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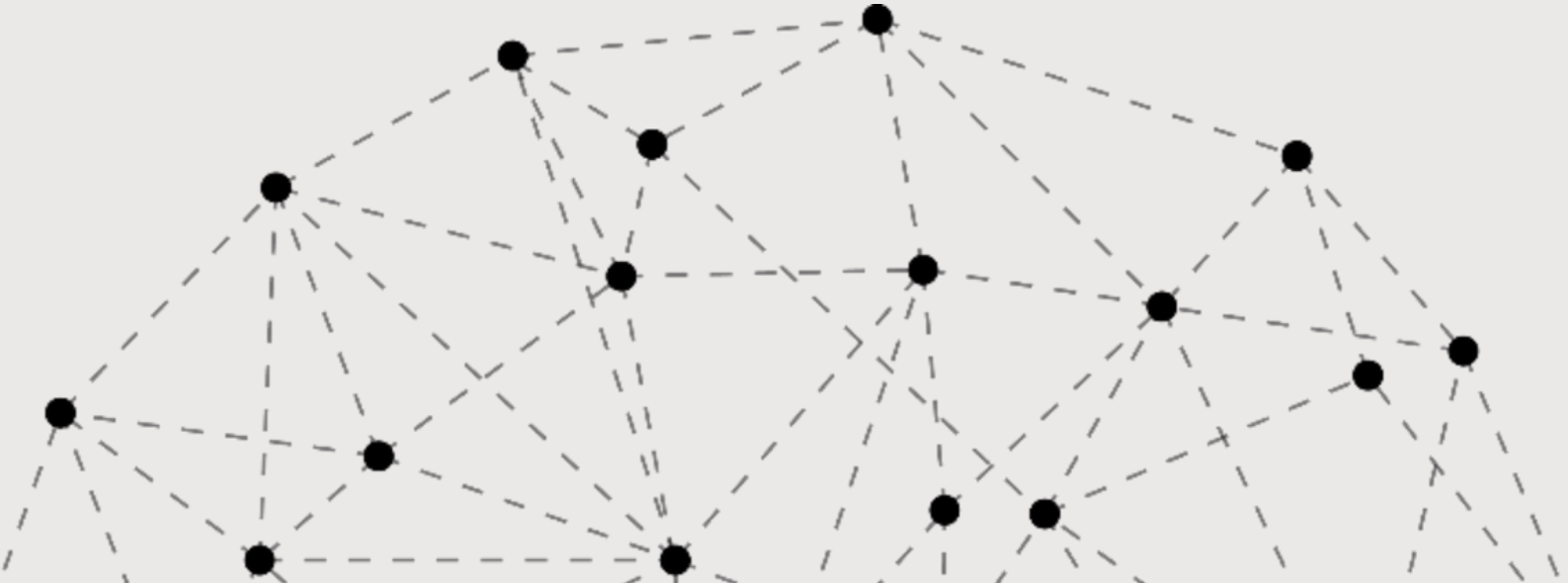
BEYOND INSTITUTIONAL BOUNDARIES

WHY WE NEED A MULTILATERAL AND GLOBAL UNDERSTANDING OF ARTIFICIAL INTELLIGENCE (AI): THE CASE OF THE SYMBOLIC/CONNECTIONIST CONTROVERSY.

Ana Beatriz Duarte

October 20th, 2023.



Policy Statement

Artificial intelligence has increasingly been a subject for policymakers worldwide, with implications in virtually all areas of our lives. Because it is a vast interdisciplinary subject, only some people are able to understand what it is and how it works - nor its potential and current impacts on contemporary society. One such obscure trait about artificial intelligence to a non-scholar audience is that, in reality, it is not one but rather two different techniques, both aiming at producing “intelligence.” Therefore, it is imperative that inter and intranational bodies are created, where stakeholders from the various disciplines will find a democratic forum to exchange points of view and influence policies and, more broadly, the public debate on the set of technologies known as artificial intelligence.

Background

Artificial intelligence has experienced peaks and troughs in public and investor interest before reaching its current prominence. How can we explain such back-and-forths? The question has no straightforward answer, but one aspect should be highlighted: in a way, the recent wave of technological advancements, which has garnered substantial attention, diverges significantly from its predecessor despite sharing the same label: "Artificial Intelligence." This contemporary AI wave adopts an entirely distinct epistemological approach.

The quote reveals the approach to achieving such a goal: logic, rules, and programming (created upon the detailed description of intelligence). That would be what later came to be known as symbolic AI, or yet the "good old-fashioned AI."

On the other hand, the event proposal also mentions the research by Pitts and McCulloch, who have created a computational model by mimicking the neuronal architecture with its layers of neurons connected by synapses. Following this model, Frank Rosenblatt would build, in the 1950s, the Perceptron, a machine designed to learn to recognize patterns from examples. But Marvin Minsky, one of the Dartmouth pioneers, wrote a negative account of the neural networks in 1969, making investments extinguish and the research virtually disappear. Only to gain new momentum in the 2010s, when optimal conditions, namely increased processing power

and the availability of vast datasets generated by the ubiquitous use of the internet have enabled connectionist models to yield promising results. This marked the end of the AI winter, which was, in fact, the "winter of neural networks" (Pasquinelli, 2017, p. 5).

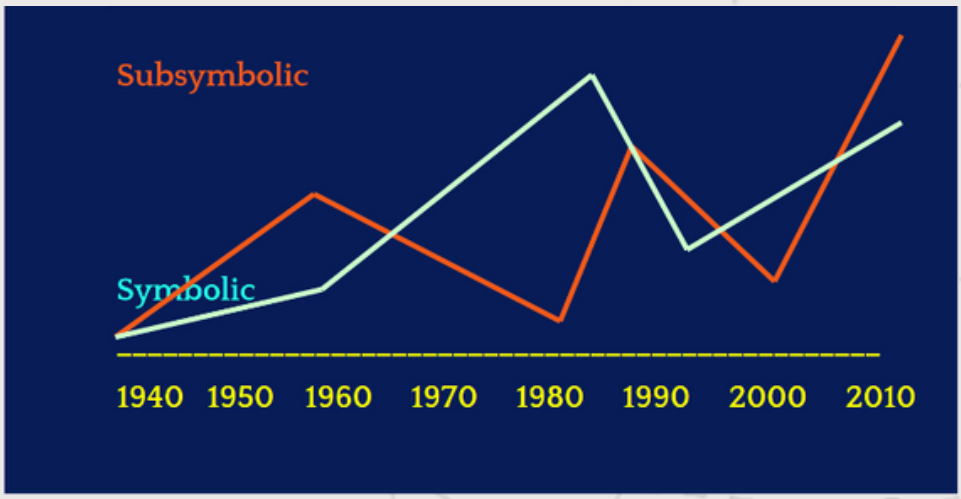
Symbolic and connectionist AI are often seen as different stages of this technology, the symbolic being the earliest. But, as mentioned above, we find traces of the connectionist one from the beginning of the discipline.

Symbolism (or functionalism) manipulates symbols. It is notably a top-down (at least following the platonic idea that ideas are at the top, and experience is at the bottom) approach that uses explicit sets of rules to make inferences. This way, it follows a deductive way of reasoning where calculations follow human logic. Here, thinking is understood as manipulating symbols according to rules (Newell & Simon, 1976).

Connectionism, by its turn, is a vastly different way of reasoning. Instead of departing from theory, that is, universal premises, it uses examples to perform statistical induction, learning from experience after a trial-and-error process. Here, the aim is to reproduce human thinking outside the brain, following the assumption that neurons establish connections beyond logical thinking.

Lieberman (2016) puts both approaches together in relation to time. It is not difficult to note that AI development's "springs" and "winters" are strongly related to the accomplished or frustrated promises related to one or the other approach.

Symbolic vs. sub-symbolic AI, 1940-2010[1]



Source: Lieberman, 2016

Findings

Notably, both of these approaches are currently experiencing a resurgence, marking their convergence for the first time since the discipline's origins. Symbolic AI should not be dismissed as obsolete. While historically, both branches have competed for scientific recognition and funding, an increasing number of experts now advocate their complementarity, advocating for a hybrid model.

While it's true that the symbolic approach has not delivered on its earlier promises, it is far from dead. Furthermore, it can address some of the challenges connectionist-only tools pose. Although controversies between experts persist (Marcus, 2022), many strive to bridge the gap by advocating for a hybrid approach (Hoehndorf & Queralt-Rosinach, 2017).

For instance, Zalila (Zalila, 2017) supports combining the strengths of both approaches: efficiency on the one hand and audibility and intelligibility on the other. One commonly cited drawback of neural networks, as evidenced by various studies (Pasquinelli, Matteo, 2017; among others), is their lack of transparency. Due to their complex structure and probabilistic calculations, understanding the decision-making process leading to a particular outcome is often challenging. This issue, commonly referred to as "AI black box," has spurred a counterinsurgency movement advocating for "explainable AI."

Each approach presents problems of different kinds. While neural networks have achieved new frontiers in AI development, ruled-based AI is far more transparent and interpretable. Beyond the black-box discourse, symbolic AI may add a layer of explainability and safety, although less powerful.

In this scenario, the difference between symbolic and connectionist AI is more than technical detail. Policymakers worldwide trying to anticipate potential risks artificial intelligence may bring should be aware of them.

One good news is that the European Union Artificial Intelligence Act avoids restricting AI to its recent, astonishing achievements. While the proposal has been highly criticized, it acknowledges the heterogeneity of the technology.

Its Annex 1 lists AI techniques and approaches, adaptable for future developments through amendments.

(a) Machine learning approaches, including supervised, unsupervised, and reinforcement learning, using a wide variety of methods, including deep learning; (b) Logic- and knowledge-based approaches, including knowledge representation, inductive (logic) programming, knowledge bases, inference and deductive engines, (symbolic) reasoning and expert systems; (c) Statistical approaches, Bayesian estimation, search and optimization methods. (Proposal for a Regulation of The European Parliament and of The Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts, 2021)Annex 1, (Proposal for a Regulation of The European Parliament and of The Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts, 2021).

The proposal states a definition for "artificial intelligence system," not for the more polysemic phrase "artificial intelligence." Since there is no universally accepted definition of artificial intelligence (AI), the European Commission has chosen to refer to AI systems, similarly to what the Economic Co-operation and Development (OECD) had adopted. The aim is to emphasize legal responsibilities. The OECD and Unesco are among the leading multilateral organizations that issued general guidelines for AI development and employment ethics.

The United Nations, by its turn, has set up an expert group, within the scope of the Convention on Certain Conventional Weapons, to draft recommendations about the so-called killer robots, that is, lethal autonomous weapon systems that might be able to "decide" between life and death without the supervision of humans. For the Convention on Certain Weapons. But not much has been concretely achieved after years of meetings.

Considering this is an eminently transnational topic, these efforts are far from enough. This is why an international body dedicated to artificial intelligence and able to create binding regulations or influence existing bodies that could do so should be urgently considered.

Recommendations

(I) Policymakers should be aware of the specificities in AI epistemology, namely the symbolic and connectionist AI debate.

(II) All legislation levels should consider this polysemy when addressing the issue and providing definitions in regulatory texts.

(III) Finally, we join the efforts of other individuals and organizations (Mulgan, 2023) that advocate the creation of an international, interagency AI observatory to guide policy and give voice to various stakeholders involved.

Conclusions

Most expert and public debate around artificial intelligence only considered its connectionist approach. These discourses erase symbolic AI as something from a past that we have overcome. The dominant discourse refers to AI as a synonym for machine learning, leaving all other “methods” invisible.

Nonetheless, as shown here, the symbolic approach could and should complement the connectionist one, offering essential checks and balances.
Disputed scientific and philosophical values are inscribed in future technical objects.

This is why, although in a very niche academic field, the scientific controversy between symbolic and connectionist AIs should be accessible to a broader audience employing an international body devoted to ensuring justice and accountability.

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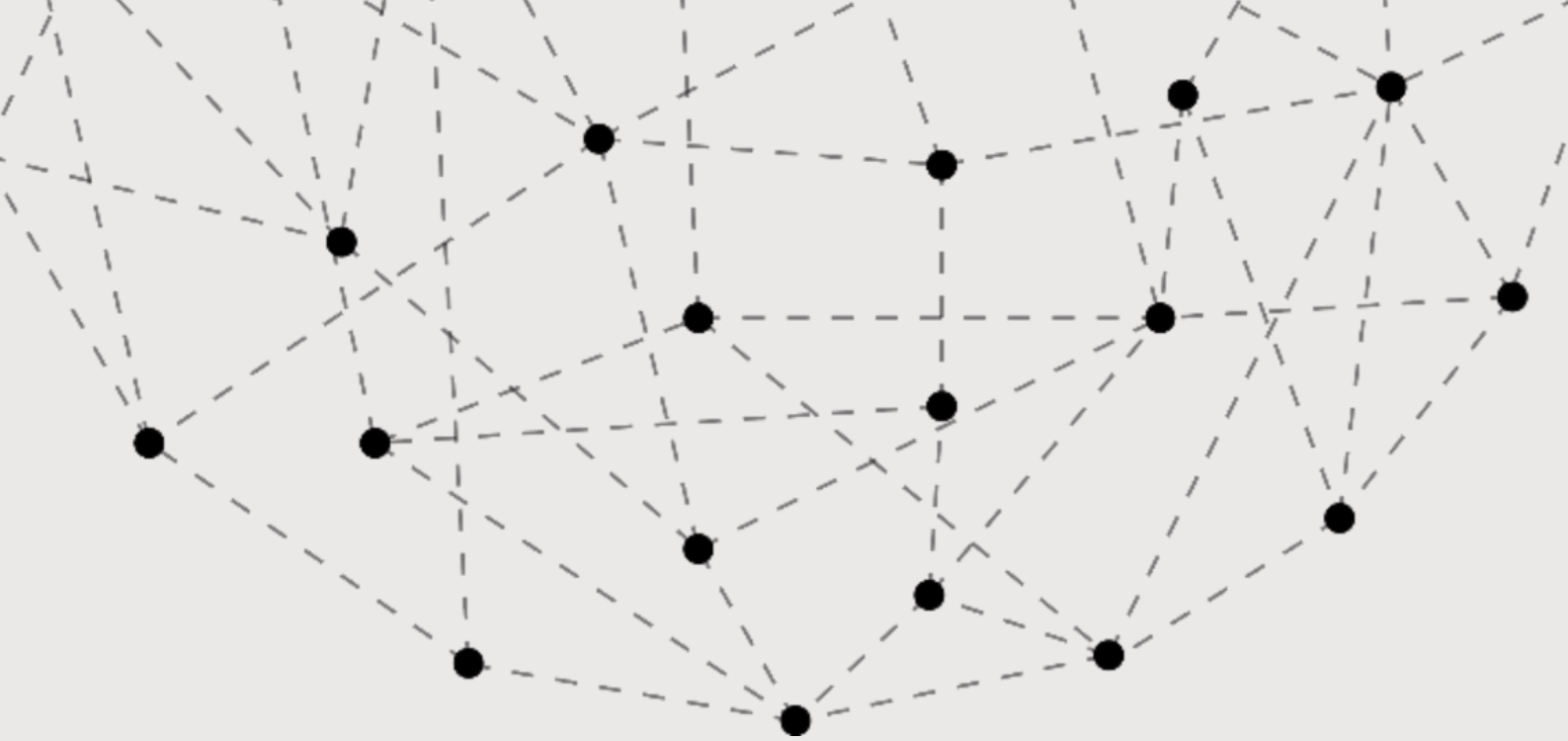
Ana Beatriz Duarte (InterAgency Institute; Coimbra University): Ph.D. candidate in Contemporary Studies at Coimbra University. She holds a BA in Journalism and a Masters in Social History.

[1] Subsymbolic is understood here as a synonym for connectionist, although it has also been taken as something "between the neural and symbolic levels" (Smolensky, 1987).



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