Inheritance and Blockchain: Thoughts and Open Questions

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Abstract

Inheritance is the fundamental building block of civilization. This is the addition of wealth, knowledge and properties over time that produce the society in which we are living. Every generation does not have to start from zero and can capitalize on the efforts of previous generations. Blockchain based assets are very efficiently and securely transferred between living entities. Yet the actual way to make heirs inherit cryptoassets is seldom discussed. It appears that the problems linked with the inheritance of crypto-assets raise a lot of technical, societal and legal issues. Part of those issues have to be tackled with at the level of the blockchain infrastructure itself. The aim of this paper is to open a research field, and to discuss some ideas, with regards to this overlooked issue. Inheritance is neither a peripheral question nor one that can be dodged. It comes with its own set of challenges that have to be met if blockchain based finance, and asset management, is to be taken seriously.

1 Introduction

Crypto-currencies, starting with Bitcoin [Nak09], have shaken the world of finance in less than a decade. It has moved from a pipe dream concept to an every day tangible reality in the meantime. At the time of writing the global market capitalization of emitted bitcoins is around 10% of the global market capitalization of gold. There are many discussions on the nature of money, and assessing the relative merits of Bitcoin versus gold as a store of value is still an ongoing discussion.

Among the mandatory properties that a store of value must have, the property of being inheritable is a major one. Over a sufficiently long period the survival rate of everyone drops to zero. Transmitting wealth to the future generations is neither a peripheral issue, nor one that can be dodged. The body of laws, stories and traditions about inheritance is immense. In fundamental texts like the Bible [Bib] or the Odyssey [Hom], the question of who inherits what

from whom, and more generally all kinds of problems linked with succession, are major preoccupations.

The issue of inheritance is orthogonal to the actual implementation of the store of value. Society, in a very broad sense, is the tool traditionally used to transfer titles, assets, and to settle questions like: "Who is the new King?". Regarding material wealth, objects do not disappear when their owner dies. These remarks no longer hold with crypto-assets. Indeed, one fundamental feature of the crypto-assets is that it is only with the knowledge of the appropriate keys that the assets can be transferred. The actual ownership of crypto-assets amounts to the knowledge of the keys and vice-versa: everyone that knows the keys is deemed to be a rightful owner of the associated crypto-assets. But by definition, and under these circumstances, one cannot actually implements his/her own succession because either the knowledge of the keys disappears with their death or the ownership of those crypto-assets has to be shared with a third party. It appears that we are finding ourselves painted into a corner: on one hand a crypto-asset should only be transferred by its legitimate owner; and on the other hand, the owner cannot transfer anything once dead, making the succession of crypto-assets seemingly impossible.

In this paper we discuss various challenges and ideas linked with the inheritance of crypto-assets from a computer science point of view. The idea of the discussion is to think about what desirable properties should be looked for, in the original spirit of crypto-currencies, inheritance of crypto-assets. Indeed, the easiest way to "solve" the inheritance problem would be to write the keys into the wills. This solution is going to be discussed further later in the paper in section 2.1. But clearly, it is not in the spirit of crypto-currencies because it relies on a third party. It clashes with the fundamental idea of crypto-currencies which is to be able to establish trust without having to rely on third parties.

In section 2, basic issues linked with the issue of crypto-asset inheritance are discussed. Problems are addressed in a colloquial way and presented by increasing level of complexity. In section 3 is done a state of the art review. Future themes for research and reflection are pointed out in section 4. We finally conclude in section 5

2 Informal discussion on the inheritance of cryptoassets

2.1 Delving into the complexity

Let's examine some issues, as well as some workarounds, raised by the issue of the inheritance of crypto-assets step by step. In this section we explore this question from a naive point of view in order to give an intuitive idea of the landscape. In this section we focus on intuitive understanding of the issues, a more technical/disciplinary point of view approach is considered in section 4.

A one liner frame of the question to be addressed goes something like this:

How can my eight years old daughter inherits my crypto-assets?

This is a starting point, there are many more subtler sub-problems. Actually, the more the problem of inheritance is considered seriously, the more its inherent complexities appear. Let's examine a sample of those issues, together with some tentative solutions, by increased level of sophistication.

- 1. The first idea to solve the basic "eight years old daughter inheritance" problem is:
 - (a) To set up a meeting with a lawyer.
 - (b) To write down the wills on a document, including the appropriate private keys.
 - (c) To seal off the envelope.
 - (d) To hope for the best.

This natural solution presents many challenges. The more salient being that crypto-currencies have been built precisely to provide agreements without having to rely on identified third parties. There is maybe nothing as opposed to this aim than having to go to see a lawyer, and having to rely on the professional integrity and competence of this lawyer. This is a poster child of all the issues linked with centralization. There are many additional issues. One can think of anonymity related issues: for instance in order to establish the wills, a comprehensive list of all crypto wallets has to be done. Another class of problems is the risks inherent to this solution. Typically for lawyers that will be targeted by wrongdoers if this practice becomes mainstream (because stealing the keys give effective control of the crypto-assets). The saying "not your keys not your coins" sums it all accurately. The simple fact that you have to give your key to a third party amounts to lose the ownership of the associated crypto-assets. Essentially this solution reintroduces the single point of failure with all the drawbacks attached to it.

2. The second idea that may come to mind is to put all the keys on a thumb drive, or write them down on a piece of paper, and lock them into a safe at home. It marginally improves on the previous point if family is more trusted than professional lawyers. It is a more distributed solution because each individual implements a particular version of this protocol.

Besides the hazards that such a practice would produce if it were widely adopted (basically the same issue than the one discussed with the lawyer's solution and the incentive for wrongdoers to steal keys), it has the following additional drawback: actually my eight years old daughter is not my only heir. Let's say there are four kids and seven nephews between whom the inheritance is to be shared. It is not as if dramas about succession, struggles within families, and communities, are a literary genre unto themselves. Moreover, how can someone be sure that the individual opening the

safe will behave correctly? It is harder to cheat with a pile of physical gold because there may be witnesses, the material has to be physically moved around etc. With crypto-assets, one just has to remember a passphrase. No one can stop someone knowing the correct keys from using them later. Short of killing, it is impossible to delete a passphrase from the memory of another person.

3. It is possible to be smarter and to write a smart contract that implements the succession wills. It solves the "four kids, seven nephews" problem: the smart contract is going to perform the sharing. It can be seen as an equivalent of the wills in the blockchain world. It raises a new problem tough: how will the blockchain be aware of the death of the owner of the smart contract? This is a variant on the famous oracle problem [ABRSS20]. The first ideas to deal with this issue would be to rely on some sort of state based service reintroducing a centralization problem. This specific issue is discussed more thoroughly in section 4.1.

At this point another class of issues, that are not primarily technical but have technical implications, appears: the heirs may not be of age to understand the crypto technologies involved. Maybe the don't have the legal rights to access such kind of funds either. Some of the heirs may also not have crypto-wallets in the first place. If so the mechanisms by which the proper credentials could be transmitted to them, without being compromised, remain mysterious.

There is another type of issue: what if the four kids and the seven nephews die with the one that they are supposed to inherit from? Let's say, for instance, that they all (or any subset) disappear simultaneously in a plane crash? It is not possible to re-write the smart contract: that is the very idea of smart contracts. Then the inheritance disappears (more precisely it becomes inaccessible) in such a scenario. In real life there are specific laws and legal practices to deal with such kind of situation. This issue is discussed more precisely in section 4.3

- 4. A rather simple solution is to set up an equivalent of a time capsule. If a date is chosen sufficiently far away in the future, then the death of the capsule owner becomes a certain event. It can be done via smart contracts that just have to wait until some block number is reached in the blockchain before being executed. The drawbacks lie in the lack of flexibility and the necessary approximation of the time of death. A middle-aged victim of a traffic accident or an unexpected death could potentially lead to an inheritance process stalled for more than half a century. Moreover, the probability that the potential beneficiaries of the inheritance may have died too in the meantime increases.
- 5. An improvement over the previous idea is to use a dead man's switch. Instead of using the maximum age plus a safety margin for the time capsule deadline, it is possible to use a shorter frame. If necessary one has just to

edit the time capsule deadline before it is executed. The death of the time capsule owner stops this process of reprogramming, and the time capsule is eventually delivered. It, partially, solves the issue of the lag between death and succession. On the other hand it requires a constant vigilance and work. It also opens possibilities of denial of service attacks. The denial of service can be malicious or due to life circumstances, typically the owner of the dead man's switch cannot access the blockchain for technical or medical reasons (for instance being in a coma etc.).

6. Everyone is going to die but we hope that it will happen as far away in the future as possible. Life expectancy has improved a lot lately. From a technical point of view it is a very challenging aspect of crypto-asset inheritance to manage. It is very difficult to anticipate the technological environment a few decades from now. However, any credible proposal for the inheritance of crypto-assets must be resistant to the future. It suggests that any solution should be integrated within the crypto platform itself rather than having to rely on outsourced processes. This problem is more thoroughly discussed in section 4.5.

2.2 Decentralized Society and inheritance

It is not yet clear how much blockchain based technologies are going to have a fundamental impact on society. Bitcoin has changed the financial landscape in deep. The most important central banks are considering to either develop their own crypto-currencies and on ways to regulate this new field [Bha22]. Some actors go as far as suggesting that the nation-state framework could be impacted [Sri22], or more modestly that a new kind of society, the decentralized society [WOB22] will emerge.

What is going to happen is very hard to discern precisely but it is clear that the impact are not going to be restricted to the technical/technological tiers of the society. The question of inheritance of crypto assets is going to be major concern.

There are already tricky issues linked with death and social media: what is supposed to happen when the user of a social account dies? Is the account frozen for ever? If people have access to this account (for instance because the password was saved in a personal computer) can they use it? Should the account be deleted? Those questions are not light and not easy to deal with. There are propositions to use Artificial Intelligence in order to have a digital clone of the dead person [Ceb21]. Is it ethical or not to impersonate a dead person through an artificial intelligence piece of software? On what grounds? Likewise there were studies on security implications of social media account of deceased persons [DCB22]. Those accounts contain many important data that can be used before the knowledge of the death has been spread.

It turns out that those questions, though difficult and important, are just a small aspect of a larger one: what becomes the concept of legacy in the digital space? The problem of the inheritance of crypto-assets is a part of this larger

issue. It raises challenges that are both technical, technological and societal.

3 Existing solutions review

At the time of writing there has been very few proposals to tackle with the various issues raised by the inheritance of crypto-assets. Some workarounds have been proposed.

• Sarcophagus [sar20] is a dead man switch implementation that is blockchainenabled. It is resistant to censorship and immutable. It is done by the combination of Arweave [WJ17] for a permanent storage of data, and Ethereum [But13] to support the ERC20 Sarco Token. This token is used to pay so called "archaeologists" which are in charge of releasing the data (essentially an encrypted file) to the person of interest. The user have to select one or more existing archaeologists. The archaeologist public key is used as an outer layer of encryption. This outer layer has to be re-wrapped at predefined dates in the future. If one date expires then the archaeologist decrypts the outer layer. The inner layer is the data encrypted with the public key of the final receiver that can decrypt it.

In addition to the problems linked with the dead man switch that are discussed in section 2.1, there is the presupposition that the receiver of the time capsule is already well identified and as access to the necessary public key infrastructure.

- Ternoa [Ter22] is a french start-up that proposes a "death protocol" which is basically a smart contract triggered by the API's of local authorities registering deaths. It presents the problem of relying on a centralized Oracle. One issue is that it is easier to hack the local authorities database (or to bribe agents working for this agency) than to break a distributed solution relying on crypto technologies. Another issue is that there is no standard API to deal with this issue that is shared among countries. Each solution is limited to one nation-state at best. Finally there is no warranty that the API are not going to change in the future.
- Casa [Cas22] is a company that proposes solutions based on multi-signature schemes. Their primary service is to provide better resiliency for crypto wallets. They also have an inheritance product that is basically a technological implementation of the second point examined in section 2.1.

4 Themes for future research

4.1 A distributed protocol for the death announcement

The aim is to define a protocol that is safe, distributed and has some privacy properties such that the blockchain is aware of the death of a particular in-

dividual. This is the basic signal that is going to be used as a trigger for smart-contracts, whatever they might be (see 4.3), implementing the wills.

Every solution to this problem must at least meet the following criteria:

- 1. It should be adaptable to any blockchain modulo an appropriate tuning of technical details and of governance peculiarities of the considered blockchain.
- 2. It should respect privacy in the sense that before the death has been enacted by the blockchain, there should be no way to link specific wills, whatever there form are, to a specific crypto-wallet/crypto-address.
- 3. It should present some warranties of a good execution, namely that the inheritance will be done as it was planned. This point is not trivial because the solution has to rely on a distributed system for which it is generally hard to have hard warranties of execution.

In [Pro22], I have proposed such a protocol. The idea behind the *Tales From the Crypt Protocol* (TFCP) is the following: the signal of the death is set when a predetermined amount of coins is transferred to a special wallet after a predetermined time has elapsed. The coins are stacked by witnesses that testify on the death of a particular person. This stack can be lost if it turns out that the information of death proved false. The proof of life is adjudicated by the existence of a financial move on the account of interest. Once the network has acknowledged the death signal, then another group of actors decrypt the information allowing to make the link between the dead person and the corresponding crypto-assets and smart-contracts. I refer to the paper [Pro22] for the technical details.

4.2 Transmitting secrets to the future

Cryptography is very efficient at allowing multiple parties to exchange secrets. The untold assumptions of this field are that both parties have to be *alive*, and most of the time *identifiable*. Both of those assumptions may not be necessarily true in the case of inheritance. One edge case is that the heir might still be in the womb when the giver dies. There are also those stories of the research of the heirs that takes years or even decades. There is even a profession "probate genealogist" whose job is precisely to solve work on those kind of puzzles.

Without having to go as far as these extreme cases, it is clear that, within the realm of crypto-assets inheritance, the issue of transmitting the right credentials to the right person is a major preoccupation. Indeed the knowledge of the keys amounts to the proof of ownership of those crypto-assets. Thus the paradoxical requests: the secrets have to be transferred to an unknown third party at an unknown time, and in the meantime there should be some warranties that the secret is not revealed to any other party while the owner of the secret have disappeared. The fact that the time lapse can very easily be counted in years only makes the issue more complex.

A first idea would be to adapt some secret sharing scheme [Bei11], but it doesn't look a trivial endeavor at first sight. Indeed, whatever the scheme would be, the fact that shareholders should be forbid to collude to reveal the secret is harder to implement: as we mentioned time lapse is very large. In facts it is so large that shareholders might have to transfer their shares to another shareholder for instance.

Another idea to develop is to objectify shares in order to regain some control. The raw idea would be to find ways to produce clones of objects that do not require any digital process. A very simple idea is the following: you can produce material keys (pieces of metal) that are clones using key duplicating machines. Those machines are analogical: there is no file recording how the clone can be produced. Then these clones can be used in the future as a shared secret: by making standard measurements on the object, it would be possible to generate some bits of shared information. One interesting point is that the measure has not to be fully specified at the time of production. The only property that has to be met is that they are really clones from one another, meaning that any physical measurement on both objects will give the same results. Another desirable property would be that it should be materially difficult to produce other clones: simply scanning the object should not be enough. The underlying idea is that those material keys are going to be saved in a physical safe, and just having access to them should not be enough to make clones. Another important property that such an artifact must have is the stability of the object across long periods of time. The physicality/materiality aspect of this kind of solution could be a way to work around the issues raised by the non destructive, and perfect copy of information, that digital technologies allow.

4.3 Flexibility of wills

One of the very basic motivation behind the smart contracts [HHL⁺21] is the fact that once they have been enacted, it is impossible to change them. This feature is very interesting in a variety of application. In the case of inheritance, typically when the wills are implemented via a smart-contract, it can be a hard problem to solve. Indeed, as discussed above, the identity of the heirs is not always the one that was initially defined. There are more subtle problems, like, for example, some evolution of the inheritance laws between the coding of the wills. Those problems essentially comes from the fact that there is an incompressible part of the inheritance process that cannot be completely foresaw in advance. Therefore, developing smart-contracts more flexible is an important task from this perspective.

This has not to be an evolution of the fundamental ideas behind smart-contracts but rather a way to develop an ecosystem that adds overlays on top of the smart-contract in order to achieve more flexibility. Because death is both unavoidable and unique it can be implemented as a set of ad hoc governance rules. Yet those rules have to be clearly determined and studied. Their interactions with the rest of the blockchain could be tricky to precisely analyze.

4.4 Blockchain and civil status

The inheritance process brings to the forefront many problems around links between the virtual world and the material world. One of these issues is known as Oracle's problem: how and by what rules is the blockchain "aware" of what is happening in the outside world? Regarding the inheritance process there is a dual type of issue: how is the blockchain being able to reach the outside world? If you narrow the problem down to first principles, in order to perform an inheritance one has to reach specific individuals. A first problem is that people that are looked for do not necessarily have a presence in the blockchain of interest. In the basic "8 years old daughter" scenario the problem is illustrated by the fact that young children don't have a crypto-wallet. Another similar issue is that, even if such crypto-wallets exist, they might not be known by the giver. How can it be represented within the blockchain? There must be some kind of link between the blockchain and the real world, i.e. the "social security name" of heirs. Again you don't want to depend on third parties for this link.

A recent proposal by Weyl, Ohlhaver and Buterin in [WOB22] is the idea of "Soul Bound Tokens" or SBDs. The idea is to have NFTs that can't be transferred. Their use could be to represent non-transferable and persistent social relationships. Many legacy issues could use such a novel proposition in order to bridge the gap between virtual and real world.

4.5 The long term problem

Any solution to the inheritance issues of crypto-assets is going to face a particular challenge: the solution is not going to be used before a, hopefully, very large lapse of time has elapsed. Since it is not possible to foresee the exact time of death, the inheritance process of young people may have to stay put for many decades before being actually used. It is always possible to rely on the end user to continually adapt to the new technological environment. But this is clearly not a satisfactory answer both from a practical, societal and philosophical point of view.

From a practical point of view, the inheritance issue is not something that one should have to work constantly on. It should be set once for all unless very specific events occur: loss of an heir, new wedding in your family, apparition of new heirs etc. Changing your wills when such extreme events happen is normal, but otherwise one shouldn't have to tinker with his/her wills on a regular basis. Remember than most of the time, in most civilizations, there are no explicit wills. There is a "by default" mode, embodied into customs and dedicated laws, that applies. Wills are used when something specific has to be implemented, and more often than not laws restrict the extent to which wills can be differ from the default procedure.

Inheritance is the engine behind culture building. Therefore, the process of inheritance cannot be completely let to the hand of individuals. In the same way that there are basic laws (murder, stealing are forbidden etc.) for a society to work, there are basic rules regarding inheritance that do not simply rest on

subjective/personal choices. This has strong implications on the inheritance of crypto-assets, indeed any implementation might have to change because legislation has evolved. On the course of many decades it is not surprising, or even unexpected. This is somewhat contradictory with the previous point. The fact that maybe there are parts of the inheritance process that are going to evolve do not solely rest on the whim of individuals.

From a more abstract point of view the inheritance process is by nature a trade-off between individual wishes and societal rules. This trade-off slowly evolves as time goes by. This has an impact on any technical "solution" to the inheritance of crypto-assets. The whole idea of the blockchain governance must have to take this into account. How are these issues going to be solved remain subject to many trial and errors, but unlike most of other functionalities that can be tested in real time, the inheritance functionality cannot be tested on a large scale quickly. The development of simulations is both mandatory and difficult: what are the correct model of users? How the fact that rules are going to change over time can be coped with? Those are some of the questions that have to be tackled with.

4.6 The customer is not the end user

Inheritance can be looked at both from the giver's side and from the heir's side. What is unique in the "inheritance application", viewed as a feature of the blockchain, is that the giver, by definition, may never check whether things have unfolded as planned, and that the heirs may not even be aware that they are heirs. Therefore the inheritance application is a very specific kind of application for which incentives are very hard to set up correctly. Indeed, almost by definition there are no customer feedback. Even if you inherit, meaning that the processed somehow worked, how do you know that the process was correctly executed? Moreover, because the inheritance may include privacy management it is not even clear that the heirs of a single giver may know each other. So they cannot regroup together to check that whole process has worked as it was intended to. This is not intrinsic to the inheritance of cryptoassets. But it is relatively new from a computer engineering perspective. Indeed, in real life institutions, and society, are set to solve this issue. Somehow the community "knows" who is who and what belongs to who, even if this knowledge is distributed and somewhat fragmented. There are informal ways to have feedback which is also known as "reputation". An equivalent has to be found in the world of blockchain.

Another related point is that heirs may refuse the inheritance. This is a possibility in many cultures. Usually this choice has important legal implications like accepting/refusing debts of the giver. In the blockchain context it may translates in accepting/refusing the result of some smart contracts that are executing. This contributes to the inherent complexity of inheritance process within the blockchain context. If the smart contract wait for an acceptance/refusal tick how does it warn the interested parties? What if no one accepts? Etc. The list of questions grows larger as closer as you look into the issues. Some problems

are just programming issues but others are specific to the inheritance process. The thing is that inheritance is a global functionality of a community and not just a personal issue. Just like the functionality of funds transfer is not up to the individuals. What is up to the individual is the definition of the receiver and the amount to be transferred. But the idea is not up to the whim of the user. Some parts of the inheritance process are of this nature. To pinpoint which ones and to find out how they could be implemented in a blockchain world remain open questions.

4.7 Atomicity of wills

If only because of technical limits, the inheritance process has always been, historically, an atomic process in the sense that it was performed locally and executed as a batch. It could take time to gather all heirs and compute who inherits what but the process itself is clearly identified. It is no longer the case with crypto-assets and it raises specific challenges that are neither purely legal nor purely technical. For once, crypto-assets are not going to rely on a single blockchain. Each blockchain may propose its version of inheritance.

In [WOB22] the case for a decentralized society is made. Among the many points raised, the idea that the key primitives are the accounts, or the wallets, is central:

Note there is no requirement for a Soul to be linked to a legal name, or for there to be any protocol-level attempt to ensure "one Soul per human." A Soul could be a persistent pseudonym with a range of SBTs that cannot easily be linked

The whole idea of inheritance is impacted by this. The questions raised are not only of the technological realm.

Another non trivial evolution, that has both societal and technological implications, is that, by essence, a Blockchain is not an object that can be located in a specific place. Therefore, it is not clear how the legal liabilities may be inferred. Typically something like "which court has jurisdiction?" is not an easy question to settle. The same questions arise regarding the tax code to be considered.

Many pages of similar problems could be filled. They are not trivial issues. As mentioned earlier, the body of laws, practices and customs linked to legacy is immense. It looks like that the useful abstractions in order to think about those issues have yet to emerge. In that respect the inheritance problem is very singular: the problem to solve is not yet clearly defined and cannot be possibly well defined. Solutions and concepts are going to emerge from practice and adoption. Yet those are not issues that can be totally outsourced, from a blockchain point of view.

5 Conclusion

In this paper we have discussed many problems and ideas around the theme of the inheritance of crypto-assets. There are several levels to consider. They range from a broad societal point of view down to the technical details and the specifics of protocols. Most of the challenges remain open at the time of writing. It is not yet clear either what should be part of the blockchain infrastructure, and what should be delegated to the outside world. This question is an integral part of the discussion that has to be done.

Studies on the inheritance issue of crypto-assets are interesting in and of themselves. They have the potential to lead to interesting results in the field of blockchains in general.

- The inheritance process is partly a social issue. As such every technological proposition should be made with that caveat in mind. In particular, it means that solely technical solutions are not going to make it.
- Any proposition should be such that it includes new possibilities for the blockchain to interact with the outside world. Those interactions should be more sophisticated than what the current implementation of Oracles offers. Typically, the fact that heirs may not necessarily be users of a blockchain implies that there are tools that have to be developed in order to allow interactions from the blockchain towards the real world. Which is a dual problem than the traditional problem that is addressed by Oracles.
- By its very nature the inheritance process is a very long time problem. The time horizon counts in decade. Very few issues have this property, but as the move towards a digital society accelerate, more and more aspects of our lives will be tackled using digital technologies. And so more and more digital products will accompany us throughout our lives. How to manage such a kind of products? How can they be tested? Are some of the questions that will have to be answered.

The intrinsic social dimension of many aspects of the inheritance process suggests that social media should be a useful tool to investigate. The interesting feature of social media is that they are inherently distributed. Moreover, they could be used to develop virtual identities that do not rely on a number recorded in a database. Indeed, digital identity could be seen as the sum of interactions within a social network rather than a number inside a centralized database. This is of major importance because the whole point of having a blockchain based mechanism for inheritance is to have a mechanism that is not relying on third parties. How and with what level of warranties are the important questions that future researches will have to address.

References

- [ABRSS20] Hamda Al-Breiki, Muhammad Habib Ur Rehman, Khaled Salah, and Davor Svetinovic. Trustworthy blockchain oracles: Review, comparison, and open research challenges. *IEEE Access*, 8:85675–85685, 2020.
- [Bei11] Amos Beimel. Secret-sharing schemes: A survey. pages 11–46, 05 2011.
- [Bha22] Gita Bhatt. Reimagining money in the age of crypto and central bank digital currency. *International Monetary Fund Blog*, September 2022.
- [Bib] The Bible.
- [But13] Vitalik Buterin. Ethereum white paper: A next generation smart contract & decentralized application platform. 2013.
- [Cas22] Casa, https://keys.casa/bitcoin-inheritance-plan, 2022.
- [Ceb21] Daniel Cebo. Scientific relevance and future of digital immortality and virtual humans. CoRR, abs/2101.06105, 2021.
- [DCB22] Graeme Dickerson-Southworth, Brian Chen, and James Braman. Securing the accounts of the deceased: Implications of compromised profiles. In Constantine Stephanidis, Margherita Antona, and Stavroula Ntoa, editors, HCI International 2022 Posters 24th International Conference on Human-Computer Interaction, HCII 2022, Virtual Event, June 26 July 1, 2022, Proceedings, Part IV, volume 1583 of Communications in Computer and Information Science, pages 467–472. Springer, 2022.
- [HHL⁺21] Tharaka Hewa, Yining Hu, Madhusanka Liyanage, Salil Kanhare, and Mika Ylianttila. Survey on blockchain-based smart contracts: Technical aspects and future research. *IEEE Access*, 03 2021.
- [Hom] Homer. The Odyssey.
- [Nak09] Satoshi Nakamoto. Bitcoin: A peer-to-peer electronic cash system, http://bitcoin.org/bitcoin.pdf, 2009.
- [Pro22] Frédéric Prost. On the heritage of crypto assets tales from the crypt protocol, 2022.
- [sar20] Sarcophagus a decentralized dead man switch, https://sarcophagus.io/, 2020.
- [Sri22] Balaji Srinivasan. The Network State: How To Start a New Country. 2022.

- $[Ter 22] \qquad \text{Ter noa-white paper, https://github.com/capsule-corp-ternoa/white-paper/blob/main/white-paper/blob/white-paper/blob/m$
- [WJ17] Sam A. Williams and Will Jones. Archain: An open, irrevocable, unforgeable and uncensorable archive for the internet. 2017.
- [WOB22] E. Glen Weyl, Puja Ohlhaver, and Vitalik Buterin. Decentralized society: Finding web3's soul. SSRN Electronic Journal, 2022.