
A PROPOSAL TO IMPROVE RESEARCH IN AI ALGORITHM AND DATA GOVERNANCE

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ABSTRACT

This paper is a proposal to research on governance of artificial intelligence algorithms and data from a comparative study of relevant works and also from experience in Internet governance. Complementarily, the results from this study will be made available for discussion and improvement in a decentralized control environment, implemented especially for this purpose.

1 Introduction and justification, with a summary of the fundamental bibliography

Artificial Intelligence (AI) is the term used for computational systems that attempt to mimic aspects of human intelligence, including functions we intuitively associate with intelligence, such as learning, problem solving, rational thought and action [1]. In general and regardless of the application, these systems are used as overriding black boxes, with asymmetric information between the developers and the users [2]. One of the saddest examples highlighting the possible consequences of this asymmetry is the design of the MCAS⁵ system of the Boeing 737 MAX, which led to two accidents with 346 deaths in October 2018 (Lion Air) and March 2019 (Ethiopian Airlines). When the angle of the attack sensor failed, the built-in algorithms forced the plane to lower its nose, resisting repeated attempts by the confused pilots to turn the nose up.

Ben Shneiderman, in his book Human-Centered AI, which comments on the two Boeing 737 MAX accidents, considers that the future of these AI algorithms is human-centered, mainly becoming super tools, which amplify human abilities, empowering people in remarkable ways but at the same time ensuring human control [3]. Ben named these algorithms as **HCAI**, an acronym of the title of his book.

There are numerous applications using AI techniques that behave disproportionately. A detailed description of so-called algorithmic biases is in Safya Noble's book, Algorithms of Oppression [4].

Asymmetric information, biases, and other concerns are bothering developers, researchers and other stakeholders, all determined to find out what is missing [5]. Perspectives of interest, like ethics [6, 7, 8, 9], regulation [10, 11, 12, 13, 14], governance [15, 16, 17, 18, 2, 19] and many others [20, 21, 22, 23, 24, 25, 26, 27, 28] are on the agenda of all stakeholders in search for appropriate alternatives – these perspectives are widely discussed, for example, in [3].

*<http://lattes.cnpq.br/7092085044582071>

†<https://fenix.tecnico.ulisboa.pt/homepage/ist13522>

‡<http://lattes.cnpq.br/4008970012663480>

§<http://lattes.cnpq.br/7111526592323456>

⁵ Acronym for Manoeuvring Characteristics Augmentation System

The objective of this proposal is to study the state of the art in algorithm and data governance, producing a document that, besides aggregating the most significant insights, acknowledges and compares the results of the experience from Internet governance, a traditional but determinant application domain. We believe that this comparison will elucidate on premises - technical and non-technical - towards a provably beneficial governance [29].

In parallel, we intended to disseminate and make available the proposed conclusions in an environment suitable for stakeholder debate and consequent refinement.

Internet governance and its debate environment are discussed in sub-section 1.1; the concept of Decentralized Autonomous Organization (DAO) is presented in sub-section 1.2. Next, sub-section 1.3 lists the studies that will be filtered in the final selected bibliography.

1.1 The Internet

The Internet is a network of computer networks. Such computer networks are called Autonomous Systems (ASes) and have a unique identifier. The ASes are interconnected by means of a complex telecommunications infrastructure, spread all over the earth and beyond. The operation of ASes using this telecommunication infrastructure is done by programs, i.e. algorithms generically called protocols. Therefore, the Internet infrastructure is a decentralized organization, i.e., there is no central control, and its structure can be seen, abstractly, in Figure 1.

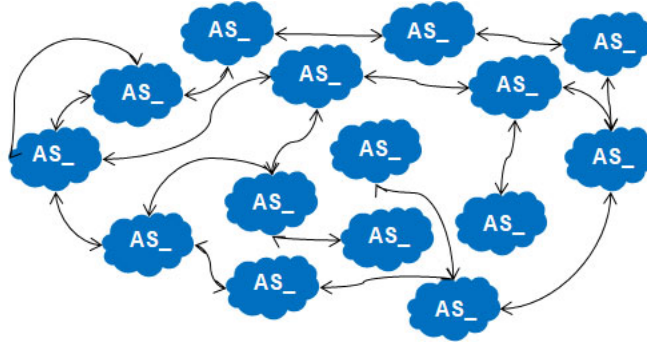


Figure 1: How the Internet organizes itself. Source: [30]

Internet complex governance environment and the institutions involved in it are shown in Figure 2.

The need to manage systems for consistent distribution of unique numbering (ASes numbers, IPv4 and IPv6 numbers, among other [31, 32]), which are defined in standardization documents (the so-called RFCs⁶), was the main motivation for establishing a decentralized Internet governance model [33].

On the other hand, thousands of volunteers are interested in contributing to algorithms for the Internet infrastructure, who meet through e-mail groups, and in person three times a year, around an institution called *Internet Engineering Task Force*⁷ (IETF). They do so motivated by the goal of making the Internet increasingly better. The algorithms are defined in draft documents and submitted to a consensus among volunteers, who are organized in groups that approve or not the presented proposal. It is similar to scientific journal's peer-reviewing processes, but more rigorous than the traditional two or three peer reviewing process. The documents, either approved or still in the approval process – these being changed at various times – are submitted and preserved in a repository controlled by a group gathered together under the name RFC Editor⁸, which is part of the governance process of Internet protocols, as we can find it inside the dashed box in Figure 2.

There is a fundamental distinction between algorithms that make the Internet infrastructure work and algorithms behind popular higher layer applications. For instance, Google search engine, Facebook, Twitter, Instagram, and many others; all these applications have some kind of centralized control somewhere in the globe. Skype has a decentralized behavior from the operational point of view (it adopts the peer to peer mechanism), however it is still subjected to a rigid centralized control. On the other hand, as we will see in subsection 1.2, there are available fully decentralized and secure Internet technologies for the development of higher layer applications.

⁶ Acronym for Request for Comments

⁷ url <https://www.ietf.org/>

⁸ Organized at <https://www.rfc-editor.org/>

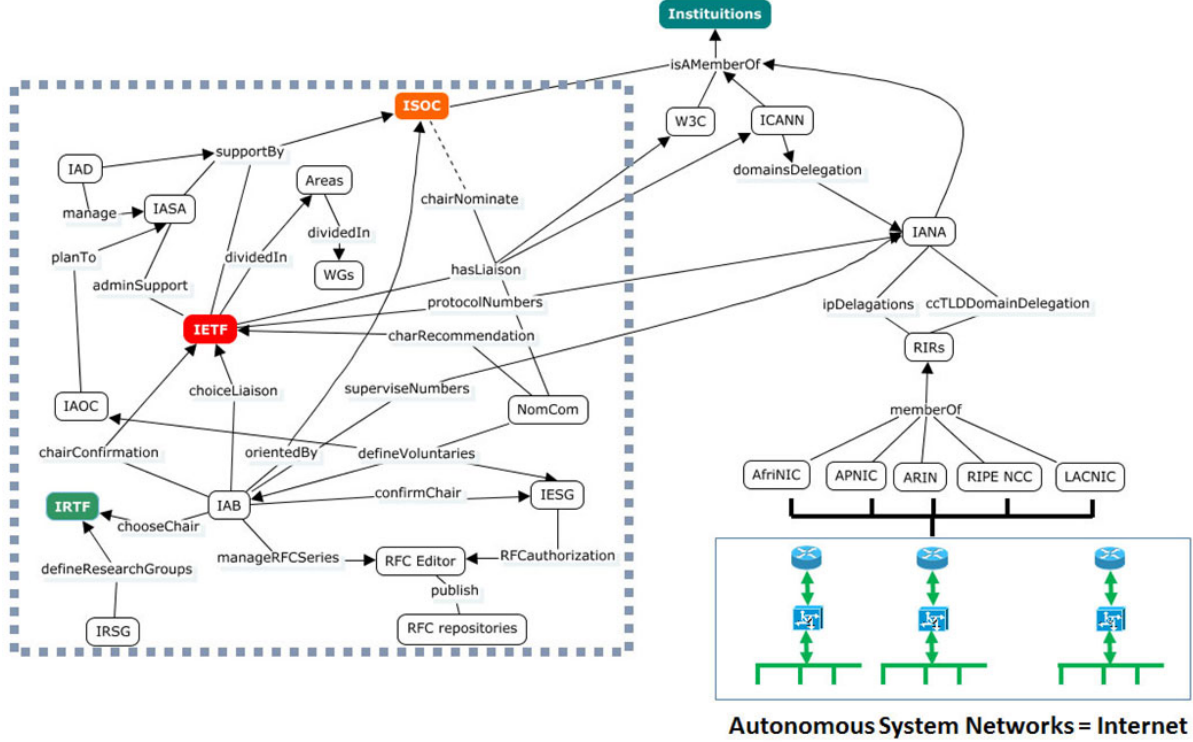


Figure 2: Internet Governance Ecosystem. Source: [30]

In the development of the project, the behavior of the institutions and people who are part of the Internet governance ecosystem will be studied, in order to understand how they are able to ensure the development and maintenance of algorithms underlying the set of so-called protocols. Moreover, the study will include a comparative characterization of the relevant points for governance found in applications' algorithms, particularly those that have any AI technique attached.

1.2 Decentralized Autonomous Organization (DAO)

In October 2008, Satoshi Nakamoto, a pseudonym, published an article entitled Bitcoin: A Peer-to-Peer Electronic Cash System, in which he predicted the need to establish a payment system on the Internet, with peer-to-peer characteristics and that is autonomous, secure, and limited in quantity. Then came Bitcoin launched on January 3, 2009, where each Bitcoin cost US\$0.0008 [34]. Today, almost four years later, one Bitcoin costs approximately US\$20,000.00 and there are 20,930 different cryptocurrencies⁹.

Nakamoto proposed that Bitcoin be implemented on top of a data structure called a blockchain. A blockchain is a set of list-like data structures, whose items (blocks) are chained together backwards to form a distributed database, with the contents of the blocks, and their chaining pointers, encrypted, making this chained structure inviolable and indestructible. This blockchain, in effect, is like a public ledger of all the transactions or digital events that have been executed and shared between the interested parties. Each transaction in the ledger is verified by consensus of a majority of its participants, who have produced blocks in the chained data system [35].

Over the years, Bitcoin's blockchain experience evolved and new techniques for researching and manipulating the blockchain appeared and a new currency emerged, along with the inclusion of programs (i.e., algorithms) within the blocks that could be executed. This evolution came about with the emergence of Ethereum, a currency that strengthened the blockchain as a completely decentralized structure and guaranteed anonymity for its users.

⁹<https://coinmarketcap.com/>

And this new property of decentralization with guaranteed anonymity (as well as being inviolable and indestructible) has been called Decentralized Finance (DeFi). It has been joined by a host of innovative applications, including, in 2016, the Decentralized Autonomous Organization¹⁰ (DAO), with structure shown in Figure 3

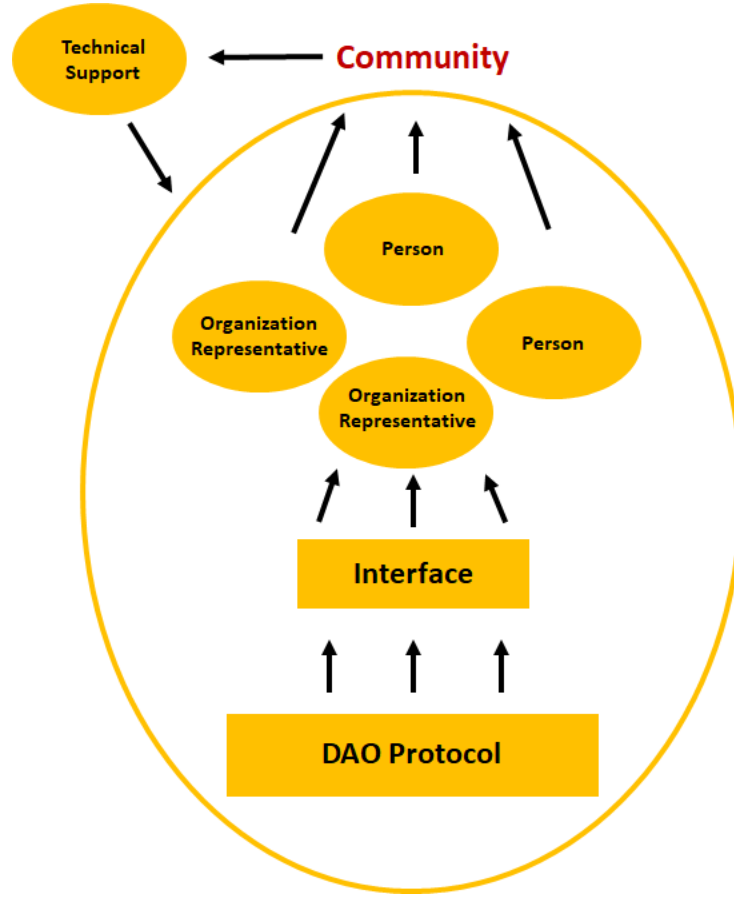


Figure 3: Proposed structure for DAO. Adapted from Ribon's Moriah Pacheco Rickli presentation at Lift Learning¹¹

To build a DAO requires a well-designed project, and this will be done by giving rise to a document detailing such planning in a document named Human-Algorithm agreement, where the rules established in smart contracts (processable algorithms in web3) will be characterized. The algorithms, residing in the blocks of the chain on which the DAO will be implemented, obviate the need for human controllers. This document and the rule-compliant code will be written as specified in the schedule (Table 2) and will occur in the first few months of the project, with the support of the stakeholders gathered via Discord¹². The Discord environment, also called Human-Algorithm, can be accessed via the invitation URL <https://discord.gg/sKG8ypS7ed>.

Figure 4, shows a set of DAOs built by 2021, characterized by interest areas. In particular, the DAO **Uniswap**^{footnote}<https://uniswap.org/community> is an ecosystem of users, developers, designers, and educators, much like the DAO that is being proposed in this paper. Hayden Adams and colleagues describe the latest version of the Uniswap protocol [36].

1.3 Fundamental Bibliography

Table 1 identifies the literature to be analyzed in order to look for different approaches regarding algorithm and data governance and, also, to allow a comparison of the recommended proposals.

¹⁰<https://bit.ly/daoland>

¹¹<https://ribon.io> and <https://bit.ly/lift-06>

¹²Discord is an online collaboration environment, widely used by web3 users

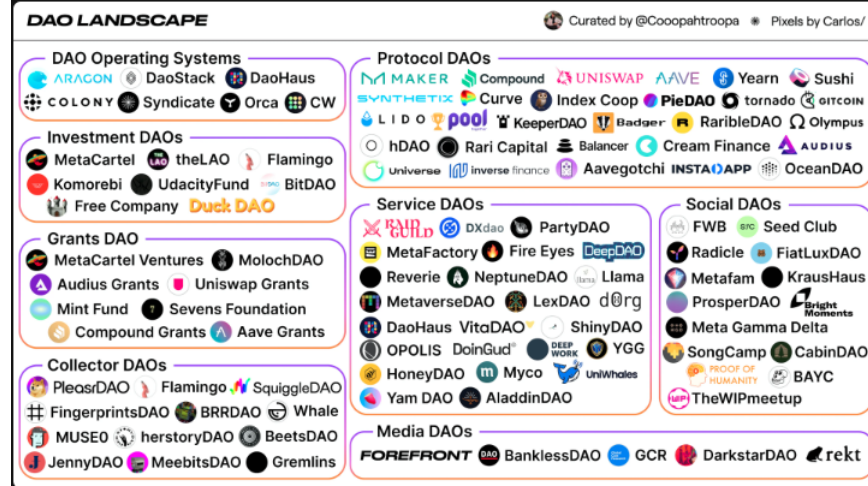


Figure 4: By 2021 there were over 100 DAOs in operation, handling over USD 10 billion in assets. Source: <https://bit.ly/daoland>

Table 1: Works of interest to this project, to be evaluated

#	References	Classification
1.	[37],[38],[39],[33],[40],[41],[42],[43],[44],[45],[46],[47]	Internet
2.	[48],[49],[50],[51],[52],[53],[54],[55],[56],[57],[58],[59],[60],[61],[62],[63]	Algorithms
3.	[64],[65],[66],[67],[68],[69],[70],[71],[72],[73],[74],[75],[76],[77],[78]	
4.	[79],[80],[81],[82],[83],[84],[85],[86],[87],[88],[89],[90],[91],[92],[93],[94]	
5.	[95],[96],[97],[98],[99],[100],[101],[102],[103],[104],[105],[106],[107],[108]	
6.	[109],[110],[111],[112],[113],[114],[115],[116],[117],[118],[119],[120],[121]	
7.	[122],[123],[124],[125],[126],[127],[128],[129],[130],[131],[132],[133],[134]	
8.	[135],[136],[137],[138],[139],[140],[141],[142],[143],[144],[145],[146],[147]	
9.	[148],[149],[150],[151],[152],[153],[154],[155],[156],[157],[158],[159],[160]	
10.	[161],[162],[163],[164],[165],[166],[167],[168],[169],[170],[171]	
11.	[172],[173],[174],[175],[176],[177],[178],[179],[180],[181],[182],[183]	DAO
12.	[184],[185],[186],[187],[188],[189],[190],[191],[192],[193],[194],[195],[196]	Economics
13.	[197],[198],[199],[200],[201],[202],[203],[204],[205],[206],[207],[208],[209]	
14.	[210]	Others
15.	[211],[212],[213],[214],[215],[216],[217],[218],[219],[220],[221],[222],[223]	
16.	[224],[225],[226],[227],[228],[229],[230],[231],[232],[233],[234],[235],[236]	
17.	[237],[238],[239],[240],[241],[242],[243],[244],[245],[246],[247],[248],[249]	
18.	[250],[251],[252],[253],[254],[255],[256],[257],[258],[259],[260],[261],[262]	
19.	[263],[264],[265],[266],[267],[268]	Governance
20.	[269],[270],[271],[272],[273],[274],[275],[276],[277],[278],[279],[280]	
21.	[281],[282],[283],[284],[285],[286],[287],[288],[289],[290],[291],[292],[293]	
22.	[294],[295],[296],[297],[298],[299],[300],[301],[302],[303],[304],[305],[306]	
23.	[307],[308],[309],[310],[311],[312],[313],[314],[315],[316],[317],[318],[319]	
24.	[320],[321],[322],[323],[324],[325],[326],[327],[328],[329],[330],[331],[332]	
25.	[333],[334],[335],[336],[337],[338],[339],[340],[341],[342],[343],[344],[345]	
26.	[346],[347],[348],[349],[350],[351],[352],[353],[354],[355],[356],[357],[358]	
27.	[359],[360],[361],[362],[363],[364]	
28.	[365],[366],[367],[368]	Literature Review
29.	[369],[370],[371],[372],[373],[374],[375],[376],[377],[378],[379],[380]	Social
30.	[381],[382],[383],[384],[385],[386],[387],[388],[389],[390]	

The references in table 1 are classified into eight preliminary categories:

1. **Internet:** They include the references that address the topic of Internet governance.

2. **Algorithms:** These are the references that showcase AI algorithms in various application areas.
3. **DAO:** References that address DAOs and the respective techniques on which they are built (blockchain and cryptocurrencies).
4. **Economics:** References that address issues related to the economics of algorithms and their environments.
5. **Others:** A set of references that describe the involvement of AI algorithms to the subjects: Bots, Discrimination, Software Engineering, Games, Robotics, Security.
6. **Literature Review:** Literature review papers, including systematic reviews.
7. **Social:** Texts referencing the social, philosophical and ethical aspects of algorithms.

In addition to the project description, the section 2 presents the Work Plan with the respective schedule. The section 3 describes the project development methodology. The 4 section presents the alternatives for analyzing the results. The section 5, expresses the authors' thanks. The project ends with the complete presentation of the additional consolidated bibliographical references up to the date of availability of this article.

2 Work Plan and Timeline

In Table 2 the main stages of the project are broken down, with their respective involvements in the months of the project's duration, whose initial milestone will be the first week of October 2022.

Table 2: Project's Chronogram

#	Task	Date								
		10/22	11/22	12/22	01/23	02/23	03/23	04/23	05/23	6/23
1.	Project description	•								
2.	Article development	•	•	•	•	•	•	•		
3.	Article submission								•	
4.	Evaluate publication in preprint								•	
5.	Literature selection	•	•	•	•					
6.	Literature evaluation	•	•	•	•	•	•	•		
7.	Discord implementation	•								
8.	Team evaluation	•	•	•						
9.	DAO agreement	•	•	•		•	•			
10.	DAO development	•	•	•	•	•	•	•	•	•
11.	DAO implementation				•					
12.	DAO testing				•	•	•	•	•	•
13.	Off-chain resources of the DAO	•	•	•	•	•	•	•	•	•
14.	Availability of the DAO					•				
15.	Inclusion of new references	•	•	•	•	•	•	•		

There is a Portuguese version of this paper at <https://doi.org/10.31219/osf.io/xcpsd> [391].

3 Methodology

The bibliographical survey of the present work was obtained from the references distributed by the Catedra Oscar Sala. This survey may grow during the course of the project, based on further references obtained from non-systematic bibliographic. The evaluation will be qualitative and comparative in references that directly propose AI algorithm or data governance. This indicates that the text analysis will be concerned with the subjectivity of the researcher and will highlight the differences and similarity between the proposals. In those references that do not touch on governance issues, the concern will turn to the aspect related to the contribution it makes to the governance proposal.

During the development of the work proposed in this text, inputs will be gathered from the collaboration among stakeholders, which is supported by two environments: (1) the repository in the Open Science Foundation (OSF) framework [392] and, (2) the Discord group, whose invitation to join is <https://discord.gg/nMUdGeUT>.

The project management will be done through ProjectLibre¹³.

¹³<https://www.projectlibre.com/>

The implementation of the DAO will be achieved with possible support from a specialized team or a *startup*, both of which are under evaluation. The implementation should ensure the behavior of the DAO adheres to its *smart contracts* and the specifications described in the *agreement* referenced above.

During the implementation of the DAO, there will be a programming effort using the language *Solidity*¹⁴ to adapt the original *smart contracts* [393]. This adaptation will take place by analyzing the *smart contracts* against the DAO proposal characterized by *agreement*.

The evaluation process of the implemented DAO, with the modifications of the *smart contracts* will be done through the interested parties, in the DAO itself, in the *Discord* and/or in the public repository available in the OSF [392].

4 Analysis of results

The project will be followed up:

- By advisors, in the development of the paper in Overleaf,
- Exploring the DAO implementation,
- Through the public environment at OSF [392],
- By advisors, in the private collaboration environment of the project development team, created in the OSF [394] e,
- Through the ProjectLibre file, which will be published in the private environment at OSF and updated weekly.

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¹⁴[urlhttps://en.wikipedia.org/wiki/Solidity](https://en.wikipedia.org/wiki/Solidity)

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- Trata do comportamento dos sistemas de AI, cuja compreensão é essencial para nossa capacidade de controlar suas ações, colher seus benefícios e minimizar seus danos. Em síntese, entender o comportamento dos sistemas de AI, para maximizar seus benefícios e minimizar os danos em relação à humanidade.**
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