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Editorial

Some Gaps in Machine Learning

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Introduction

The relationship between Mathematics, Science and Technology is complex. Science is a conceptual construct that maintains a relationship of equivalence with observable reality, involving many experimental methods. This equivalence allows for the quantitative models that constitute scientific knowledge and technological development, which are Theories. Many scientists share this idea despite its rudeness.

However, it currently presents additional problems. The connection between the theories and reality is an equivalence relationship. Any postulate -law or proposition- is (i) intelligible (reflexivity), (ii) is related to some element of the world (symmetry) and (iii) for a concept or instance related to another and the latter in turn to a third then, the first is also to the third (reflexivity). Also, the model does not describe the world features in detail and the model is a simplification. In a classical sense, the model constitutes a paradigm that is the knowledge according to the current state of the art.

This equivalence relationship allows for Machine Learning as a simplification of reality and it constitutes knowledge. But its nature complicates the question of how knowledge of the world is concerning to the world. This old-age question has been the subject of countless philosophical debates and is the center of any worldview. In our time, classic attempts to respond have hints of romanticism: the machine is also capable of hoarding knowledge. This question, was introduced into the scientific debate by the mathematician Norbert Wiener in the 1950s (Wiener, Norbert. Cybernetics or Control and Communication in the Animal and the Machine). Thinking machines or those provided with algorithms that learn, are another entity introduced into the current paradigm.

Machine Learning methods are devoted to writing code to execute tasks as a human does, a field with a vertiginous increase in terms of concepts and applications in the last two decades. They constitute a branch that uses methods of a very diverse nature. Formally, Machine Learning has been defined as the learning of a task T, with a metric for its evaluation M based on an experience E, being the intersection of Computer Engineering and Statistics. (Mitchell. The discipline of machine learning).

Historically, the positions adopted regarding this problem are Philosophical. The methodologies derived from these philosophical approaches determine the worldviews. Preferred methodologies derive from each worldview. The shared views adopted by the elites of each field are highly influential in the dominant paradigm. No intellectual activity is alien to this precedence. In the scientific context, these are fundamental criteria for the acceptability of knowledge, providing value criteria faced to the used methods (acceptance or plausibility) that affect the results of a theoretical type (those in which the result for new knowledge is based on necessity) or on experimentation.

The current dominant paradigm in almost all sciences and Machine Learning is no stranger, of a positivist nature. It sacrifices the issues of explainability and interpretability to the results and the ease of obtaining them for massive data. The predominance of results over explainability and/or interpretability has been accentuated by the propagandized great effort dedicated to the COVID vaccines. In addition, in the current state of the art, it is not possible to formulate hypotheses that give rise to knowledge theories based on Machine Learning algorithms. They focus on searching for data and verifying the accuracy of hypotheses.

In the basic sciences, the results obtained with mathematical tools do not admit discussion (discussion on these points would be a symptom of superficiality. Bunge. Matter and Mind.). In the case of Machine Learning, the debate becomes complex. Well-sound theoretical developments may present problems in practical data analysis, while others have no theoretical foundation. In Machine Learning the validation of a method is called experimentation. Those methods usually compare proposals and confuse the applicable techniques in each case, their advantages and limitations (an example is dimensionality reduction: while it seems to be a solid procedure, the criteria are a diaspora, depending on the analyst's data).

Within this panorama, the position I defend is modest. It is concerned with explainability and/or interpretability. Explainability derives from the foundation in algebraic techniques (sometimes we use some analytical tools) and the Theory of Probability, among others. I understand programming techniques and mathematical tools as analytical knowledge. Interpretability refers to the machine-learned tasks in human terms, for which a vast arsenal of graphic techniques exists. I mean, Machine Learning provides knowledge from data analysis except for denialism positions.

However, the criticized results-oriented paradigm offers opportunities for research, both theoretical and applied. The continuous appearance of techniques and methods has created important gaps. They are unexplored items that could be fields of knowledge. Some relevant authors have pointed out that the relationships between methods remain unsolved. Furthermore, in my opinion, the lax application of mathematical concepts leads to the neglect of statistical properties related to the basic concepts, the behavior of many results and the poor relevance of the Information Theory in the current context.