

The Importance of History in Decentralization

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Abstract

Chapter 9 emphasizes the role of history in the creation of decentralized organizations. Access to historical records creates transparency and accountability and enables punishment and rewards in decentralized organizations which changes the motivations of members from a focus on immediate rewards to the future, encouraging delayed gratification and sacrifice for the good of the group. Historical review changes the game theoretical perspective from a single stage game, to a repeated game. This leads to more efficient cooperation instead of internal competition. Review helps create a decentralized history for decentralized organizations, which gives them momentum. History is the basis for making governance more effective. History brings clarity and stability.

The book can be accessed here:

<https://www.amazon.com/Decentralization-Technologies-Organizational-Societal-Structure/dp/3110673924/>

and here:

<https://www.degruyter.com/view/title/569051>

Chapter 9. Historiography

We are not makers of history. We are made by history.
--Martin Luther King, Jr., Strength to Love (1963)

Dual to cryptography, which is the process of writing secrets, historiography is the process of distilling and sharing information publicly. Historiography is the way you choose to write the past—how it's recorded, what information is stressed as important, how it is presented. Do we present history as a list of the important decisions kings and queens have made, or do we stress the social developments that provoked

those decisions, or do we point to the technological innovations that fomented those social changes?

In business, your choice of historiography determines what past events are important to consider when making economic decisions. Your historiography is your perspective. To achieve liquidity, marketplaces must be trustworthy. They need momentum. It's not enough to achieve motion in any particular instance. Momentum must be observed to give trust to the marketplace. These observations need to be collected in a history to give them weight and meaning.

In decentralized organizations, governance is the key ingredient for driving effective collaboration towards a goal. Governance relies on meaningful reputation to decide who or what to focus on. The meaning of reputation is determined by its history and how that history is analyzed and presented. Information, especially through news sources, controls a decentralized organization.

How is our attention focused and organized? Which details are important? Which narrative do we follow? What is the internet search engine for the decentralized P2P environment? How do you tell the story of what the data means? How trustworthy, how efficient, how effective is any particular DAO, compared with other DAOs? To answer all of these questions, you need to answer how history is recorded and disseminated.

The choice of historiography is the design choice of the architecture of higher-order information storage. The purpose of the judicial branch is to finalize information storage, to decide what is true. The architecture of history, historiography, is the architecture for judicial governance. Historiography is our method for putting the authoritative stamp on what is true. This stamp sets the stage to analyze our situation and decide what to do next (legislative governance/information processing), then to do it (executive governance/information transmission).

In this chapter we describe how to build decentralized news services for DAOs, known as oracles. Incidentally, this explains how to revitalize our failing news media, the vaunted Fourth Estate, and educational institutions that are essential to the functioning of the larger DAOs of our democratic societies, using the principles of decentralization.

Oracles

In the decentralized economy, trusted news sources become even more important than in the traditional economy. Business contracts are becoming more automated, reacting immediately to news events. Automated news services in P2P systems are called oracles.

Many oracles exist today which work with P2P projects, such as Provable (formerly Oraclize) and Town Crier, which are centralized (Provable uses Amazon's Web Services virtual machine and Town Crier uses Intel). These centralized oracles are recommended for any contemporary P2P project, because as of 2020, no decentralized oracle is robust enough to be trusted for valuable transactions. To make DAOs secure in the long run, however, many different types of trusted decentralized oracles need to be developed.

Why do you need a decentralized oracle? The same reason all the other institutions that business relies on need to be decentralized before a DAO can reach its full potential. Any time your DAO relies on a centralized feature, that is a centralized point of failure that is a threat to the survival of the organization. That means the system is technically centralized. In that case it would be more efficient to completely centralize around the single point of failure the DAO is automated around. The effort you're making to decentralize and give each member redundant power is wasted, because the point of failure might as well be the supreme leader.

For example, if the DAO relies on a centralized oracle, that means someone in the oracle's hierarchy has the power to decide what information to share. A DAO is automated by its smart contracts to rely on the information coming from the oracle. The DAO is automatically triggered to make monetary transactions based on that information. Eventually, the people who have the relevant power in the centralized oracle will become aware of the power they have over the DAO. Eventually there will be an opportunity to exploit that information. And from a game theory perspective, given the competitive nature of capitalism, they are right to take advantage of that power.

You can never achieve a perfectly decentralized system, any more than any organization's hierarchy can ever become perfectly centralized. There is always going to be a problem and weakness somewhere with any practical instantiation of any project. And machines don't need to be perfect in every regard to work. But if we can identify a weakness, we can address it.

Theoretically, you can make overarching centralized laws dictating such exploitation shouldn't happen. In fact, there are many laws related to this sort of insider information. But the very existence of this opportunity for arbitrage means systems will evolve around whatever rules exist to exploit the advantage. Instead of legislating, the proper response is to engineer a better system. More to the point, robust decentralized oracles would be superior.

A robust decentralized oracle would find better information. The wisdom of the crowd can be employed to discover the truth. Averaging information is typically better for any complex situation, since they're less subject to the prejudices of the individual, who has more limited information. All things being equal, the individual mistakes that overestimate some measurement are balanced by the individuals that underestimate. Decentralized oracles are more reliable. Their failures will be smaller, because they

are more diluted through averaging. Centralized oracles have more singular sources of information, leading to higher variance in their mistakes.

Condorcet's Jury Theorem

A rigorous explanation of the wisdom of the crowd was first introduced in 1785 by Condorcet. The same French revolutionary genius whose paradox (Chapter 4) prevents us from finding a perfect democratic voting method also gives us this argument in favor of democracy. Condorcet's Jury Theorem says bigger democracies are better than having smaller groups in charge. Sort of. Condorcet demonstrated that larger groups of slightly intelligent people are better than smaller groups for democratically finding the truth.¹

Here's the setup: Suppose you have a group that is going to vote on an issue. Also suppose the group is slightly intelligent, meaning the average group member is more than 51% likely to get the right answer, rather than the wrong answer. In this case, the more people you use to vote on the issue, the more likely they are to come to the truth. The bigger the network, the more efficiently it will come to the correct answer. The crowd's answers are much wiser than the average individual's answer.

Since it's a rigorous logical result, it also is balanced by the fact that larger groups of slightly stupid people are worse than smaller groups of stupid people. The idiocy of the mob is the counterbalance to the wisdom of the crowd. Stupid, here, is defined as being wrong slightly more than half the time. It's not clear whether any mortal escapes that assignation in sum—perhaps we're all slightly stupid in the larger scheme of things. But in some areas, we can train ourselves to be at least slightly competent. So an oracle DAO needs to filter its network to guarantee the average member is correct, at least slightly more than they are incorrect. Then the larger and more decentralized the network becomes, the quicker and more certainly it will converge on the truth.

SchellingCoin protocol

One decentralized approach to generating oracle information is based on the SchellingCoin protocol, explained for Ethereum in 2014 by Vitalik Buterin. The idea is to have your Oracle DAO members stake their reputation tokens on their answer to a question a DApp is asking. Then you reward those closer to the resulting median value

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¹ Bernard Grofman, Guillermo Owen, and Scott Feld, "Thirteen Theorems in Search of the Truth", *Theory and Decision*, 15, pp 261-278, (1983).

and punish those whose answers deviated further. The median answer is the Schelling point, a concept from game theory.

For example, suppose an insurance DAO needs to know whether to pay out to policy holders for a hurricane. The policy stipulates that it will pay out if the wind in your coastal town is higher than 100 mph. Oracle DAO members may post their estimate of the top wind speed in Virginia Beach last Thursday and encumber their reputation tokens in a smart contract. When the deadline to report the wind speed arrives, the smart contract calculates the median value of all submissions, weighted by the stakes. Then the encumbered reputation tokens are redistributed to the group, with more tokens given to members who answered closer to the median, and less for those whose answers were farther away.

There are infinitely many choices for the redistribution process. The original proposal suggested minting some amount N of new tokens and distributing them to those with answers between the 25th and 75th percentile. Incentivization can be optimized by selecting over the set of all designs. Different questions and DAO behaviors should have different reward schemes. For instance, if all members are behaving honestly, and the answers are satisfactory within a predetermined tolerance, your reputation shouldn't be arbitrarily reassigned because you were a tiny fraction of the median value further away than the majority. In that case everyone should earn a share of the new reputation.

What protocols are followed in answering any particular oracle questions should be determined by the experts on the particular subject. Giving the experts, themselves, control of their own organization is better than relying on a static centralized hierarchy. The experts know best how to game their own system, and how to prevent gaming to protect their hard-earned reputation. The experts will find the most efficient and secure methodology for providing trustworthy answers.

Assuming there is no systemic bias in the members, meaning that the group is diverse and decentralized, the median should be close to the truth, so Oracle DAO participants are incentivized to answer as honestly as they can. Fees are later distributed among the Oracle DAO members proportionate to their reputation holdings.

This approach may also serve as a forecasting device. Members would stake their reputation tokens on bets on future events, making the DAO into a more literal oracle from mythology.

Though decentralization improves information discovery, it further improves when you filter out the bad sources of information. All things are not equal. Every network has biases that need to be filtered out. Reputation, governance, and review provide a stable system for filtering the bad sources of information and improving accuracy.

Unfortunately, robust decentralized oracles don't exist, yet. Proposals have been well funded by ICOs since 2017, but we have little confidence in any scheme currently being built. Chain.link has a protocol that demonstrates proof of concept—the technology exists to build a decentralized oracle. But the difference between theory and practice is often vast.

Put simply, decentralized oracles are DAOs, so they still lack the proper incentive structure and governance processes and history that all DAOs suffer from. Until the decentralized protocol is secure and robustly enacted, it is better to rely on centralized oracles, and make sure your network doesn't grow to gain such a large monetary value that an incentive arises for the centralized newsfeed to manipulate the data. A decentralized oracle is not secure until it has significant momentum and history—an oracle is not even truly decentralized until this is achieved, until it has a large network of active members.

When sophisticated DAOs that represent banking and lending and insurance finally emerge, the structure will be easy to mutate to adapt to properly motivate and govern oracle DAOs. Unfortunately, oracle DAOs and deFi DAOs rely on each other for their very existence. Which will come first, the chicken or the egg? Mixing two more metaphors, the skeleton of our proposal for priming the pump is detailed at the end of Chapter 4, above. People first have to prove their worth in a development period, before they become invaluable to other DAOs and can charge fees for their services.

News and education

Centralized civic institutions always become corrupt in time. Then this corruption becomes obvious once a new technology disrupts their operation, revealing their weaknesses. Today, trust in the news media has cratered due to the corruption of the institution.

People periodically give up their power of information transmission to centralized institutions which are more effective and efficient. These institutions become corrupt after their hierarchies centralize and ossify, then new technology allows people to bypass these centrally controlled media institutions. It used to be that a far greater percentage of people were publishers. Letter writing was relatively decentralized among anyone literate who could afford ink and paper. Then book-making concentrated the power of information storage throughout medieval Europe in the clergy, as teams of monks were devoted to the task. Economies of scale made it prohibitively expensive to produce a book of comparable quality without going through the Church. Europe trusted in the institution of the Christian hierarchy which became corrupt in time and eventually stultified individual progress. With the power of information creation and storage, the Church had the power of making history, which is ultimately the power

of thought, as was used famously against Bruno and Galileo. The Church's corruption was revealed when the new technology of the printing press unleashed the Protestant Reformation, under which the Catholic hierarchy collapsed and reformed.

The printing press automated book making, so that a few people could do the job of hundreds of monks. Every small community of a few hundred people had competing printing presses.² This gave people power to make local broadsheets so that local newspapers could run local stories written by local citizens on local interests. Naturally, power eventually concentrated again, through economies of scale, until a few global corporations now primarily run global stories catering to globally powerful interests.

Throughout history, advances in technology give individuals more power to spread their information to more people, but unchecked competition accumulates power in hierarchies of more successful groups. We give our individual power to institutions which initially serve us more effectively and more efficiently. But as these institutions age, they become more corrupt. This is revealed as new technology disrupts their operations, as the internet is currently doing.

Today global news media institutions of all types are being revealed as weak and corrupt. Unprofessionally produced stories reveal the major professional media corporations are failing to provide unbiased and relevant information for their average consumer. These unprofessional stories are spread with the new Web 2.0 technologies, such as Twitter, YouTube, and Wikipedia, displaying this corruption widely.

If we don't build transparent democratic institutions to replace the corrupt institutions, new opaque centralized institutions will. Already, Facebook, YouTube, and Twitter are creating secret algorithms that control what type of story can be spread through their platforms, with absolutely no democratic power of oversight. To prevent the corruption such centralized control inevitably leads to, we must foster transparency and individual autonomy over information. Powerful decentralized media institutions need to be built, using dynamic governance design principles to keep them stable and responsive. How do we use P2P tools to achieve this?

Decentralization has always been a crucial factor in manufacturing the news. Social truth can only be discovered using diverse and decentralized sources. What is a fact? What facts are important? The ultimate answer is, valuable knowledge affects people's lives and experiences and decisions; it helps humanity. How do we best organize news collection and dissemination to create valuable knowledge?

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² For example, by 1550, less than a century after Gutenberg's original printing press, Geneva had more than 300 printing presses and 17,000 citizens, for an average of 1 printing press per 57 people. Elizabeth Eisenstein, *The Printing Press as an Agent of Change*, Cambridge University Press, p. 410, (1979).

Traditionally, a healthy news media, our fourth estate, relies on a variety of competing companies. Truth discovery in any market, including the marketplace of ideas, is more effective and efficient when news aggregators are more decentralized. When there are 10 newspapers reporting on a story, a more accurate historical picture emerges than when one newspaper reports on the story 10 times. “The wisdom of the crowd” is the phrase that distills the fact that this diversity improves the focus and accuracy of the information reported, and it improves as it becomes more diverse, from the level of companies all the way down to the individual. Newspapers, radio, and movies, from television to internet platforms, diversity of media company ownership contributes to diversity of viewpoint and serves more audience interests, from local to national to global audiences and between groups at each scale.

On the one hand, advances in information technology have been regularly improving our ability to disseminate news and history to the masses for centuries, increasing the quantity of stories and the number of people they reach.

On the other hand, economies of scale naturally lead media companies to merge and concentrate power in territorial monopolies and trusts. American faith in media has reliably fallen in direct correlation with the consolidation of broadcasting power, as long as active statistics have been studied. Since the 1990s with the Telecommunications Act of 1996, and especially with several decisions by the FCC in the 2000s, there has been a string of deregulation which has allowed global companies to increase their power in local communities. In 2007, the FCC voted to eliminate media ownership rules that included a law forbidding a single company from owning both a newspaper and a television or radio station in the same city.³ Since then, iHeartMedia (formerly Clear Channel Communications) grew to 1200 radio stations. In 1983 the top 50 companies owned 90% of the media and entertainment industry in the U.S.,⁴ comprising businesses that produce and distribute movies, television, commercials, streaming content, audio recordings, radio, newspapers, books, video games, and supplementary services and products. By 2012, 90% was controlled by the top 6 media conglomerations. As an application of Zipf’s law, the values scale roughly exponentially, with AT&T owning roughly twice as much as Comcast, which is worth twice as much as Walt Disney Corp, then Viacom, then Fox. Without external regulating forces, this is the natural and predictable result for centralizing forces under competition.

Figure 1: 2019 valuations of the top media corporations follow Zipf's Law.

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³ Labaton, Stephen, “Plan Would Ease Limits on Media Owners”, The New York Times, 18 October 2007.

⁴ Lutz, Ashley, “These 6 Corporations Control 90% Of The Media In America”. Business Insider, 14 June 2012.

The most obvious problem with news consolidation is that national or international centralized corporations do not devote the same degree of focus to the interests of the local communities they serve.⁵ Again, love doesn't scale. Diversity of viewpoints is diminished when power is concentrated. Editorial freedom is decreased. News corporations certainly must value accuracy and truth in their reporting; but they also must consider what news stories and perspectives will attract and maintain advertising, what positions serve their owners' interests. A mega trust conglomeration, like GE and Comcast each owning half of NBC, diminishes market liquidity with large scale static power relations which leverage the increased internal firm efficiencies through economies of scale, leading to frictions and corruption that undermine the efficiency of the larger market.

Wide scale decentralization of power in the media will not collapse the power of centralized corporations, any more than file sharing services like Napster and BitTorrent⁶ collapsed the power of the centralized music companies. These disruptive technologies merely transformed how entertainment is consumed and business is done. The entertainment industry is more powerful and pervasive in our global culture than ever before. Decentralization is more efficient for empowering individuals in every way. It doesn't take power from centralized actors, it increases everyone's power. Decentralization is only a threat to those who refuse to participate in the new collaborative networks and embrace the new tools of communication at our disposal. Musicians and record companies now have more influence in their fans' personal lives through social media. Decentralization creates new opportunities for collaboration at a higher level.

Simultaneous with the consolidation of traditional media outlets in the 2000s, Web 2.0 companies like Facebook, Twitter, and YouTube decentralized content creation while retaining centralized ownership and general control. This centralized control had the same effect in media communication that it did in commerce with Amazon and Alibaba—users go largely unregulated until a major problem comes to the attention of the central authority. Fake news generators, trolls, fact checkers, and citizen

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⁵ The Communications Act of 1934 mandated that the FCC must act in the interest of the "public convenience, interest, or necessity." The FCC argued in 2006 that consolidation would bring more focus on local news, because the larger organizations would have more resources. This argument failed in practice, as there was an average decrease exceeding 10% of local news stories within the first year of transfer of ownership. Obar, Jonathan (2009). "Beyond cynicism: A review of the FCC's reasoning for modifying the newspaper/broadcast cross-ownership rule". *Communication Law & Policy*. 14 (4): 479–525.

⁶ Hundreds of decentralized file sharing programs and communities have evolved to avoid centralized legal restrictions. See https://en.wikipedia.org/wiki/Timeline_of_file_sharing for a list of some of the major historical developments.

reporters now unite into communities within hours and scatter just as quickly, thanks to platforms such as Twitter and Reddit which leverage the new information technology to tap the talent of the masses to generate news content. Without editorial control, the content is self-evidently unreliable. People rely on unconscious algorithms which use popularity to determine what is authoritative content. But the lessons of the Folk Theorems again arise, to remind us that such algorithms can always be gamed. A more effective means of distilling what information is important is required. To handle the profusion of information created by empowering the populace with decentralized content creation, we need a decentralized solution.

A central authority is perfectly well incentivized to ignore minor problems which only partially eat into their profits, as long as they maintain ultimate control of profits. When users are given more control of their content, decentralized regulation can be more effective, with immediate policing and protocol changes. With proper reputation design, history and momentum can be built to filter the information more productively. With decentralized governance, where all members have a proper balance of power to police their platforms, regulation of these decentralized platforms can be more effective. Stories can be properly evaluated, with proportionately increased or decreased visibility according to their merit, without censoring them.

News organizations with greater power decentralization have been proposed such as WikiNews (funded by the same non-profit Wikimedia Foundation that publishes Wikipedia), the Decentralized News Network (DNN), and Steemit (2016). All of these examples appear to us to have failed to gain wide adoption due to a lack of ambition. The goal should be to empower individuals with greater ability to communicate and cooperate.

Imagine a hybrid mix of social media platforms (like Facebook or LinkedIn) with the news and entertainment media corporations (like BBC or New York Times). Instead of a paywall, newspapers should be encouraging participation. If you read many articles on a particular subject you are more expert in that subject. If you comment productively on articles, or if you create the content, you are more expert. If your discussions stimulate more discussions and more content, you are more of an expert. If an article generates more meaningful, reputable connections, then the article is more valuable. If it doesn't, it isn't. Your expertise, your reputation, is based on whether you are helping create content or bringing attention to something that actually matters—meaning it is connected to profitable enterprises. If you create content that does not connect to something profitable, or if you promote such unproductive knowledge, especially if you are a troll, your reputation will not grow in the DAO which values other behaviors and polices their reputation properly. Different definitions of what profitable means, will lead to different types of reputation or expertise that people strive to attain, and different measures of power in different endeavors with separate DAOs.

Major news corporations have the opportunity to rival the power of Facebook by decentralizing their institutions. People could have news accounts that keep track of how many articles they've read, how many comments they've made, on which subjects, with a Reddit style accounting system of up and downvotes⁷ for how well their contributions are appreciated, by which people, who have how much and what type of reputation. How many articles have you initiated? How much do those articles contribute to further comments and articles? Each article is weighted, based on how much extra content it generates, and recursively, based on how influential that content ultimately proves to be.

Every software programmer understands how important the contributions to Stack Overflow⁸ are, but these contributions are not rewarded by anything but bragging rights. If we can find a fair way to value such contributions, it would contribute to a more effective and efficient system of collaboration. Following the principles of building secure and meaningful reputation from Chapter 6, articles must have a foundational meaning in fungible currency. New reputation should only be minted when the articles are connected to profitable endeavors—advertising, paid analyses, new protocols that are relied upon for decentralized business contracts. Then other contributions gain valuable reputation if they are linked through references.

The exact process of Steps 1-7 for the Software Review DAO in Chapter 4 can be cloned to build a news story review DAO. Reviewers could judge stories' veracity according to the standards the News DAO chooses. As before, reputation in the News DAO becomes valuable once News DApps steer viewership to stories based on your News DAO reviews. Then media sites will pay fees to get their stories reviewed more quickly. Reviewers will be incentivized to give honest reviews despite fees, because the reputational system rewards members mostly based on future fees. Unlike centralized platforms, like Twitter, which don't fairly share profits or power with their members, policing can be properly incentivized in a DAO, to discourage reviewers who erode the integrity of the system. The success of this system, however, will depend on the effectiveness of the choice of protocols which govern the DAO.

The purpose of news media is education. Such a system, which takes advantage of our new power in information technology, can track our attainment of expertise (or

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⁷ Better yet, they would build an automated system of staking your reputation on your up or down vote using some of the methods explored in Chapters 6, 7, and Section 9.4, below.

⁸ Stack Overflow is a social media platform for computer science professionals which promotes good questions and answers with a gamified upvote system similar to Reddit where users can earn badges. It has become so valuable in programming circles, they joke that the solution to any new software programming problem is to copy code from Stack Overflow.

lack of attainment) more accurately than our traditional systems of professional licensures or college degrees. Tracking and aggregating our reputations in various DAOs can build a more accurate picture of our expertise and experiential gaps than our traditional educational institutions have. The expertise that has evolved in the century of public education⁹ would be essential to designing effective curricula. Meaningless certification and licensure programs would be quickly revealed as the worthless pursuits they are.

Notably, the transparency and openly reviewable nature of a DAO greatly adds to the trustworthiness of the system. Being eternally open to audits and reviews from anyone on the planet greatly improves the integrity of the system. Such improvements to transparency and accountability in the institutions of media and education have the opportunity for improving many aspects of society.

Such transparency is a hallmark of the open source culture that is a pillar of the Web3 movement. Unfortunately, the open source culture makes no sense.

Open source culture requires a culture of respect for history

The open source culture of the Web3 movement is absolutely essential to the goals of decentralizing the economy. Transparency is crucial in a decentralized network. Every function needs to be publicly auditable for people to trust it. Without a central authority to approve it, unexpected malicious behavior can be built into any opaque code. The open source culture has been extremely successful in generating useful distributed applications which are essential to the functioning of Web 2.0. An open source environment is much more innovative.

But open source culture makes no sense from a business perspective. Whenever we've tried to explain the open source culture to a nontechnical business person we've been met with incredulity. It might make sense in a fantasy world utopia, where we imagine no scarcity, where everyone is an angel who shares freely with no expectation of enjoying the rewards of their labor. But it certainly doesn't make sense in our capitalist business world, where the incentive structures address our essential, base instinct of selfishness that has preserved life for more than a billion years. Open source makes no sense from an economic perspective. So why do people do it? From the

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⁹ The institution of education is as old as civilization, but the current system of compulsory public secondary schools started around 1910 during the Progressive Movement in the U.S. The majority of the U.S. public first earned high school diplomas in 1940. Jurgen Herbst, *The Once and Future School: Three Hundred and Fifty Years of American Secondary Education* (1996)

game theory perspective, the current open source culture advocated in the Web3 movement is not sustainable in the long term.

Unless we marry it with a culture of respect for history.

The way to build sustainable incentives for fostering open source culture is to simultaneously foster a culture which acknowledges the contributions of the past. Academics of all stripes have lived in an open source culture for centuries, even millennia. Like Web3, academia thrives on transparency and open collaboration with strangers. Periods when societies are less transparent with their ideas, less collaborative, are usually referred to as Dark Ages. Open source culture has always been the lifeblood of progress, in societies around the globe, throughout history. But to sustain that open culture, a culture of respect for the past simultaneously evolves, so resentment doesn't build. The solution to the game theory conundrum of how to incentivize a player to freely give up their intellectual property at one stage of a repeated game, is by guaranteeing a reward in a future stage, by fostering a culture of acknowledgment of past contributions. The players then seek the future rewards of fame by freely distributing their work in the present.

Some academic subjects have stronger cultures respecting history, such as philosophy and theology and especially the law, as evidenced by the density of footnote references in any paper. Some are weaker, such as science and especially mathematics, where typically a few essential references are perfunctorily tacked on at the end of their introduction.

It's not efficient to be constantly conscious of the source of our ideas. It's easier to simply state your ideas and build your arguments without referencing each idea's debt to previous thinkers. It's unnatural to have a culture of respect for history, and needs to be consciously policed—it's another of the essential catalyst institutions which needs to be built into the decentralized economy.

But the new advances in information technology allow us to create a more sophisticated system of acknowledging minute past contributions than previously imagined possible, with digitally accurate, automated accounting methods.

Let's take a final brief digression into technical territory to explain how these new architectures are built.

Review gives momentum

Mathematical analyses of the different ways the network of references can be weighted makes it possible to design protocols for promoting the goals each particular DAO happens to value. This network of references is technically referred to as a citation graph. As indicated in Chapter 7, governance needs to be designed in harmony with the values of the group. A full example is beyond the scope of this text. However, the elements of citation graph analysis are quite basic, similar to how all of the symbolic logic involved in the most complex smart contracts boils down to understanding

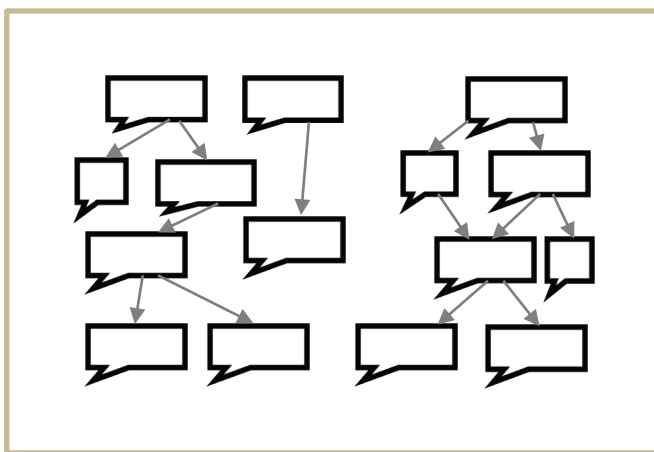


Figure 2: The forum as a weighted directed acyclic graph (WDAG)
the NOT and AND operators.

The set of all posts and comments in a News DAO can be interpreted from an abstract perspective as a weighted directed acyclic graph (WDAG). This technical math jargon is the term for a relatively simple concept in graph theory, which underlies the mathematical analysis of any network.

Figure 3: Elements of graphs

A graph is a mathematical term which distills the crucial elements of a network. A graph consists of two collections: a set of vertices (the dots, or the nodes, or the posts, or the members of the network) and a set of edges (connections, or references, or citations, or transmission lines in a network). If we add an arrow to an edge, indicating one post is referencing another, the graph becomes a directed graph. A graph has a cycle if 3 vertices are connected to each other in order, with vertex A connected to vertex B which is connected to vertex C which is connected back to vertex A. Citation graphs, or reference graphs, don't have cycles, since an older post cannot reference newer posts before they exist. We call such graphs acyclic. Finally, we can allow a post

to indicate precisely how important its connections are, how important the older posts are, by weighting the references. When we attach weights to the edges/references, the forum of all posts/comments becomes a weighted directed acyclic graph.

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Figure 4: Weighting the references changes older posts' values.

The idea of the weighted references is to determine how much the new posts affect the older posts with their review. If you give a high weight, close to 100%, then the reference will affect it more than a low weight, closer to 0%. A positive weight suggests that the referenced post deserves to increase in value. A negative weight suggests the older post should diminish in value—it is not contributing value to the DAO.

Figure 5: Weighted references cascade value to older posts, increasing or decreasing their value. This enables review of past behavior, rewarding long-term contributions and guarding the DAO against gaming.

Simple arithmetic will change the value of the older posts. The changes cascade through the WDAG of posts in the forum, readjusting the value of all connected contributions, continually improving previous judgments.

There are many choices that need to be made for exactly how the cascade works. How many levels deep do the references affect the value of posts? The deeper the calculations go, the more history is relevant. How much do the new posts share their value with old posts? More value-sharing with older posts will promote long-term contributions and innovations and increases stability; less value-sharing encourages new contributions and immediate work. How you design the calculation tells us whether you give more value to long-term or short-term contributions. Deeper graph theory analysis allows us to optimize design choices to incentivize behaviors which lead to the goals which further the DAO's particular values.

Hard protocols stipulate how the algorithm automatically calculates the changes to the value of the posts. Soft protocols stipulate how the DAO requires the posters to behave. An example of a soft protocol is the requirement that whenever a poster discusses a new topic within a category, like local politics, they must reference the previous protocols posted which set up the DAO's rules for discussing the politics of how to spend taxes—say 0.1%. This enables the DAO to reward older contributions, from the time when the DAO was initially being developed and not yet attracting

money. If a new post doesn't reference older posts properly, according to the protocols that have been established by the DAO, then the UI of each user can follow the soft protocols and automatically punish the poster with downvotes. Again, the governance design, in this case the parameter choices, reflect the values of the DAO.

In summary, reviewing through references enables punishment and rewards in DAOs which changes the motivations of members from a focus on immediate rewards to the future, encouraging delayed gratification and sacrifice for the good of the group. Review changes the game theoretical perspective from a single stage game, to a repeated game. This leads to more efficient cooperation instead of internal competition. This makes business sense for how the open source environment, essential to the decentralized economy, can be sustained in the long run. Review helps create a decentralized history for a DAO, which gives them momentum. History gives meaning and focus to our perceptions. History is the basis for making governance (steering) more effective. It allows members to judge whether they are properly promoting their unifying transcendental values. History brings clarity and stability.

To keep a decentralized organization stable in the long run, they need this momentum gained from a clear history. But momentum toward what purpose? If the system is not moving toward a healthy and productive goal, it will not last long. The most important aspect of a decentralized organization, the feature that ultimately determines its long-term success, is the group's set of transcendental values.

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Formating example:

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