena under observation, including social relations. They are fully replaceable by recording structured and unstructured data that, according to data science, descend directly from phenomena. We have only to record the appearances of social phenomena, via all the available digital tools, and by processing those data algorithmically we can make predictions about phenomena without making any sense of them. The extraction of data from phenomena appearances is enough to allow us to trust the quantification embedded in the data structure and to imagine that it corresponds directly with the measurability of phenomena under observation.

The second step that we have to make is relative to the interpretation of technization in data science. We do not need to adopt a theoretical and abstract attitude toward science and its knowledge production. The technical tool that we introduce into scientific knowledge production is the embodiment of a calculating layer to "treat data" so that we can make predictions about the future behaviour of the variables taken into account. The technical tools used in Data Science are algorithms, the aim of which is the substitution of the cognitive capabilities needed to make connections and create links between data in order to make sense of them.

The chosen technical tool is not analysed using an epistemological perspective. It is instead taken for granted that the algorithmic machine, based on machine learning methods, is responsible for creating correlations between data in order to recognize patterns that are relevant to making predictions over the phenomena under observation.

Numerico T., *Alan Turing e l'intelligenza meccanica*, FrancoAngeli, Milano 2005, and Numerico T., *Intelligenza artificiale e algoritmi: datificazione, politica, epistemologia*, «Consecutio rerum», III, n. 6, 2019, pp. 241–271.

5. The externalization of reason: a suggestion by Hannah Arendt

According to Hannah Arendt in *The Human Condition* (1959)[30] one of the first acts of the modern science was linked to the telescope. This gesture by Galileo was the creation of a new space, which was dependent only on the new technology of vision. In order for this process to start, it was necessary to agree that, although the senses were not enough, human reason could access knowledge using abstraction from concrete contingencies and the measurability of phenomena.

The technology of the telescope arranged the externalization of the human senses with the aim of increasing the level of precision in the perception of the external world. By relying on a tool for the externalization of vision in order to investigate into a new space, a new object of research, we were still in control of the mind, which was the unique actor with respect to the correctness and reliability of representations and models of reality. The interpretation of the methodic doubt of Descartes' subject was dependent, according to Arendt, on the failure of the senses, that needed to be entrusted with a new enhancing tool capable of magnifying human senses. Only the joint system created by the assembly of the telescope with the abstraction capabilities of the human reason could understand the world that was at stake in modern science. In this new scenario, human reason had the unique and delicate task of assessing the certainty of representations and models by guaranteeing their believability, while facing the failure of perception.

The objective of modern science was to save phenomena from appearances that were unstable and related to the subjectivity of the senses. The senses had showed their demonstrable unreliability, so in order for the cognitive process to be solid and trustworthy, human beings needed new methods. Abstraction, mathematization, formalization, control and the other thought technologies were the scientific tools adopted in order to save phenomena from appearances, while guaranteeing a correct epistemological explanation and the prediction of future behaviours of the phenomena.

In Arendt's opinion western universalism relied on the assumption that representation can exhaust the object under consideration, which was completely explainable inside the model.

However, knowledge is possible only if conditioned by the awareness of the partiality of explanation. The project of mathematization of science (formalization of algebra, quantification of physics) finds its limit in the exceeding

(30) Arendt H., *The human condition*, University of Chicago Press, Chicago 2013 (1959[1]).

of the world that cannot be completely appropriated, but only approximated. Only if the human being places himself outside of the world could he or she apprehend the world as a whole:

> If we wish to put this into historical perspective, it is as if Galileo's discovery proved in demonstrable fact that both the worst fear and the most presumptuous hope of human speculation, the ancient fear that our senses, our very organs for the reception of reality, might betray us, and the Archimedean wish for a point outside the earth from which to unhinge the world, could only come true together, as though the wish would be granted only provided that we lost reality and the fear was to be consummated only if compensated by the acquisition of supramundane powers.[31]

The universalistic pretence of western modern science was related to the Archimedean point outside the earth, in Arendt's opinion. We can comprehend the world only by ceasing to be a part of it. The externalization of the senses and the universal understanding of the world are strictly intertwined together. The methodical doubt proposed by Descartes as the unifying procedure that gave birth to the new subject of knowledge was responsible for legitimizing the actions of the new scientist and the control over his or her cognitive capabilities. But what would happen if we externalized the cognitive structure of human reason in favour of machines?

Husserl and Arendt dissented about the will of reason to consider itself outside the world it wanted to grasp, dominate, control, exploit, by using different forms of technization. The aim of this externalization was to be empowered against the subjectivity of the senses. However, this critique is no longer valid in the artificial intelligence context. The telescope and all the following laboratory tools had the objective of increasing the quantification capabilities of the senses, while algorithmic reason proposes itself as a substitution for the human cognitive capabilities of abstraction. In algorithmic reason representations and models depend directly on the automatic interpretation of data, which is completely outside the control of human cognitive capacities, unless we intend the building and training of the algorithmic machine as being the incorporation of reason in the device.

The abdication of human reason in making sense of the external world risks standardizing the process of knowledge creation in dangerous directions with respect to the capacity of human reason based on creativity, pluralism

(31) Arendt H., *The human condition,* cit., p. 262.

and originality. If we externalize the faculty of understanding, we lose contact with the capacity to resolve doubts, address possible confutations of results obtained, revising previous knowledge that was at the centre of the progressive secularization of reason that characterized the birth of modern science, modern reason and cartesian subject. The potential perverse effect of the externalization of reason in the machine is that the world is no longer accessible by knowledge creation processes. Data is built by the structure of sensors and variables definitions. This process substitutes the role of memory in human understanding. Reason is externalized by the calculative capabilities of the algorithmic structure that extracts complex correlations from data. The external world is completely internalized by the formalization and the calculation of appearances of phenomena. There is no space for doubt, no space for explanation, no space for error detection, no space for exit from the standard vision that is implicitly implemented in the machine

The concept of explanation changed in science according to methods adopted for understanding the world, including our inner world. At present, the substitution of explanation with correlation together with the opacity of the black box of algorithmic reason implies that no explanation is ever possible, because according to Stiegler: «Ce gouvernement automatique n'a plus besoin ni de disparation, ni d'individus, ni de signification»(32).

When we interact with the world using algorithmic machines as the only form of mediation, we are not accountable for the effects of the mechanical prediction of future behavior of phenomena, which is the aim of datification. Moreover, the special condition of assumed predictability — especially in social phenomena — influences the events that they claim just to describe, introducing a level of normativity that end up in influencing behaviours that the system was only supposed to anticipate. Following on this line are the reflections of Rouvroy and Berns that interpret algorithmic reason by summoning the epistemological domination of:

> un certain type de rationalité (a)normative ou (a)politique reposant sur la récolte, l'agrégation, et l'analyse automatisée de données en quantité massive de manière à modéliser, anticiper et affecter par avance les comportements possibles.(33)

(32) Stiegler B., *La société automatique. 1 L'avenir du travail*, Librairie Arthème Fayard, Paris 2015, p. 234; eng. tr. *The automatic Society*, Polity Press, London 2016.

(33) Rouvroy A., Berns T., *Gouvernementalité algorithmique et perspectives d'émancipation*, «Réseaux», (1), pp. 163–196, pp. 169–170.

6. Saving appearances instead of phenomena

After describing Husserl's and Arendt's positions, we support the thesis according to which, although it is legitimate to build abstraction criteria to extract data from phenomena in order to make sense of them, we have to remain in control of our epistemic methods, by checking adopted models and data proxies. We need to be responsible for the explanations and for the predictions that we obtain about the phenomena under observation, even if the algorithm makes it impossible to assess the results it obtains. Who is the agent of the data science creation?

What happens when the process of abstraction occurs in ways and with tools that nobody can control from outside of the closed box of the automation? What happens when the results of the abstraction/technization process have normative effects on its research objects, imposing expectations and predictions of people's behaviour according to predictive analytics?

Negative results in logic show clearly that no unique technical representation can be enough to understand everything, even inside the formal system. Turing suggested that in order for the machine to be intelligent it ought to be able to commit errors from time to time[34]. However, when we cannot check the process and the outputs of algorithmic suggestions for a decision, how can we detect which are the untrustworthy suggestions? There are various issues that need to be addressed if, and when, we want to acknowledge the usefulness of algorithmic processes for decision–making in real life situations, where the context of information is uncertain, and the data is incomplete or misleading. We can just list some of them:

- transparency of the decision mechanism, of the training data, of the data gathering criteria and of the objectives of the algorithmic process.
- accountability and audit of the results.
- explicability of the machine learning techniques that produce the results.

It is apparent, then, that there is no possibility to completely understand the context in which we need to take decisions. In situations which are essentially uncertain, there is no way to make unquestionable predictions. But if they have normative effects, we have to pay attention to the uncontrolled epistemic consequences of the vicious circle in which we are trapped.

(34) See Turing A.M., *Computing Machinery and Intelligence*, «Mind», 49, 1950, pp. 433–460.

Big Data rhetoric is based on the hypothesis that the large quantity of data allows the algorithms to work with so much information that it prevents the possibility of distortive effects and potential mistakes being significant to the outcomes. Calude and Longo showed, in their paper on spurious correlations[35], that the increase of data gathering is linked to the intensification of the presence of spurious correlations. Such correlations of variables have no meaning whatsoever in terms of explanation or prediction of future events. Another hypothesis is that algorithmic methods for pattern recognition interpret the meaning of available data on the objects of research more efficiently than human beings. So, the algorithmic reason is capable of capturing the cognitive value of data for the purposes of univocal categorization of the objects of the research and for predicting the probability of future events.

These two hypotheses are neither demonstrated nor independently validated; rather they have only been assessed and rhetorically reinforced by the supporters of the successful Big Data industry. Moreover, the combination of dirty, old or non–controlled data, of rigidity in the inferential capacity of learning algorithms and of the utilitarian orientations of their experimental design, could produce socially dangerous outputs in terms of interpreting, modelling and predicting behaviours, especially in contexts in which the decisions impact on social rights of citizens[36].

Datification and predictions based on correlations suggest that data driven science is founded on the hypothesis that recognizing correlations of variables linked to phenomena under observation can substitute their explanation. This attitude seems to suggest that we can rely on appearances instead of saving phenomena from appearances: «letting go of mechanical explanations, some radical perspective on Big Data seek to save the phenomenon by simply saving the appearances, this shift, […] largely driven by forces that operate outside the science […] pushes the earlier trend […] in breaking the bridge between phenomena and appearances — to its logical limit»[37].

Big Data science aims at predicting the appearance without taking into account the explanation of phenomena, without seeking to save phenomena from appearances, as it was the case with the true objective of modern

(35) See Calude C.S., Longo G., *The deluge of spurious correlations in big data*, «Foundations of science», *22* (3), 2017, pp. 595–612.

(36) There is no space to deepen this concept adequately here, for more information see Numerico T., *Big Data e algoritmi*, Carocci, Roma 2021.

(37) See Ekbia H., Mattioli M., Kouper I., Arave G., Ghazinejad A., Bowman T., Sugimoto C.R., *Big data, bigger dilemmas: A critical review*, «Journal of the Association for Information Science and Technology», 66 (8), 2015, pp. 1523–1545, p. 1529.

science according to Van Fraassen[38]. We are not posing the question here about which of the different approaches embodies the scientific method we wish to preserve. However, especially in social sciences we face some unanswered questions about reliability of the algorithmic reasoning methods. In this context, in fact, the control over data is held in a few hands and the predictions may be tainted by self–fulfilling expectations and normativity.

7. Conclusion

Machine learning algorithms for pattern recognition work according to some basic implicit assumptions: the first is the induction principle, which states that what happened in the past will recur in the future; the second is a probability principle founded on the principle that people categorized as similar (in some respects) will behave similarly. The induction principle assumes the interpretation of the past as an anticipation of the future, while the similarity principle is fundamental for the efficiency of clusterization, which is one of the most important tools used in interpreting and managing digital traces of online services users' behaviour.

Neither assumption is completely sound from an epistemological viewpoint, instead they are powerful interpretative tools that embed all sorts of prejudgements that can produce biased conclusions, which are accepted nevertheless because of their opaque, implicit, undisputed neutrality[39]. The role of the externalization of memory in this context cannot be underestimated.

The results of the blind trust in algorithms' interpretations (in terms of categorization based on similarity) and measurements (in terms of recurrence probability) of human actions risk the reintroduction of biased and unfair decisions that could disproportionately impact vulnerable people, as it is already the case in some situations. The attribution of oracular capabilities to algorithms weakens any accountability for decisions taken according to the algorithmic suggestions. Such an exercise of power therefore happens without the accountability of anyone for the conclusions it reaches[40].

(38) For more information on this issue see Van Fraassen B.C., *Scientific representation: paradoxes of perspective*, Oxford University Press, Oxford 2008.

(39) It is not possible to deepen the concept in this context, for more information see Numerico T., *Big Data e algoritmi,* cit., pp. 169–177.

(40) Campolo A., Crawford K., *Enchanted Determinism: Power without Responsibility in Artificial Intelligence*, «Engaging Science, Technology, and Society», 6, 2020, pp. 1–19.

In modern science the use of new tools for augmenting the power of the senses and their precision allowed the introduction of new methods, used to socialize the control over experiments, by permitting their replicability and the eventual refutation of false results by the scientific community, as a whole. The methods of quantification and measurability of phenomena under scientific scrutiny were adopted in order to dismiss belief in religious theses about the world, the credibility of which relied only on the authority of those who asserted it. The social controllability of scientific conclusions was an advance in the campaign against the obscurantism of traditional authorities, whose only merit was to be protected by their social power, as the unique depositaries of revealed truths on nature and on human beings. The methodical doubt of the Descartes' subject shielded the scientific community from the potential limitations imposed by prejudices or false beliefs. Modern science's aim was the liberation of human reason from obstacles represented by traditional authorities and from the limits of perception itself, in order to access the phenomena beyond all appearances and beyond all untrustworthy and undemonstrated conventional beliefs.

Algorithmic reason instead introduces new constraints and new inexplicable layers between our capacity to reason and the understanding of phenomena, including social phenomena.

The first uncontrollable layer of data driven science is related to the data collection and organization. As was shown by Licklider's genealogic approach to data and understanding(41), it is impossible to access the fund of knowledge without the substantial help of the "memory" machine that will access and systematise data, on our behalf. The second layer outside the control of human reason is the algorithmic interpretation of data, the aim of which is to extract and abstract useful correlations for predicting the future behaviours of the variables under consideration. Both layers are opaque and do not allow human beings to be accountable or responsible for the output of the algorithmic process, unless we arrange an epistemic vigilance and ask for the introduction of explicitly explainable strategies for data gathering and algorithmic interpretations(42). The only activity which remains under the control of human reason is the interpretation of the output proposed by the algorithmic reason.

(41) See Licklider J.C.R., *Libraries of the future*, cit.

(42) For more details on epistemic vigilance on data and algorithmic interpretation see Rieder G., Simon J., *Big Data: A New Empiricism and its Epistemic and Socio–Political Consequences*, in Pietsch W., Wernecke J., Ott M. (eds.), *Berechenbarkeit der Welt? Philosophie und Wissenschaft im Zeitalter von Big Data*, Springer VS, Wiesbaden 2017, pp. 85–105.

The effect of algorithmic reason is the reproduction of a new technological authority that cannon be questioned or discussed. Its power is blurred, opaque and magical and human reason is left at the margin of epistemic accountability. This is particularly problematic when decision making procedures have consequences on real lives of people as in recruiting practices, recidivism evaluation, access to credit, affect recognition practices based on face scanning, etc.[43]. Classification has winners and losers, and we never know the reliability of a particular clusterization method, both for society and for the people trapped in the categorization process.

(43) For a detailed discussion on the epistemic problems of algorithmic decision making in various contexts of social relations and the defense of citizens' rights see Crawford K., *Atlas of AI*, Yale University Press, New Haven, London 2021.