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Roundtable:

The future of culture in more-than-human worlds of being

Machine politics: The cultural science of permissionless systems

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The survival of permissionless blockchains is typically cast as a cryptoeconomic security problem for mechanism designers to resolve. This essay argues that, long-term, these networks may require something that looks more like a UNESCO protection convention for machine culture than an equation. Ethereum's machine culture is observable through the formation of a "'we'-group" (Hartley & Potts, 2014, p. 76), which is necessary for the establishment of common knowledge. While entry to the group is permissionless, maintaining membership boundaries demands active contributions from validator nodes. The paper discusses concerns that Ethereum's consensus may be used for purposes beyond itself, making Ethereum vulnerable to external, non-machine political forces. As this begins to manifest, the need to safeguard Ethereum's intrinsic machine culture becomes apparent—not merely for the sake of the blockchain but to maintain a stable foundation for emerging digital economies and governance structures.

> *To summon DankShard, our guides point us to a Ceremony. All members of the Lands of Ether and abroad are encouraged to contribute. Each will add their unique contribution to the collective and in doing so, illuminate the path forward.* – EF Protocol Support Team's (2022) call for participants in the KZG (trusted setup) ceremony.

Introduction

Consider a network of computers that need to coordinate and reach agreement. Together they decide what's in and what's out, resulting in shared knowledge that people use to perform various activities including trade and decision-making. These machines can banish a nefarious actor from their network if it tries to undermine their shared view of reality. Both endemic rules and markets inform what happens between the machines, but neither the network's economy or its institutions would exist without a collective coordination action. How do we explain the processes and agency of the machines in this network? While the question might seem like nothing more than an odd humanities expedition, how we answer it may one day inform whether the network is exploited or protected.

The network I am referring to is Ethereum, but it could be another Proof of Stake blockchain with sufficient decentralisation (Schneider, 2019). My proposition is that if we look deep into the workings of Ethereum, at how it holds together, we find *culture*. By this I don't mean cultural products or the certificates that accompany them (such as non-fungible tokens) but the formation of what Hartley and Potts (2014) call ""we"-groups", "demes" or "groupishness" that are a precursor to knowledge formation. While most discussions of blockchain consensus commence from game theory (a rather good example being Schär, 2020), cultural science helps to show how a permissionless system like Ethereum manages to endure, grow or falter by placing boundaries around its membership through an ongoing assessment of which actions are valid and useful, and which are melliferous.

The patterns and constraints of this machine culture warrant our attention independently from what can be built on a blockchain or the rules that can be enforced through it (such as Werbach, 2018). In Ethereum's early years, validators have worked only on storing and securing Ethereum's own data structure. As the blockchain grows, the validator set may be used for purposes beyond itself, making it vulnerable to external political dynamics. A counter-intuitive problem emerges; rather than protecting humans from machine culture, should we be protecting Ethereum's demic processes from our own non-machine politics?

To explore this question, I start with a description of how validators enter the permissionless system of Ethereum and perform attestations to produce knowledge about the state of the blockchain, made possible through the threat of punishment. I then turn to a concrete example (first suggested by co-founder Vitalik Buterin) of how validators could be used in ways that destabilise external political configurations and how this in turn could destabilise Ethereum.

On-chain demes

According to cultural science, the function of culture is to form and sustain groups. Groups make knowledge, which is the "currency" of both politics and economics (Hartley, 2020, p.3). Culture is therefore "constitutively prior" to both (Hartley 2020, p. 7).

> A "we"-group is a locus of identity and cooperation. It determines, in advance of individual choice, with whom we may cooperate, and which other groups we may oppose. It is built

> around a **common inheritance** in ways of seeing the world and interpreting its contents and meaning. Culture is a system of references – through symbols and artefacts, and all manner of practices and prospects – that forms a knowledge base for a "we"-group. Culture is group-making knowledge (Hartley & Potts, 2014, pp. 76-77, my emphasis).

Among humans, groups form through social learning via stories, art, fashion etc – a process that is aided and altered by communication technologies. A growing body of research is now focused on how intelligent machines such as recommender systems and large language models are "evolving as contributors in generating cultural traits" (Brinkmann et al., 2023, p. 1855), resulting in an infusion of machine culture into human culture[1]. Evolutionary selection, in these accounts, is a process whereby machines either select what humans learn or humans select machine behaviour (Brinkman et al., 2023, p. 1861). The machine culture of blockchain that I am describing is different in that it creates the virtual machine itself - a process of group selection from within a network of participating nodes, which commences with the network's ability to manage its own membership whilst remaining permissionless.

The success or otherwise of that group selection then influences a range of other cultural and market processes. While these are not my focus here, successful permissionless blockchains produce state-like formations involving rules, markets, practices and rites. In Ethereum's case, non-machine groups include a meritocracy of researchers who discuss and propose changes to the protocol (All Core Devs meetings) as part of a global scale polycentric system (Alston et al., 2022). An informational network extends through in-person meetings (Denver in late February), in Decentralised Autonomous Organisation governance forums, self-help technical forums (Dappnode's Discord server), and social media platforms (Farcaster). There are ceremonies too, such as the 2023 "trusted setup" KZG Ceremony (quoted at the start of this essay), which was required to make Ethereum faster and reduce fees for users[2].

All these group formations contribute to an infrastructure that people can use to coordinate because they are confident that the system works as promised (De Filippi et al., 2020) and produces a reliable set of facts about the world. Yet all of these various economic, political and cultural formations are only possible through the existence of the machine culture that occurs between nodes.

A virtual machine

In Ethereum, computers running the Ethereum client software – called nodes – keep the chain's data structure live and intact, including the current state of account balances and smart contracts that exist within the Ethereum Virtual Machine (EVM). The nodes share this "common inheritance" just as human culture is shared within groups of people. When a major protocol change is proposed (known as a fork upgrade), node operators effectively choose which version of the blockchain to support by updating their software clients (or not). If enough node operators perform the upgrade, Ethereum itself changes[3].

[1] Brinkman et al use the example of Alpha Go Zero generating Go strategies without referencing human gameplay, which people in turn developed on.
[2] For the Ceremony to succeed, only one participant out of the eventual 141,416 needed to be honest and not publish their part of a shared secret for the final output to be secure.
[3] If some refuse to upgrade during a fork, two versions of the blockchain are produced (as occurred with miners in 2016 following The DAO exploit, which resulted in Ethereum and Ethereum Classic).

As described in the Ethereum documentation:

> The EVM's physical instantiation can't be described in the same way that one might point to a cloud or an ocean wave, but it does exist as one single entity maintained by thousands of connected computers running an Ethereum client […] At any given block in the chain, Ethereum has one and only one 'canonical' state, and the EVM is what defines the rules for computing a new valid state from block to block (Ethereum Foundation, n.d.).

The network becomes secure by becoming too difficult or expensive for a person or entity to spin up enough nodes to be able to form a majority and alter account balances in their favour (Nuzzi et al., 2024). For this to work, Ethereum needs to know which validators are in the "'we'-group" and which might be a "bad neighbour" (Hartley & Potts, 2014, p. 78).

A key property in this machine culture is its permissionlessness, a term referring specifically to the fact that, from the standpoint of the protocol, a validator can enter the system and participate in block production processes without needing to go through an approval process. It works as follows:

- The node operator undertakes to stake 32 ETH (individually or as a squad[4]), maintain common computing hardware, ensure that the software clients are up-to-date and set correctly, and provide sufficient and ongoing internet connectivity to the node.
- Once these things are in place, the node's client will wait for the validator to become activated on the network and assign it an identifier that enables it to be called upon to propose and attest to blocks (determined by a pseudo-random algorithm). The process repeats until the operator of the validator exits the validator system voluntarily or is exited by the network for being lazy or malicious.

While entry is not permissioned, remaining in the "'we'-group" requires some effort. A system that anyone can enter needs a way to get rid of those who try to undermine or destroy it. The validator deposit provides the means to punish and banish. Rewards can flip to deductions if a validator is slow or offline. In extreme cases – for instance, if the validator attempts to change history or votes on two competing blocks at the same time – the original deposit of 32 ETH may be 'burnt' (permanently removed from circulation).

The staking deposit is in part an incentive for node operators to maintain their node and not collude, but it also enables the network to self-correct when things go wrong. For example, for a block to be considered final, two thirds of all validators must agree on the state of the chain at certain intervals known as checkpoints. If more than one third of validators are offline or fail to submit correct attestations, the network will enter "a kind of emergency state" called an inactivity leak (Edgington, 2023). In this event, which briefly played out in May 2023 (Offchain Labs, 2023), attestations are paused and the stakes of inactive validators are reduced until participating validators again control 2/3 of the remaining stake.

The "groupishness" that is observable among validators is therefore not a club in the Buchanan (1965) sense of cooperative membership wherein the number of members is controlled at the point of entry (such as entry to a swimming pool). With Ethereum, receiving rewards from the beaconchain is non-rival to validators (with some randomness thrown in) but excludable to non-validators (as per Kealey & Ricketts (2014) theory of contribution goods. See also Rennie & Potts, 2024). Benefits are conferred on all users – a public good by-product – but validators benefit more for being contributors. Controlling who is a contributor is achieved through processes such as the inactivity leak whereby

[4] Using distributed validator technology, such as Obol.

membership boundaries are formed by discerning good validators from hostile or lazy ones. Ethereum therefore exists and thrives through the actions of its spontaneous group of contributors.

Beyond consensus

For Ethereum's co-founder Vitalik Buterin, a crucial question is what belongs on the consensus layer – among validators – as opposed to what happens at the application layer or through other off-chain processes. As Ethereum grows, developers are looking to utilise the validator set for purposes beyond Ethereum, including 're-staking' middleware that uses Ethereum's validators and staked ETH as security for other protocols.

In a blog post, Buterin (2023) paints a sci-fi picture of how various scenarios could impact on Ethereum's own security. One such scenario involves a stablecoin oracle that leverages validator votes to establish prices every hour, with incentives to ensure accuracy and penalize deviation from the median retrospective vote. This system, initially promising, expands to cover additional currency indices. However, by 2034, a political crisis in Brazil leads to a contentious situation affecting the oracle's operation. The crisis results in two competing Brazilian digital currencies (CBDCs), BRL-N (North) and BRL-S (South), each backed by different factions and international opinions, causing a split in the Ethereum community over which rate to support. The disagreement escalates into a proposal to fork the Ethereum blockchain, aiming to isolate validators supporting the "incorrect" currency rate, eventually causing two versions of the Ethereum blockchain[5].

Buterin's story highlights the vulnerability of global, permissionless platforms like Ethereum to geopolitical events, contradicting its objective to remain a neutral ground beyond the reach of national and political conflicts. He writes:

> As soon as a blockchain tries to "hook in" to the outside world, the outside world's conflicts start to impact on the blockchain too. Given a sufficiently extreme political event - in fact, not that extreme a political event, given that the above story was basically a pastiche of events that have actually happened in various major (>25m population) countries all within the past decade - even something as benign as a currency oracle could tear the community apart (Buterin, 2023).

By asking that Ethereum's consensus process not be exploited for other uses, Buterin is suggesting that, rather than safeguarding humans from machines, it may be more critical to protect Ethereum from external, non-machine politics. Ethereum's machine culture may be among the first of its kind to seek status as a protected group.

Conclusion

A permissionless system only works by creating boundaries, defining its membership and banishing that which attempts to corrupt the chain's ongoing production of what is mathematician Silvio Micali calls "common knowledge" (Micali in Fridman, 2021). The processes of knowledge formation are therefore at the heart of permissionless systems and these processes require agreement among a

[5] The story is not so outlandish given that National Unity Government, Myanmar's anti-coup administration in exile, has already created what it referred to as a central bank digital currency on the Stellar blockchain, asserting the illegitimacy of the military administration (Fishbein & Hein, 2022). The difference between this and Buterin's fictitious example is that the NUG's DMMK was not using the validator set as an oracle to peg it to the kyat.

group of machines called validators. Attesting to the validity of the ledger and agreeing on the state of the virtual machine occurs as part of a continuous, collective, relational effort.

These processes are typically explained through the language of mechanism design, which suggests that the crypto-economic blueprint of the protocol designers is simply powered up into production mode (not unlike transmission theories in cultural studies). Yet as many competing blockchain developers have discovered, a good mechanism can fail to produce a sustainable chain. Focusing on how group-formation and cooperation occurs in a permissionless virtual machine context is a necessary step to understanding new economies and politics in the making. Ethereum is an exemplar of a permissionless yet groupish system, where entry is open but ongoing participation requires adherence to collectively upheld agreement processes. Machine culture among nodes creates boundaries that protect the blockchain from malicious actors while fostering growth, including a global, polycentric system of cultural, economic, and political practices. However, as Ethereum expands its functionalities it risks becoming entangled in external geopolitical events. Ethereum's unique machine culture, formed through the coordination of its nodes and validators, is an intrinsic aspect that supports its survival and evolution. It may one day warrant protection from the external forces – human politics – that could destabilize it.

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