

“CODE IS LAW” AND SMART CONTRACTS. EMBEDDING ETHICS IN DECENTRALIZED LEDGER SYSTEMS

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Abstract: *“Smart Contracts” are tools based on distributed ledger technologies deployed in order to increase the efficiency of transactions. Their adoption is growing at an exponential scale due to the undisputable advantages brought by their property of self-executing tasks, yet on the opposite it raises concerns since it does not require any sort of moral scrutiny. In our paper we first address how the current ethical discussion can be framed in Decentralized Ledger Technologies, then we unfold the evolution in legal theory of a decentralized approach – epitomized by the motto “code is law” – finally we focus on “smart contracts” discussing the application of “engineering ethics” or the implementation of “ethical oracles”. At the end we conclude with a few remarks and some perspectives for future research.*

1. DLT and ethics: “dust under the carpet”?

Decentralized Ledger Technologies (DLT) are known since 2008 for cryptocurrencies¹, but also and more recently for their industrial applications – especially in the field of security – and for allowing “smart contracts” to operate².

The key feature of DLTs is decentralization. Indeed, it is not just the pattern adopted for Internet infrastructure³ and also in DLT – although differently depending on the technology implemented – but, as the creator or Ethereum, Vitalik Buterin, pointed out in a Medium post, it is a conceptual model which can be considered under three perspectives: architectural, logical and political⁴. Deepening the many facets of decentralization is crucial in order to achieve a thorough understanding of digital artefacts, social phenomena – as economy or law – and their mutual interactions.

In this paper we intend to tackle ethical issues in DLTs, and more specifically “smart contracts”. Here we will neither digress on technical analysis – the discussion on the “consensus mechanism” between “proof-of-stake” and “proof-of work” for example – nor address general topics, such as malicious uses of DLT (e. g.: ransomware attacks) and their “disruptive” impact on the economy and society. Instead, we discuss whether and how an ethical evaluation can be embedded into the technological platform and be shaped in a decentralized fashion⁵.

¹ NAKAMOTO, Bitcoin: A Peer-to-Peer Electronic Cash System. <https://bitcoin.org/bitcoin.pdf> (2008).

² SZABO, Micropayments and Mental Transaction Costs (1999).

³ BARAN, On Distributed Communications Networks, RAND Corporation papers, P-2626, RAND, Santa Monica (California), 1962.

⁴ BUTERIN, The Meaning of Decentralization. Medium (2017).

⁵ REIJERS/COECKELBERGH, The Blockchain as a Narrative Technology: Investigating the Social Ontology and Normative Configurations of Cryptocurrencies, *Philosophy & Technology*, volume 31, issue 1, 2016, p. 103–130.

We can argue that “smart contracts” embody a blatant paradox in new technologies. Despite the recent proliferation of academic contributions⁶ or “grey literature”⁷ raising ethical concerns of algorithms, robotics, AI and so forth, the debate seems to leave aside DLTs⁸. Specifically, the success of “smart contracts” relies on their capacity to perform self-executing tasks, which entails the total absence of human intervention, thus of moral scrutiny, in their workflow. The relevance of such concerns is not minimal, as shown by the DAO scandal of 2016 which, as many know, divided the Ethereum community and ended up with the “hard fork” of Ethereum Classic (now ETC) from Ethereum (now ETH).

The reminder of this contribution is as follows. In Section 2 we offer a preliminary elucidation on the current debate in moral philosophy, observing how the many views – especially the traditional ones – find it difficult to adapt to the decentralized model. In Section 3 we analyse how ethical concerns have faded overtime with the evolution of a technological vision of the legal system which is expressed by the motto “code is law”. In Section 4 we propose a viable solution which could allow embedding ethical assessment exploiting existing technologies. In conclusion, we offer some final remarks and draw paths for future research.

2. Ethics, law and technology: a never-ending discussion

Before tackling the ethical problems concerning DLTs, and specifically smart contracts, it is essential to stress that the lines between ethics and morals are often blurred even because of the manifold ways in which such a distinction has been understood. Indeed, both these wide areas are aimed at establishing a difference between proper and improper human actions, and – behind them – decisions taken as well as intentions harboured. But when a distinction is made, then “morality” refers to and denotes most of all a system in a given theoretical tradition: be it a religion, a philosophy, a civilization, a culture or a society. This systematic approach is based on various principles, standards, obligations, duties as well as responsibilities, that are often supposed to be universal by its adherents. Whereas in this case “ethics” would rather be argued in a pragmatic and practical way, on the foundations of human rationality, concentrating on various virtues to be reached and internalised. There are also many perspectives in moral philosophy, depending on the criteria adopted in the ethical evaluation, which can be focused (1) on the actor, (2) on the action in itself or (3) on its consequences. The first position, namely “virtue ethics”, takes into consideration the intrinsic features of the agent in order to qualify her or his conduct. The main position concerning the second perspective presents itself as a “deontological” theory, since it provides prescriptions, which agents are expected to follow. The third, which has been called “consequentialist”, assumes that the moral value can be inferred by a description of what can result as most adapt in a given context. The major example in this latter sense is the position called “utilitarianism”.

As we know, in the intertwin between morals and law new arguments have been brought in the last century according to new approaches to legal ontology⁹ and ethics¹⁰ challenging both the tradition of natural law and more recent theories.

In this scenario the distinction among centralized, decentralized and distributed approaches mentioned in the introduction can be contextualized. Such categories have made a remarkable evolution since their origins – and have been adopted for describing even complex social phenomena¹¹. Therefore, we can argue that an ethical set of values can be represented either in a centralized schema, when it emanates from a unique

⁶ TSAMADOS/AGGARWAL/COWLS/MORLEY/ROBERTS/TADDEO/FLORIDI, *The Ethics of Algorithms: Key Problems and Solutions*, 2020.

⁷ Report on the safety and liability implications of Artificial Intelligence, the Internet of Things and robotics (2020).

⁸ TANG/XIONG/BECERRIL-ARREOLA/IYER, Ethics of blockchain: A framework of technology, applications, impacts, and research directions, *Information Technology & People*, volume 33, issue 2, 2019, p. 602–632.

⁹ HOHFELD, *Fundamental legal conceptions as applied in judicial reasoning and other legal essays*, Yale University Press; H. Milford, New Haven; London, 1919.

¹⁰ MOORE, *Principia ethica*, At the University Press, Cambridge, 1903.

¹¹ BENKLER, *The wealth of networks: How social production transforms markets and freedom*, Yale University Press, 2006.

and uncontroverted authority, or as a distributed pattern, if each entity linked to each other in the network is supposedly entitled to produce its own values. In the middle, as a third and intermediate model, stands decentralization, where ethical principles are shared and jointly processed by all the components of the network.

The status of ethical values in a decentralized perspective is still open to discussion since they depend on many factors: among others, on the interactions among the agents, on the single agent, as well as on the context. In this sense, it has been proposed that the ethics of complex systems could be unified in a comprehensive model where the fundamental value is the preservation of the “infosphere”¹². What remains still unanswered, in this sophisticated meta-ethical construct, is the question whether there could be a substantial foundation for ethical principles.

An essential aspect suitable to determine the set of ethical values of a community of users, under a practical point of view, is the basic layout on which the ledger can be implemented. Indeed, there is a radical distinction between permissioned and permissionless DLTs, since in the first kind participation is limited to users which are admitted under certain requirements, while anyone is allowed to access to the second type. In other terms, only in the first case technology in itself permits the emergence of a governance system, hence a definition – and then likely the imposition – of ethical paradigms. In this contribution, for the sake of brevity, we focus on the second kind, which seems to be more interesting, since the shaping of values is the pure outcome of self-organization by users.

3. “Code is law” from “Lex Informatica” to “Lex Cryptographia”

It is well known that the debate on law and ITCs dates back since the origins of cyberlaw, thirty years ago. Indeed, at that time the race for the electronic frontier was pushed by the *credo* that Internet – and especially first World Wide Web communities of users – would have been a space free from any kind of interference from public authorities, thus a moral established set of principles. The concept was expressed as “code is law”, meaning that the only limit to freedom had to be posed by the technological capabilities of the medium. Particularly evocative is, in this regard, the quote of a sentence by David Clark, one of the pioneers of the Internet: “*We reject kings, presidents and voting. We believe in: rough consensus and running code*”¹³. Fiercely opposed to this claim, rooted on neo-libertarian utopias, stood the old-fashioned belief that ordinary regulations could be applied indifferently to the Internet. This line of argumentation was known as the “law of the horse” with reference to an example provided by Justice Frank Easterbrook¹⁴.

The discussion was almost ended by the Supreme Court of the United States which, in the famous case *ACLU / RENO*, declared that the Internet had to be qualified “*a wholly new medium of worldwide human communication*” (Supreme Court of the United States No. 96–511, 19 March 1997 – 26 June 1997). A few years after the utopias of “code is law” was reformulated in a more reasonable opinion, expressed as “Lex informatica”. According to this view, technology, as a whole, would require a radically new kind of regulation of human affairs, both legal and technological¹⁵. Against such a thesis a remarkable argument was proposed by Lawrence Lessig, who objected that this new concept of law – called “cyberlaw” – had not to be applied to the Internet in itself, but only to online communities. Only there, in the virtual realm, law could be really programmed as code, thus embedded as infrastructure of social ties¹⁶. According to the position held by Lessig we can argue

¹² FLORIDI, *The Ethics of Information*, Oxford University Press, Oxford, 2013.

¹³ RESNICK, RFC 7282. *On Consensus and Humming in the IETF*, Internet Engineering Task Force (IETF), 2014.

¹⁴ EASTERBROOK *Cyberspace and the Law of the Horse*, University of Chicago Law School, issue 207, 1996, p. 206–216.

¹⁵ REIDENBERG, *Lex Informatica: The Formulation of Information Policy Rules through Technology*, *Texas law Review*, volume 76, 1997, p. 553–593.

¹⁶ LESSIG, *The Law of the Horse: What Cyberlaw might Teach*, *Harvard Law Review*, volume 113, issue 2, 1999, p. 501–546, LESSIG, *Code and other laws of cyberspace: version 2.0*, Basic Books, New York, 2006.

that only in virtual communities a participative – and thus, decentralized – concept of ethics could be built, although it would be limited to a too restricted realm.

Twenty years after, the motto “code is law” resurfaced in the “DAO case” mentioned in the introduction. As many would remember, facing the theft of 50 million dollars by an anonymous user, the Ethereum-community was divided between those who vouched for the reimbursement of the victims, even if that would have reversed the blockchain, and those who opposed, claiming that the algorithm should have been left untouched since, once again, “code is law”. The latter opinion was put in minority notwithstanding the rhetorical power or the argument that recalled the “rough consensus” of the pioneers of cyberlaw and was supported by the zealots of crypto-anarchism.

As today, more importantly, we can argue that “code is law” can be endorsed by the “Philosophy of Information” by Luciano Floridi¹⁷, according to which the human existence in digital society can be represented as synthesis between the online dominion and the off-line world. In such “on life” experience, “rule of law” is overhauled by a “rule of code” hence a new concept of law¹⁸, has flooded from its original field – not anymore the virtual communities, but the crypto-users – to the entire worldwide society. In its conquest, “Lex Cryptographia” brought with itself a decentralized concept of ethical framework.

To sum up, provided that with “Lex Informatica” there was still a difference between the “real world” and the “digital reality”, so the ethical framework could be different between the two realms, in “Lex Cryptographia” such a dualism ceases to exist, consequently the first is absorbed in the second, creating a decentralized fabric made of data, algorithms and code which is shared by artificial agents, human beings and other lifeforms. In this sense, eventually human “law” and technological “code” become interchangeable regulatory tools¹⁹.

4. Legal issues of smart contracts

One of the most debated utilizations of the DLT is the smart contract. Smart contracts are widely discussed from practical to legal point of view since it made possible a broader application of DLT and in addition the naming appealed to futuristic, computed legal opportunities. The authors claim that this idea – even in its imperfect status – is something which may be the closest to the “code is law” motto (even if there are some known examples when a smart contract does not aim to create legal bond²⁰).

When it comes to ethical concerns regarding smart contracts, one may be reminded of the loss of the moral considerations in modern contract law in the first place. In the western legal world, on the one hand, contract means a rather serious commitment in order to fulfill the obligations (see the principles of Roman law e.g.: *pacta sunt servanda*) and on the other hand there are some restrictions as regards highly immoral (and unethical) contracting aims (again in Roman law, e.g.: *ex turpi causa non oritur actio*). The importance of morals in the fulfilment of the contract has been questioned by the field of the “law & economics” movement promoting for example the notion of “efficient breach”. Such view bases contracting on mere calculations of effectiveness (which approach has been criticized by many authors for example by Alain Supiot)²¹ and this logic leads us to smart contracts which may be the symbol of this economic-driven approach since this enables

¹⁷ FLORIDI, *The Philosophy of Information*, Oxford University Press, Oxford, 2013, FLORIDI, *The logic of information. A theory of philosophy as conceptual design*, Oxford University Press, Oxford-New York, 2019.

¹⁸ DE FILIPPI, *Blockchain and the Law. The Rule of Code*, Harvard University Press, Harvard, 2018.

¹⁹ WEBER, “Rose is a rose is a rose is a rose” – what about code and law?, *Computer Law & Security Review*, volume 34, issue 4, 2018, p. 701–706, GANTER, “Code is Law” aber “Is Law Code”. In: Schweighofer, E./Kummer, F./Saarenpää, A. and Schafer, B. (Eds.), *Datenschutz / LegalTech – Tagungsband des 21. Internationalen Rechtsinformatik Symposions IRIS 2018: Data Protection / LegalTech – Proceedings of the 21st International Legal Informatics Symposium (Colloquium) Editions Weblaw / Österreichische Computer Gesellschaft, Bern (CH), 2018, p. 123–130.*

²⁰ GUADAMUZ, All watched over by machines of loving grace: A critical look at smart contracts, *Computer Law & Security Review*, volume 35, issue 6, 2019.

²¹ SUPIOT, *Homo juridicus. On the anthropological function of the law*, Verso, London, 2017.

to conduct financial transactions more efficiently and faster. This aspect can be connected to the fact that it has been argued that DLT is qualified by an “a-legal” nature²². This observation is crucial, since it points out correctly that DLT disrupts traditional ethical considerations, besides the fact that such technologies allow any kind of transactions, many of whom are illegal in most countries.

Although this issue can be tackled under many aspects, in this section we will focus only on those which seem to be more realistic provided the current state-of-the-art technologies: first, the consideration of ethical scrutiny as a professional duty for designers and code developers; second, the inclusion of moral evaluation as part of the processes that govern the workflow of smart contracts.

As regards the first aspect, one obvious solution would be to guarantee ethical and moral considerations by the coders themselves as in others professional category, such as notably lawyers and physicians. This type of thinking has been posed by Mik in the sense that she explicitly identifies coders as the new type of intermediaries replacing lawyers in the blockchain world²³.

Although there were more initiatives to give programmers a general code of conduct, the impossibility of enforce such a code and the variety of the topics which should be governed render this idea somewhat unrealistic. While in former times the accessibility to computers artificially filtered the number of professionals, nowadays it would be extremely hard to either prohibit someone to use computers or to create some sort of authorization process in order to regulate a special professional branch²⁴. Furthermore, the content of a hypothetical code may be too long and complex since in case of software developers both technical and practical issues may be posed as some sort of ethical problems. In this sense, it is remarkable the authoritative opinion of Bob “Uncle” Martin, who refers a combination of two kind of processes: the first relates to the figure of the “clean coder”, namely the tools and strategies for developing a successful professional career (how one should maintain and develop his/her skills, how to organize and solve tasks etc.)²⁵; the other regards the result of the “clean code”, as the methods to write a readable, (re)usable, concise and effective programming²⁶. This latter concern becomes an ethical issue whenever the conduct of the coder has an impact on other individuals (teammates, users). It seems that drafting a code of conduct which could consider those aspect is quite difficult, especially considering the expansion of consequent liabilities.

The second problem could be tackled introducing ethics through so-called “oracles”. Since smart contracts cannot handle ethical questions through programming code, the ethical considerations may enter to their ecosystem through external inputs. Indeed, “oracles” add a real-time, sophisticated element to the functioning of a smart contract which may be an automated tool / device or a human²⁷. In such a case, a smart contract could conduct entire transactions as a mere agent, which is a raised idea in the literature (see the article of Kolvart²⁸) and supported by the famous example of Szabo’s “humble” vending-machine. In short, smart contracts could be coded leaving to the oracles to verify the fulfilment of certain ethical requirements or the achievements of certain expectations. For example, recalling the principle mentioned in the example at the beginning of this section, a human oracle could evaluate if a special kind of agreement could be afflicted by turpitude, and feed

²² DE FILIPPI, *Blockchain and the Law. The Rule of Code*, cit.

²³ MIK, *Blockchains: A Technology for Decentralized Marketplaces*. In: Poncibò, C./DiMatteo, L.A. and Cannarsa, M. (Eds.), *The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms*, Cambridge Law Handbooks Cambridge University Press, Cambridge, 2019, p. 160–182.

²⁴ HOLMES, *Some ethical imperatives for the computing profession* Chapter Author(s): Neville Holmes Book Title: *Book* Author(s): Published by: ANU Press Stable URL: <https://www.jstor.org/stable/j.ctt5hgxws.9>. In: Weckert, J. and Lucas, R. (Eds.), *Professionalism in the Information and Communication Technology Industry* ANU Press, Canberra, 2013, p. 49–62.

²⁵ MARTIN, *The clean coder. A code of conduct for professional programmers*, Prentice Hall, Upper Saddle River, N.J., 2011.

²⁶ MARTIN, *Clean code. A handbook of agile software craftsmanship*, Prentice Hall, Upper Saddle River, 2009.

²⁷ TAI, *Challenges of Smart Contracts: Implementing Excuses*. In: Poncibò, C./DiMatteo, L.A. and Cannarsa, M. (Eds.), *The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms*, Cambridge Law Handbooks Cambridge University Press, Cambridge, 2019, p. 80–101.

²⁸ KÖLVART/POOLA/RULL, *Smart Contracts*. In: Kerikmäe, T. and Rull, A. (Eds.), *The Future of Law and eTechnologies* Springer International Publishing, Cham, 2016, p. 133–147.

the output to a smart contract, whose process could be stopped in case of negative assessment. However, oracles may undermine the whole concept of the DLT which may be posed as the “oracle-problem” (raised in a recent article²⁹) and the solution for such problems are not straightforward and obvious yet. In summary, this solution brings back the questions posed at the beginning of the present contribution, regarding the discussion on the foundation of moral values, the ethical assessment in general and its application to the ITC domain. We can argue that “oracles” can become gatekeepers of values in permissionless DLTs – allowing their acceptance by other participants – as well as in permissioned DLTs administrators select, monitor or even uncompliant expel participants from their system. In the first case, are filtered values, while in the second users are.

5. Conclusions

We can agree that DLTs are disruptive technologies, as many others which are witnessing an extraordinary growth (artificial intelligence and so on). As such, they should be addressed entirely in the discussion that is currently ongoing worldwide on the real benefits that we, as members of the human genre, should expect from them, and on the disadvantages that should be avoided. Instead, very little has been debated in this specific field.

The main opportunity, in this sense, is offered by the fact that decentralization is suitable both for the meta-ethical approach suggested by the “Philosophy of Information” and the “a-legal” ecosystem operated by the “Lex Cryptographia”. Such model should be embedded both in the technological infrastructure and in the social practice.

We have seen that, while human intervention is currently considered a crucial ethical conundrum in AI and robotics, unexpectedly with DLTs that seems not to raise the same level of concerns³⁰. Many explanations can be provided for that: on one side, different technology have various impact on ethics, on the other, diverse community of experts have different ethical responsiveness. Whatever it may be, there should be no reason for inactivity.

In this contribution we have detected many challenges. Of them, the following are deemed to be the most interesting for us.

A first line of research is intended to analyse if and how the different kind of platforms – public, permissioned or private, permissionless – influence the model of ethics which can be applied.

A second line of inquiry leads to assess a list of principles which could be included in a code of conduct or guideline for DLT developers. Although it is improbable that if any would be established or enforced, that could lead at least to assess how value design principles, for example, can be adapted in this field.

A third path regards the adoption of “oracles” in order to map the existence of ethical preferences or decisions and to interact with smart contract. In this sense, the research concerning the way of achieving a “rough consensus”, possibly including artificial agents, could be fascinating.

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²⁹ CALDARELLI, Understanding the Blockchain Oracle Problem: A Call for Action, *Information*, volume 11, issue 11, 2020, p. 509.

³⁰ Indeed, in the text adopted on Tuesday, 20 October 2020 by the European Parliament, Framework of ethical aspects of artificial intelligence, robotics and related technologies, P9TA(2020)0275 blockchain technologies are mentioned only once (see paragraph 100) as a kind of safety measure.

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