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What Is Money and a Brief History of It?

This chapter explores the fundamental concept of money and its evolution through human history, providing essential context for understanding blockchain-based financial systems and smart contract development. By examining how money functions as both a technology and a language for value exchange, you'll gain insight into why decentralized systems like Bitcoin and Ethereum represent the next evolution in monetary and contractual relationships.

The chapter addresses key questions: What makes something valuable enough to serve as money? How have societies historically solved the coordination problems of value exchange? How do cryptocurrencies and smart contracts build upon these historical patterns while introducing new capabilities?

Through detailed analysis of primitive money systems, modern banking, and emerging crypto networks, you'll learn how money's core properties—medium of exchange, store of value, and unit of account—manifest across different technological implementations. The chapter connects these concepts directly to smart contract development by examining real-world applications ranging from tokenized real estate to decentralized autonomous organizations (DAOs).

By working through historical examples and modern case studies, you'll develop a crucial foundation for understanding the problems that smart contracts aim to solve and the new possibilities they enable. These insights are essential for designing effective decentralized applications and financial protocols that align with fundamental economic principles while leveraging blockchain's unique capabilities.

WHAT IS MONEY?

This, first and foremost, is a Solidity book. However, money is integral to cryptocurrencies, to blockchains such as Ethereum, to Solidity, and to smart contracts. Thus, a short chapter on

money in this book is essential for you to fully and deeply understand and appreciate the bigger picture of what it is that people are, in essence, building when they use Solidity to create smart contracts. In this chapter, we'll cover the history of money for a deeper understanding of Ethereum, Solidity, smart contracts, and cryptocurrencies in general.

Money has many meanings and definitions. Money has been called a medium of exchange. This commodity represents the time and energy given to an employer to build or do something. In exchange, we get money. Another way of defining money is as energy—spent in service of an employer or on creating a service or a product—that takes physical form as coins and paper notes that can then be used in exchange for someone else's energy, who was spending their energy building a car, organizing a vacation, working at a hotel we visit, preparing the meal we would eat, and so forth. These are just a few definitions of money throughout history.

Since this is a technology book, we will look at money not as a commodity but as a language and technology, seeing the current global economy—and those before it—as a protocol built on this language and technology. It is estimated that there are around 7,000 languages in the world that people use to communicate with each other every day. There are around 700 programming languages in the world. When it comes to computers, they fundamentally understand only binary sequences of 0s and 1s, with each separate sequence of 0s and 1s meaning something entirely different from the others. Money, on the other hand, no matter the currency, is a language humans use to communicate how much they value a product or a service. On the most basic level, money is saying, “Oh, you have a great kitchen knife for sale there. I value it at 50 amounts of money. Will you sell it to me?” (Replace “amounts of money” with dollars or euro or the currency of your country.) If the person selling the kitchen knife values the labor and time that went into creating the kitchen knife to 50 amounts of money, they will say “yes,” and the kitchen knife will be sold. In this example, money acts as a language between two parties, conveying the value they assign to a specific item or service—in this case, a kitchen knife. Before finalizing the transaction, the parties use this shared “language” to communicate and agree upon the knife's value. Once agreed, the transaction proceeds: the buyer transfers the agreed-upon value to the seller, and the seller transfers ownership of the knife to the buyer.

Money as a form of technology—and the economic systems built upon it as protocols derived from this “language”—is a complex and expansive subject. It provides material spanning bachelor's, master's, and PhD programs, as well as countless books and even entire series of books, depending on the depth of exploration. In this chapter, however, we will take a condensed approach, focusing on the major milestones in the evolution of money as a technology. This will involve simplifying and omitting many details to provide a high-level overview.

Money as a Technology

Money as a technology is a contract in and of itself in two ways:

- A contract is an agreement among a community of people to use a specific type of money as a medium of exchange to transact with one another for goods and services. This agreement establishes their willingness to treat this form of money as the community's transactional tool.
- A contract between two parties that are not part of the same community needs a standard transactional tool to exchange goods and services. This ensures the transactional tool will be

valuable to the party selling the goods and services. The following are two examples of that, one historical and one contemporary:

- **Historical:** Members of two different tribes engaging in commerce with one another—with each tribe using its type of money that may not be valuable to the other—agreeing to use another intermediary for commerce, such as coins, belts, animal skins, or anything else that may be of value to both tribes.
- **Contemporary:** Modern countries have agreed to use the US dollar (USD) as a medium of exchange for international business transactions. Before USD became the world's reserve currency, countries agreed to use the British Pound Sterling as a medium of exchange for international transactions. Before the pound, it was the Dutch guilder; before that, the Spanish Real; and before even that, the Italian Florin.

When it comes to using money as technology, money has three properties, each having a separate set of subproperties to fulfill for that property to be considered viable as use for money. Those three properties and their subproperties are discussed next.

Medium of Exchange

A *medium of exchange* is an intermediary technological tool between parties that can facilitate value communication in exchange for products and services. In turn, the party that exchanged their service or product for the medium of exchange can use that medium of exchange to buy the products and services that they need from someone else in an endless, circular way until the specific medium of exchange used, be it coins, paper money, or digital money, is destroyed by being taken out of circulation or is damaged irreparably to the point that no party would accept it as a medium of exchange. In the modern era, the currency issued by a country's central bank, also known as the national currency of a country, is the primary medium of exchange for participating in an economy and exchanging goods and services.

For a medium of exchange to be *reliable*, it must have certain subproperties:

- **Durability:** This is the extent to which a currency can be used without significantly being damaged or torn.
- **Transportability:** How easily can a currency be transferred from one place to another in terms of speed and weight?
- **Divisibility:** Can the money be divided into smaller chunks? Can a 100 USD bill be divided into smaller chunks of 50, 20, 10, 5, 2, and 1 USD and then into cents?
- **Fungibility:** Is money fungible? Following the earlier dollar example, is a 100 USD bill equal to another 100 USD bill?
- **Noncounterfeit ability:** How easily can the currency be counterfeited?
- **Scarcity:** Is the medium of exchange scarce enough in supply to ensure that there is value in it? In other words, is it rare enough to come by so that people want it? When a medium of exchange is available in abundant supply, it loses value. With a “reasonable” decrease in scarcity and consequent loss of value, people raise the price of their goods. When the surplus

increases significantly, the money loses its value to the extent that it becomes useless, and nobody wants to use it anymore.

- **Acceptability:** The more acceptability a medium of exchange has, the more effective it becomes. Its acceptability can vary from one person to another or one store or merchant to another. The acceptability of a medium of exchange can be as narrow as only two parties agreeing to use something as a medium of exchange and transact with it. This would be extremely weak acceptability, but it is still nonetheless something that can be considered as acceptability of a medium of exchange. That said, when a medium of exchange is desired, its acceptability becomes much more potent and much more widely acceptable than just two parties, making it a more effective medium.

Store of Value

Another significant property of money is as a store of value. A *store of value* is a tool or property of money that allows for money's value to be saved and retrieved in the future with a degree of predictability about the value remaining, or at the very least, the same in the future. It is worth noting that a store of value is not a property of only money but also of assets, as there are different stores of value, such as gold, silver, diamonds, reserve currencies, government bonds, stocks, real estate, and other assets.

The property of being a good store of value is derived from the following:

- **Stability:** Current predictions of a stable or predictable demand for an asset, be it money or any previously mentioned assets.
- **Predictability:** An asset's stable or shrinking future supply. As all assets and currencies have a certain degree of unpredictability in value, today there is no perfect store of value.
- **Cultural and societal values:** The perceived cultural value of certain currencies or assets that may inflate their price beyond the apparent use in industrial or other uses.
- **Liquidity:** The ease with which a store of value can be converted into a medium of exchange without loss—or significant loss—in value. High liquidity means that an asset can be quickly sold or at least converted for cash (or its equivalents) when required, which enhances its utility as a store of value. For example, suppose you buy real estate and, after a few years or months, want to sell it. It could take months or possibly years to sell the real estate and convert it into money or cash. On the other hand, stocks can be sold much faster, increasing their liquidity and conversion into cash.
- **Portability and transferability:** Like the transportability of a medium of exchange mentioned earlier, how easy it is for someone to transfer the assets to someone else, from one party to another, or from one geographical location to another, without any compromise in value and reduced costs. This is, of course, much easier to do when a proof of ownership document—whether digital or physical—is available. In contrast, transporting 100 bars of gold poses numerous challenges, such as moving them from one US state to another or, even worse, from one continent to another. Such a scenario increases costs and exposes the stored value to risks including damage, theft, or other unforeseen issues.

Unit of Account

The final significant property of money is that of a *unit of account*. For a type of money to be considered a unit of account, prices must be communicated in terms of money and currency rather than other goods. For example, “I paid 10.000 USD for a trip to Europe” instead of “I paid four cows, or 66 shares of Alphabet (Google) stock for a trip to Europe.” In money’s language, prices in a unit of account properly communicate the value of goods and services, assets, liabilities, and other economic activity. In each country, the main currency tends to be the unit of account; certain exceptions apply, such as the European Union, a union of countries bound by a single currency, the euro.

For money to be considered a practical unit of account and used to communicate value for goods and services to others, it must be stable in price and not volatile. In the short term, national currencies such as the US dollar and the euro are much more stable than cryptocurrencies.

However, in the long term, the current structure of the global economy integrates inflation and the practice of printing money mainly due to money’s endless supply as a natural aspect of annual economic operations. Inflation and the practice of money printing are seen as unavoidable in the current economy and desirable in activating the economy and stimulating spending by aiming for a 2 percent annual inflation. However, actual rates frequently exceed this target. Increasing the money supply through printing money and thus creating inflation impacts the currency’s scarcity, decreasing its value over time.

The preceding discussions of money’s properties explain why no form of money today can be considered perfect: none fulfills all the previously mentioned properties. When some of these properties are taken to the extreme, they tend to negate some of the other properties, which suggests that currently the ideal economic state is a balance between these properties while maintaining periodic adjustments toward higher or lower inflation based on the condition of the economy at a given time.

THE HISTORY AND EVOLUTION OF MONEY

Now that you have an understanding of what money is, let’s pivot to gaining an understanding of its history and evolution.

Money is a fundamental part of human civilization, evolving alongside societies to meet the needs of trade, value storage, and wealth exchange. This chapter explores the history and evolution of money, from its earliest form—barter—to the development of primitive money, highlighting how humans transitioned from simple exchanges to complex economic systems.

Before currency was invented, people relied on barter within small, self-sufficient communities. Over time, the limitations of barter, such as the “double coincidence of wants,” led to the creation of primitive forms of money, including shells, wampum belts, cattle, and even salt. These items were shaped by their cultural and environmental contexts, serving as both mediums of exchange and symbols of social value.

Through this exploration, we see that money is not just a tangible object but also a psychological and social construct. Its evolution reflects humanity’s drive to create tools and systems that enable peaceful trade and cooperation, ultimately shaping the economic frameworks we rely on today.

Barter

Before any currency or form of money was invented, people lived in tiny, agrarian, self-sufficient communities where everyone practically knew each other and engaged in the communication of value, shaping of contracts, and trade of services and goods they found valuable through an activity called *barter*, which was simply trading goods and services directly and without having an intermediary tool representing money. Instead of paying to buy a cow with cash, people would trade six chickens for one cow or a few eggs from the chickens for milk from the cow. Since in many of those early communities everyone knew each other, there was no need for written contracts, and in any case contracts were mainly oral and based on honor until writing was invented. After that, people would transcribe their contracts on clay tablets. If someone from the community knew that Person X did not fulfill his part of the agreement with Person Y, their reputation would be at stake. People would refuse to enter into commerce contracts with them out of fear of them not reciprocating their part of the deal.

Barter can be an acceptable approach when an economy is tiny and based mainly on honor due to the people knowing one another. In those circumstances people could exchange the items they needed without the need for money as a technology serving as an intermediary of exchange. Such small economies were possible when humankind lived in caves or small communities. Another possibility could be when humans would start a new settlement or town. At the very beginning of the town's building, there would not be too many people living there, and hence, the villagers or townspeople could, in theory, implement a barter system instead of needing a currency or money to engage in trade of their services and products and satisfying their needs. Another historical example is when people are detained as prisoners for any reason. During World War II, Jewish people—and possibly other prisoners—used tobacco and cigarettes as currency for favors, products, services, bribes, and other economic activities, both ethical and unethical.

Barter as an economic system faces a major limitation known as the “double coincidence of wants.” This occurs when two parties must each have something the other desires to make an exchange. For example, if one person trades 6 liters of milk for 12 eggs, both must agree on the value of this trade. However, problems arise if either party needs something else afterward. Suppose the person who now has milk and eggs wants to buy three fish for dinner. They must find a fish merchant willing to accept milk or eggs as payment. If the merchant agrees, they might, in turn, need a haircut. To get one, the merchant must find a barber willing to accept fish, milk, or eggs as payment. This chain of dependencies becomes increasingly impractical. Additionally, while goods like milk, eggs, or fish can be traded, intangible services like a haircut cannot be exchanged further as tradeable assets. This limitation reduces the efficiency of barter compared to monetary systems.

Moreover, there is no guarantee that the barber, fish merchant, or any other two people will want fish, eggs, or milk in exchange for the goods or services they provide. The more people entering the equation—or the more variables there are in a function—the more difficult it is to find someone who wants precisely the goods or services you specialized in to trade his goods and services with you. Furthermore, many products, including eggs, milk, and fish, are not suitable replacements for money or currency used as a medium of exchange or even a store of value since—among other drawbacks—they go bad quickly. They, hence, are not durable or feasible to transfer rapidly in large quantities and through considerable distances.

Finally, barter may be possible for an economy that is very local, small, and unsophisticated both economically and technologically and where people know each other enough to avoid the problem of double coincidence of wants. However, what about when an economy is technologically sophisticated? How many eggs, haircuts, fish, or milk would one need to spend to buy a flight from New York to Washington or Tokyo or Brussels? Even worse, how many goods would one company need to give to another to buy an airplane and provide flight services? Therefore, barter is suitable only for small, primitive economies. But once the economy is sophisticated enough and has enough people and technology, barter becomes outdated quickly, needing a type of intermediary of value to play the role of money—which everyone recognizes and would accept within a community and would use to exchange goods and services.

Barter survives today but in very few instances, such as gift exchanges between individuals during a holiday. Additionally, there are local barter markets that allow participants to swap one item for another. Until quite recently, specifically the 1990s, countries and businesses that wanted to do business with the Soviet Union had to use barter as a means of commerce. A well-known story is that of Pepsi getting a fleet of submarines in exchange for purchase orders of its soda drink which Pepsi then sold for US dollars to make a profit.

Primitive Money

As human societies evolved in sophistication and complexity from the primitive societies that used barter, people learned to cooperate in more significant numbers as a settlement community or tribe, and barter became outdated for the previously mentioned reasons. This brought forth the need for a new way of engaging in trade and commerce, paving the way for primitive money to be invented.

As mentioned in the “Store of Value” section earlier in the chapter, primitive money took various forms depending on the society’s norms and culture. These were a few different forms of primitive money:

- **Shells:** Cowrie shells were primarily used in Africa, Asia, and the Pacific Islands in seafaring societies closer to the oceans. Besides monetary significance, shells also had a significant cultural importance, as they were used in various religious rituals and continued to be used as currency up to the nineteenth century in Western Africa. In Asia, besides being of spiritual and cultural use, shells were used for tiny transactions in the same way that we use cents and perhaps a few dollars. In the Pacific Islands, shells were used not only as currency but also as significant cultural value since they were used in ceremonies of marriage, various initiations, and peace negotiations. (Today, we see a pigeon as a symbol of peace.)

Additionally, craftspeople created unique shells, which were used as ornaments and jewelry. Even today, in the Solomon Islands, shells are used in traditional exchanges and as a symbol of prestige and wealth. This demonstrates how the forms of money (shells) used by these communities were deeply ingrained in their culture. Additionally, for the technology of the time, these shells were durable, transportable, and fungible, although shells with ornaments were probably more expensive. The fungibility element would suffer noncounterfeitable scarcity through ornamentation. Additionally, these societies used whale teeth as an additional form of money. The conditions just described made it easy to predict a steady demand for shells as currency, money, and assets, while the work put into them made them resistant to supply shocks.

- **Wampum belts:** Wampum belts are belts made from quahog clam and were used by Native American tribes as money.

Wampum belts played a crucial role in formalizing agreements, treaties, alliances, and social contracts between different Native American tribes as they served as physical records of essential events very similar and in parallel to written documents and treaties that were used in the West. In addition to documenting events, wampum belts were used to record laws and lineages and preserve historical stories, such as tribal history, for younger generations, ensuring the preservation of cultural heritage and identity. Wampum belts were also profoundly woven into the religious and spiritual fabric of Native American tribes as they were used in religious rituals, and it was thought that they could convey messages and prayers to the spirit world. Wampum belts were durable due to the materials used in their construction and were relatively easy to transport. They were also resistant to counterfeiting, as their creation required significant labor, which contributed to their scarcity and value as a form of currency.

- **Cattle:** Cattle, as a form of money—although admittedly not entirely detached from barter—was used by many human societies, particularly the Maasai in East Africa, Ancient Romans, and Ancient Germanic Tribes. Cattle were used as money across many cultures because they represented wealth and status, offering essential resources such as milk, wool, and general food security. Cattle were used in various forms, such as for dowries, for trade, and as a unit of account.
- **Whale teeth:** Whale teeth were used in seafaring societies near open seas and islands where whales could be spotted, such as the Fiji Islands and other Pacific Islands. In addition to being used as money, whale teeth were used as adornments and symbols of status, signifying wealth and social rank. They were integral to defining social hierarchies and relationships bonds as they were exchanged during important life events such as births, marriages, and deaths among others. Whale teeth were also used in ceremonies that embodied themes of respect, honor, and societal cohesion. For the era and the technology available, whale's teeth provided the ideal balance between the properties of money. Durable, transportable, fungible, complex to counterfeit, scarce, and difficult enough to obtain to not over-inflate the supply and make people lose interest in that type of money. Using whale teeth as money solidified a shared cultural identity among Pacific Island societies. Whale teeth were a manifestation of a community's relationship with the sea and its creatures, as well as embodiments of bravery, skill, and spiritual and religious beliefs of the people using them.
- **Grain:** Grain was used as money on and off throughout human civilization. However, three standout places are Ancient Egypt, Ancient Sumer (modern-day Iraq), and Medieval Europe. Grain was used as money due to the human political and social structures of those fundamentally agrarian societies, just as whale teeth were the currency of seafaring societies such as the ones in the Fiji Islands. Like in Fiji, whales and other fish were used for their meat; among other uses, grain was a staple of the diet of agrarian societies, and workers in ancient Egypt were even paid in grain. Grain as a type of money was durable compared to eggs and other similar items that were used during the barter period of human history. Grain for the time's technology was easily transportable, fungible since more or less one grain is the same as another grain, noncounterfeitable, and scarce enough since automation or modern farming had not yet been invented.

Grain was also culturally crucial for the aforementioned societies of Egypt, Sumer, and Medieval Europe. It was central in Egyptian and Sumerian religious practices and ceremonies. It symbolized many of their gods, such as Ancient Greece's Demeter, the goddess of agriculture and grain—although Demeter is not a Medieval European Goddess but an Ancient one. In Medieval Europe, the church enhanced grain's cultural perception through Biblical stories by saying that bread is the body of Christ—while wine, his blood, symbolizes spiritual nourishment and community. In addition, the importance of grain, as described, predicted a stable demand for an asset that was used as money, and it was possible to predict the asset's stable long-term supply without any massive supply shocks that either expanded or minimized its supply—besides bad harvest years, which were an exception to the rule.

- **Tobacco:** Tobacco was used as primitive money in several situations, eras, and cultures. Tobacco's groundwork as an accepted medium of exchange was laid by Native American tribes, who used it for ceremonial purposes before European colonization as it was considered a gift from God. It was used in rituals and as an offering during peace and war negotiations. During the colonial American era, tobacco was used as a currency for internal trade and exports as tobacco leaves were standardized into units of account, allowing for transactions in a largely agrarian economy that had—at the time—no stable form of currency. Tobacco warehouses issued receipts, which could be used as money, just as banknotes and other paper money are used today. Tobacco as a currency was durable in dry environments and could be stored for long periods without going bad. It is easily transportable due to its lightweight. At the same time, governments tried to control scarcity through various mechanisms, such as trade and production regulation. Regarding fungibility, tobacco had challenges to overcome due to the significantly varied quality of tobacco. Still, it was standardized and used as units of account and medium of exchange known as hogsheads.
- **Salt:** Salt was used as money throughout different cultures, geographies, and times, but the most notable use came from Ancient Rome, where salt was used to pay soldiers, which is how and from where the word “salary” came to be. Besides its use in flavoring food, salt benefited from preserving food long-term before refrigeration was invented, increasing its value and demand as a currency. This property of maintaining and preserving food was powerful enough to elevate people in social status during times of hardship when salt could become very scarce, and people would not have a way to preserve their food long-term; hence, the food would go bad, and the people would starve. Salt, although not used in religious beliefs in the same way as the primitive types of money, was used to ward off evil and in hospitality customs, symbolizing protection, welcoming, and preservation. In terms of monetary properties, salt is durable and resistant to general corrosion, decay, and spoilage, which helped its status as a store of value and medium of exchange.
- **Tea bricks:** Tea bricks played significant roles in various societies in Asia. They were used as a medium of exchange and money in places where metal coins were scarce, such as remote areas, which led to tea bricks that were relatively transportable and durable so could be used as a currency for the exchange of goods and services. Tea bricks were used as items that provided medicinal and nutritional benefits while symbolizing status and wealth for those who owned rare or manufactured tea bricks in well-known regions. Like many other primitive money types, tea bricks were additionally part of the culture of ceremonies and rituals. More specifically, even today, tea ceremonies were of significant cultural value to those societies.

- **Feathers:** Feathers, just like the preceding items, were used by different communities and societies, such as Native American tribes, Pacific Islanders, and various African tribes and cultures, for different purposes. Among those purposes are money and a medium of exchange. The scarcity, value, and demand came from the difficulty of obtaining the feathers, and especially rare feathers were used as a currency. Due to rare feathers' scarcity, they were also used as a status symbol. They were worn as adornments to symbolize wealth and bravery, like how a whale's teeth were used. Like almost every primitive form of money mentioned earlier, feathers were used for ceremonial, cultural, spiritual, and religious events. The rarest were used to decorate ceremonial masks, honor, and please deities and ancestral spirits. Feathers, being more delicate than other forms of money, were not as durable but were transportable due to being extremely lightweight and could be transported easily in bulk if put in a sack.
- **Beads:** Beads were also used as a type of primitive money in Africa, the Americas, and Asia, and their value was determined by several factors such as the material, color, and even crafting difficulty. Beads were used in burial ceremonies as offerings of protection and spiritual power and as an adornment to identify tribe affiliation and cultural heritage. Regarding scarcity, the value of beads was determined by the shortage of the materials used to produce and use them in trade. Their small size and weight made them easy to transport—for the technology of the time.

Primitive Money: Conclusion

The previous examples may feel repetitive to someone. Still, they are so to illustrate several points in terms of money, humans, and human psychology. Money in itself, by default, is not a tangible object in the same sense as we would think a chair is a tangible object that we can take, move, and sit on.

Money is, first and foremost, an immaterial psychological and biological need and concept all humans need to remain peaceful and engage in trade, buy, and sell with one another items and services they deem valuable in a quiet way—the alternative is war and violence to take something one values from another. As mentioned, money as a psychological concept needs to have the three properties of a unit of account, store of value, and medium of exchange for a material object to be considered suitable to become a type of money. The basics remained the same, unlike chairs again, which differed in design from culture to culture. Primitive money was derived from one's surroundings. It was vastly different from culture to culture in material terms—from tobacco to tea bricks, feathers, and whale teeth—but the psychological and biological basics of what constitutes money in terms of subproperties of the three main properties of money remained the same cross-culturally and across time.

Modern Types of Money

Having learned about bartering and the different social and cultural dimensions each primitive money type had on the culture that used it, the next step is to look at modern types of money such as coins and banknotes.

In addition to modern types of money, it is crucial to briefly talk about precursors of modern institutions such as central banks and Bretton Woods, a major treaty that was the last major change to money before money transitioned to the type of money that it is today: fiat money.

Coins

As human societies evolved, advancing further in sophistication, technology, and complexity beyond barter-based economies—but still primitive by today’s standards—they started to collaborate and cooperate in more significant numbers than simple tribes and started transitioning to kingdoms. This shift required a more standardized way of communicating and exchanging value: coins.

Modern coins, as we recognize them today, were invented in ancient Lydia (Ancient Greece and modern-day Turkey) in the seventh century BCE. Those coins were a mix of gold and silver. The invention of coins was a big step forward regarding money’s properties of standardization, durability, divisibility, fungibility, and, in time, acceptability and liquidity. However, two things that took a hit in terms of properties when compared to the barter and primitive money were the noncounterfeit ability and scarcity.

It is difficult to impossible to counterfeit something like cattle, whale teeth, shells, tea bricks, feathers, beads, salt, tobacco, wampum belts, and grain. Convincing someone who knows what those are, what they look like, how they feel, and their cultural significance would be nearly impossible. On the other hand, coins—and, as we will see, paper money—are much easier to counterfeit and to manipulate their scarcity. You just need to have a process for creating coins and either use a different metal to create the coin or mix the actual coin metal with something much less valuable like copper, making someone believe it is made of gold or silver. The Roman Empire did this when they were debasing their currencies the Aureus (based on gold) and the Denarius (based on silver). This practice later led the Roman Empire into financial trouble.

The Roman Empire was not the only example of coin debasement, counterfeiting, or clipping. There are multiple historical examples of this.

Coins did not become the preferred way of paying until the eighteenth and nineteenth centuries when coins were issued privately in many combinations. Both the issuers of coins and the users were clipping the coins and scraping the excess metal to keep in order to profit, which in time led to people using debased money—since only debased money remained in circulation and used for the exchange of goods and services.

Paper Money

Paper money emerged for the first time in China in the tenth century AD. This happened through receipts and deposits of coin currency because the coins used then in China were in small denominations, thus making large transactions costly and problematic since many physical coins amplify the problem of transportability. A physical paper note was a certificate of ownership that allowed the owner of it to convert the certificate into the coins stored in a deposit store. This made trading, communicating, and transporting value for large transactions much more straightforward. Rather than transporting the coins needed for a large transaction, the owner of the paper certificate of ownership needed to trade only the certificate. The person who sold the goods and services could convert the certificate to coins if needed.

The problem with banknotes started in the twelfth century AD when the Chinese government recognized the usefulness and potential of paper and started issuing banknotes, which granted the government the monopoly in issuing banknotes. Even then, money remained regional and decentralized

for a considerable time until the thirteenth century when the Song government decided to issue the first national currency in the world, eventually granting the whole area of money to the government as a monopoly.

In the Western world, depository receipts have existed for centuries. Still, the first genuinely public bank was not created until 1609 in Amsterdam, Netherlands. Its purpose was to bring efficiency to the circulation of coins in the city, which was one of the major commercial centers of that time. The bank accepted almost all kinds of coins including domestic, foreign, or even debased, and would weigh them in and evaluate them based on specific rules and common standards. Then they would exchange that money for its own bank money for which it would issue a physical certificate of receipt like China had done. This technological transformation of money helped with the standardization, communication, and use of funds between different parties as well as reduced the incentive to devalue or clip the common coins since now the confusion of other currencies was not as prevalent anymore. It was also the precursor for what would eventually become the central bank in the western world.

The Bank of Amsterdam initially operated only as an exchange, issuing a certificate of ownership. It was also a full-reserve depositing institution. Full reserve means that none of the money and valuables deposited by its customers were loaned out to other parties. This began to change when the Amsterdam bank started loaning its deposits to the Dutch East India Company on a short-term basis using other people's deposits. This is called *fractional-reserve banking* since the banks do not have all the money deposited by their customers—which is called *full-reserve banking*—available simultaneously and lending to them. This was one of the first steps toward the modern fiat-based financial system in which fractional-reserve banking activity is fully maintained and practiced today by our banks and financial institutions. It is one of the key aspects of how money is created and managed in today's economy.

One of the risks of such a system, as the Bank of Amsterdam eventually found out, is the potential for default by those it lends to. This happened when the Dutch East India Company ran into financial trouble and defaulted on its obligations to the bank, failing to pay its legal obligations. The bank ended up being saved by the city of Amsterdam. Still, it eventually went out of favor and was taken up by other banks in 1819.

Bretton Woods Conference

At the end of World War II in 1944, the major economies of the time held the Bretton Woods Conference. At the end of the conference, it was decided that the USD would be pegged to gold, and the other major currencies would be pegged to the USD. The USD would be redeemable for gold at 35 USD an ounce, but only by central banks, not citizens. The then newly formed International Monetary Fund would act as a bridge for payment imbalances among ratifying countries. The Bretton Woods agreement was abandoned by the United States in 1971. That was the end of metal-backed currencies as the world entered the era of fiat currencies, which still stands today.

Modern Types of Money: Conclusion

Between the time humans started using primitive types of money and the twenty-first century, many things have, obviously, changed technologically: humans managed to create sophisticated ships and tame the seas in ways seafaring cultures like the Vikings or Pacific Islanders would never have imagined; we managed to replace the horse and cart with a technological miracle called the car;

where our ancestors used myths such as Daedalus and Icarus, Pegasus, the ancient Greek mythical flying horse, the Norse Valkyries, and other similar creatures to imagine humans one day flying, we managed to create another technological miracle, the airplane, and can fly to wherever we want to go across the world, and, looking at SpaceX, we may soon—within our lifetimes—be able to travel in space for tourism. One thing, however, that did not change is human psychology and biology in terms of what we value as money and how it is tied to our cultures.

For example, primitive money was tied to tribal culture. If you transported an Asian who used tea bricks as currency to a Pacific Island, they would not immediately recognize whale teeth as a type of money used by the Pacific Islander culture. Similarly, if you took a Pacific Islander to an Asian tribe that used tea bricks as money, the Pacific Islander would not immediately recognize that this was a tool used as money by that culture.

Similarly, we are not that different from our ancestors; we may not use items that are used for money in religious or ceremonial events and rituals anymore as they used to do, yet, like their money, ours is emblazoned with our own cultures since our countries and nations decorate our money with our nation's heritage and achievements. For example, banknotes and coins were decorated both in old times and today with historical people, animals that symbolize the insignia of their kingdom or nation, or historical locations or buildings and landmarks of that nation, which serve as a tool for education and national pride in the nation's accomplishments and reinforces national unity and identity. The US dollar banknotes depict US presidents and the founding fathers of the nation.

However, there is a better example of this in the European Union, whose banknotes display the different architectural styles of Europe that were prominent throughout different epochs on the continent. On the other hand, the euro coins are meant to display and evoke national pride instead of continental one as the banknotes do, with each coin having different depictions in every country. For example, the German 2-euro coin depicts the Brandenburg Gate, France's 2-euro coin depicts the famous slogan "Liberty, Equality, Fraternity," in Italy's 1-euro coin one can see the depiction of the Vitruvian man by Leonardo Da Vinci, and the Greek 1-euro coin depicts Athena and her symbolic animal, the owl. Therefore, it is not far-fetched to conclude that modern countries are tribes or communities just like our ancestors when they used primitive money or barter to enter contracts with one another. The key difference is that our modern tribes are organized on a much larger scale and are much more complex in their workings and the contracts they use to cooperate than our ancestors.

CRYPTOCURRENCIES

After having seen the different forms modern money has taken and the type of money that we use today, it is time to transition to how money will likely look in the future, going completely digital. Moreover, it is crucial to briefly examine the properties of this new digital type of money using previously seen frameworks in this chapter.

Bitcoin

On October 31, 2008, a mysterious figure (or figures) known as Satoshi Nakamoto emailed several cryptographers saying "I've been working on a new electronic cash system that is fully peer-to-peer, with no trusted third party..." The paper proposed a decentralized system of money called bitcoin.

Bitcoin's Monetary Properties

Bitcoin and Ethereum have several properties:

- **Distributed:** The networks are spread across all their participants worldwide, and borders are not in a central place or one or two countries but anywhere with an Internet connection.
- **Secure:** They are secure as long as 50 percent of the miner nodes in Bitcoin are honest and 66 percent of the validator nodes in Ethereum are honest.
- **Reliable:** Transaction ledgers are replicated by all nodes (nodes is another word for the computer, but keep in mind that the term *node* encompasses all kinds of possible computers: laptops, desktops, phones, supercomputers, and those nodes are then further subdivided into types of nodes such as full nodes, lightweight nodes, etc.). However, adding the human element is crucial since humans set up all nodes and computers. Your iPhone might be, as it is called, a “lightweight, lightweight” node, but in the end, you control it; thus, it is an extension of a human.
- **Peer-to-peer:** Transactions can be made from one party to the other without a central authority.
- **Open:** Anyone can join or leave the network, validate transactions, and mine or stake coins.
- **Public:** All transactions recorded on the Bitcoin/Ethereum network are publicly verifiable and available to all the operators in the network.
- **Permissionless:** There is no need for credentials, IDs, or authorization to join the network.
- **Borderless:** The network operates freely across geographical boundaries and can be accessed practically anywhere.
- **Censorship-resistant:** No central authority or government can stop funds transfer from one peer to another.
- **Neutral:** The Bitcoin and Ethereum networks are agnostic about who, what, when, where, or why you send and receive bitcoin or Ether.

Bitcoin and the kind of currency type it falls into is a matter of debate. Fiat currencies, which are not backed by anything, rely on the trust and collective belief in the central issuer. Bitcoin may not have a central issuer, but if it is ever to work one way or another as a currency, it will be backed by individuals who believe that bitcoin has value and thus choose to enter contracts with the Bitcoin community and the broader world.

Thus, here we see again that bitcoin, ether, or any other cryptocurrency do not escape the fate of other currencies that came before them whose value is based on a biological and psychological need to transact and enter into contracts—smart contracts—with other parties and engage in trade peacefully even if both cryptocurrencies are not widely accepted as money at the time this book was written.

Bitcoin's “Monetary Policies”

If people see the decentralized issuance of bitcoin as a monetary policy, several interesting aspects can be observed. Bitcoin has a fixed and static supply with a deflationary issuance schedule:

- The protocol regulates the money supply, and only 21,000,000 bitcoin will exist. The last part of a bitcoin will be minted in 2140.

- They are currently being issued on a declining schedule. At the time of writing, they are 6.25 BTC approximately every 10 minutes, and by the time this book is published, there will be 3.125 BTC every 10 minutes.
- The inflation rate and the number of new bitcoin entering the economy's circulation halves every four years, and the next halving will be in April 2024.

Because the money supply is fixed and the halving takes place every four years, bitcoin's monetary policy is—unlike that of a central bank—predictable. From today to 2140, we know when the halvings will occur: every 210,000 blocks or every four years.

Moreover, since the blockchain and its code are public, the monetary policy of bitcoin is publicly viewable and verifiable. This can be done in a variety of ways:

- One way is to download the Bitcoin blockchain onto a computer. However, at the time of writing, the Bitcoin blockchain stores all bitcoin transactions from Satoshi's genesis block (the first Bitcoin block to be mined), and it is worth noting that each block of transactions adds to the overall size of the blockchain. At the time this sentence was written, the Bitcoin blockchain size is 560 GB.
- Another way is by using a block explorer such as blockstream.info, blockchain.com, or mempool.space. (Note that I am not endorsing any of these companies' products. They are being mentioned for educational purposes.)
- Also, you can go to GitHub and examine the code in the Bitcoin/Ethereum repository.

Finally, Bitcoin, Ethereum, and other open public blockchains are driven by consensus. This means anyone joining the network chooses to agree to the network rules.

Otherwise, they can join another *open public blockchain network besides Bitcoin and Ethereum*.

- They are free to propose changes to the network, which will be implemented if all the other participants agree.
- They can re-create the whole network with their own rules. Still, it will be independent from the original one and thus incompatible.

Key characteristics such as money supply cannot change unless most system participants vote to do so. Even then, the ones who disagree can re-create the network with the old rules and participate in that one, splitting the chain and creating two.

Now, let us examine bitcoin and ether according to the three main properties of money.

In terms of mediums of exchange, both bitcoin and ether are:

- **Durable:** Both blockchains run on thousands of computers worldwide, making them highly durable and almost impossible to break.
- **Portable:** Bitcoin and ether—Ethereum's native cryptocurrency—are highly portable. In addition, since there are no intermediaries, both networks are global. Bitcoin's confirmation takes about 10 minutes, and Ethereum's takes 12 seconds. The difference is due to different software architectures.

- **Fungible:** Both bitcoin and ether are highly fungible between themselves. One bitcoin equals another bitcoin. Similarly, one ether equals another ether. Although, of course, bitcoin and ether are not fungible among themselves.
- **Divisible:** One bitcoin can be divided into 100,000.000 smaller units called satoshis, whereas ether can be divided into 1.000.000.000.000.000 wei, the smallest unit of ether, making ether more divisible than bitcoin.
- **Resistant to counterfeiting:** Bitcoin and ether are assigned or sent to a specific address, and anyone in the network can verify the validity of this transaction.
- **Legal tender:** Bitcoin is legal tender in El Salvador, the first country to make the decentralized digital currency a recognized medium of exchange for the whole country. For now, ether is not a recognized national currency in any jurisdiction.
- **Subject to transaction fees:** One massive problem with Ethereum and ether is gas fees, which are the commissions taken by the network to process transactions. This is due to Ethereum's low transaction per second (TPS), which makes people worldwide compete in bidding each other out by paying a higher fee to the network to get their transaction processed first. This is something that people try to mitigate through Layer 2 solutions, which we will talk about in Chapter 2. Still, for the moment, it is a huge problem that even if either were to become the world's global reserve currency—theoretically speaking—it would dramatically hinder its adoption; the same goes for Bitcoin's transaction fees.

In terms of unit of account:

- Bitcoin cannot be considered a unit of account—at least for the moment—because even if someone pays in bitcoin for goods, services, or anything else, the price is quoted in a fiat currency, be that the USD, the Euro, or any other.
- A notable exception for Ether is nonfungible tokens (NFTs), whose prices are quoted in Ethereum's native token.

In terms of store of value:

- Bitcoin is highly volatile, which in the short term makes it a lousy store of value—and makes a significant fiat currency a better store of value in the short term, as mentioned earlier in the chapter. But in the long term, it tends to go up in price. Some of its properties, such as fixed supply and deflationary, have made people consider it digital gold. Thus, it is now considered a form of investment.
- Although ether has the same characteristics as bitcoin in that it is very volatile in the short term and its price tends to go upward in the long term, it has no limited supply.

ETHEREUM AND SMART CONTRACTS

After examining Bitcoin, which is seen as the first ever successful decentralized cryptocurrency, it is time to go through the next evolution, which came with Ethereum and smart contracts. Besides seeing what smart contracts are, it is vital to understand the different practical use cases of smart contracts, how they enable more complex cooperation between participants using the Ethereum blockchain, and how this more complex cooperation translates into social and cultural engagement. Finally, we'll

reflect how and if smart contracts echo every type of money that has been discussed up to now in this chapter and what the implications of this might be in the decades to come.

What Are Smart Contracts?

Smart contracts are codified contracts made of code that can execute automatically without an intermediary when a function in the smart contract's code is triggered. In a nontechnical way, one could, in a way, see the function of the contract as a “term” in the contract.

Thus, a smart contract may be new and advanced as a technology in the sense that a contract can now be codified in code and stored on a blockchain where it gets all the properties of open public blockchains—if it were to be stored on a public blockchain that is—and executes when a function of the contract is called when terms or conditions are met. However, conceptually, a smart contract is as old as barter and primitive money since our ancestors used to enter contracts in terms of cooperating to transact goods and services with one another and cooperate in a community.

Bitcoin was the first successful crypto and digital currency or digital gold, depending on how one sees the technology and asset. Bitcoin also signaled a new form of contract but, at the same time, an ancient type of contract. As we saw earlier in the chapter, money is a contract of cooperation to trade between two parties who agree to use a specific currency or type of money to communicate, transact, and exchange value with one another. In the same way that our ancestors opted in when bartering to exchange eight chickens for one cow or six eggs for 1 liter of milk or different forms of primitive money, bitcoin can be seen as a new form of currency and contract that people can use. They can use this currency instead of any other currency to exchange and communicate value, goods, and services. This is true both on a human conceptual level and in code.

Bitcoin transactions can be seen as smart contracts, albeit weak, because Bitcoin is written in script. This simple programming language is not Turing complete. That is to say that bitcoin is naturally good in only one way: it sends value from one part of the world to another very quickly. However, you cannot use it on the protocol level for more complex contracts or cooperation unless you use protocols that are non-native to Bitcoin's protocol.

This was essentially Vitalik Buterin's—the founder of Ethereum—critique of Bitcoin before he invented Ethereum. Ethereum uses Solidity, among other languages that are Turing complete, allowing for much more sophisticated applications and cooperation between people across the globe without needing to meet each other in real life. Many applications are possible with smart contracts, and if I were to enumerate and name them here, I would need a whole new book just for that. Instead, I will give the big picture of what is possible.

Tokenization of Real-World Assets

The beginning of the chapter brought up the example of selling real estate. If one wants to sell a house, it can take months or even years because real estate is not as liquid as cash or its equivalents are. With smart contracts built on Ethereum, one can create cryptocurrencies on top of Ethereum that represent the house's value and make the asset liquid. For example, suppose a house is worth 100.000\$, and one creates 100.000 cryptocurrency tokens to represent that house. In that case, they can have a value of 1 USD, and when someone buys that cryptocurrency for 1 USD, they own a small percent of the house. If they buy 1,000 tokens for 1,000 USD, they would own 1 percent of the house.

This could allow them to collect 1 percent of the monthly rent if someone in the house is renting it. Besides this, it globalizes the real estate market even further than it is now since someone in the United States could place the tokens in a smart contract to sell a house in a European country. Someone in India will go to this contract and buy the tokens. These tokens are called *fungible tokens* as they have equal value and are exchangeable with one another, just like 1 ether is fungible and can be exchanged for another ether.

Another form of tokenization is to represent the real estate as an NFT, go to an NFT marketplace, and list it for sale there, enabling people to buy the house in a global market rather than a localized one. Furthermore, the NFT can be tokenized into smaller pieces and become fungible if the owner of the NFT decides to do that in the future. In this case, it is an NFT, but can, through tokenization, transition into fungible tokens, the first form of tokenization.

SMART CONTRACT PRACTICAL APPLICATIONS

Example #1: Asset Tokenization

Propy is an American real estate tokenization platform. In 2022, a woman in Florida, United States, bought a tokenized physical home as an NFT for 653,000 USD through an online auction. The process entailed transferring the ownership of the house to a Limited Liability Company (LLC) and, from the LLC, transferring the ownership to the new owner. The old owner received the payment in a digital wallet.

This was one of the first use cases for selling a tokenized house. Since the legal system and people who still think in old ways are not yet prepared for such a change, an intermediary in the form of an LLC was necessary.

On the other hand, Red Swan CRE enables investors to have fractional ownership of real estate worldwide.

Example #2: Alcohol Tokenization

CryptoWine is an Austrian wine start-up that tokenizes bottles of Austrian and European wine as NFTs and stores them in the remote “private” cellar of the owner of the NFT. Therefore, whenever a buyer buys a wine on CryptoWine, they buy a digital representation and proof of ownership through the NFT of the wine, which they are free to keep for themselves, sell it to someone else, or gift it to a friend. When the owner of the wine clicks the digital NFT wine bottle and opens the bottle, the physical wine stored in the remote cellar is taken from the basement. It is shipped to the physical location of the owner of the NFT.

Example #3: Fundraising

Calladita by Miguel Faus is the first European movie funded entirely by smart contracts and NFTs. Buying NFTs raised money for the film through cryptocurrency for movie production. Depending on the NFTs to finance the movie, the investors

can share profits from the movie, get access to the actors and stars of the film, or even decide on plot twists and how the story progresses in certain parts.

Such use cases will be especially valuable in the future when different book communities and fans will want to fund their favorite books and turn them into movies or fund fan-made, grassroots, low-budget short movies expanding their budget and allowing them to accomplish much more than they currently can accomplish with the low budget that they have.

Example #4: Digital Fashion

Mutani, a digital fashion start-up in Antwerp, Belgium, uses smart contracts and NFTs to create digital clothing for avatars and characters in video games and virtual reality. People can buy digital clothing, express themselves in fashion online, and let their avatars wear them. It is similar to skins in video games. Still, Antwerp is much more sophisticated in fashion as it is well known in Europe and worldwide for its fashion industry. In Mutani, some of the best fashion experts work on digital clothing.

Soon, when the Metaverse becomes more mainstream and usable, these clothes will be able to be used as assets and collateral for loans in cryptocurrencies and possibly even digital fiat currencies. Similarly, Louis Vuitton bags and clothing are considered assets, and their value may increase.

The same can be done with any in-game item, including fashion and clothing. If someone plays an RPG, they could use their digital weapons, armor, or other equipment as assets and sell them for cryptocurrency or as collateral for loans.

Example #5: Digital Books

Book.io is an online bookshop that sells e-books as NFTs. There are several differences between the e-books that Amazon sells and the books sold by Book.io. One of the differences is that the buyers of Book.io books truly own the books they buy. In contrast, people who buy e-books on Amazon buy a license to read the books. Still, at any moment, Amazon or any other seller of an e-book can revoke the access to the buyer of the book, be it because the book would not be available anymore from that particular seller or if the buyer has violated specific terms of the agreement they agree to at the beginning of when they sign up for their account. On Book.io, buying digital books is like purchasing a hardback or a paperback physical book that cannot be taken away from you. It is a digital book; hence, just like cryptocurrencies, they do not succumb to tear or wear.

Another interesting use case with book.io is that, unlike the licensed e-book versions of Amazon and other similar sellers of books, people can sell, lend, or donate their digital books to someone else. At the same time, authors and publishers can earn a percentage of the resale value to the secondary market, which they cannot do with

hardback books if the owner decides to sell them to a thrift shop or someone else. Additionally, depending on how the publisher and the author manage the book, the value of the book when bought by the owner might increase instead of decrease since there are several things the author can do to increase the value of the book in the short term or long term such as giving a discount for his following books to the buyers of a specific limited edition of books or access to events or more content if they are educational books. Furthermore, the owners of a particular edition of books will have the opportunity to network with one another and earn the \$Book token as they progress through the book's reading. At the same time, organizations and libraries can distribute digital books in bulk.

Example #6: Music

Violetta Zironi is an Italian singer, songwriter, and actor who sells her music directly to her fans through NFTs, allowing her to manage her community and fans directly without intermediaries. This allows her fans to manage her music as an asset. If a song or two of hers becomes popular or a hit, it will rise in value, and her fans can sell the digital NFT representing the song she created and profit from it. At the same time, she also gets a percent of the sale, transforming how she interacts with her fans, who can now be seen as investors in her music.

Additionally, in the future, she could seek the input of her community regarding songs or any other ventures she might pursue and allow her fans to benefit, too.

Example #7: Digital Art

One of the first NFT collections was the CryptoPunks, an experiment on NFTs of 10,000 pixelated people, which were given away for free as digital art. Depending on their rarity and features, they are now valued at millions of dollars. However, these pixelated digital people may not come close to the beauty of well-known physical and historical paintings. They are valued at such high prices due to the community value they provide and their historical significance since they were the first memorable NFT collection that worked out well and will always be considered one of the first digital art examples the world has ever seen. As NFT and digital art become more mainstream, we will see more sophisticated examples of digital art. Still, the CryptoPunks will remain in history due to their significance.

Example #8: Photography

I will not mention a specific use case for photography. Still, I will talk about potential use cases, such as having collections of photographs similar to having an exposé of art. Other use cases could be selling a photographer's photo of the year or giving access to additional content from the photographer who sells their photographs as NFTs.

Example #9: Customer Loyalty

Regarding customer loyalty, the hotel Le Bristol in France launched 11 NFT keys. The collection, called L'H3RITAGE CLUB, or in English, the Heritage Club, unlocks different experiences for its loyal customers and frequent travelers worldwide.

Holders of all 11 NFTs get:

- Access to the hotel's swimming pool for two people once a week
- Access to the secret dish at café Antonia by Chef Eric Frenchon that would be changed seasonally
- Access to a secret cocktail menu at the Bar du Bristol for four people

Additionally, each NFT has a unique perk depending on what the loyal customer may enjoy. Some of these perks include the following:

- A spa experience with a private swimming pool, aquatic massage, music, and champagne
- Chocolate masterclass
- Private vineyard tour
- Cooking masterclass in the three Michelin Star restaurant's kitchen
- Barbeque on the rooftop terrace of their Signature suite, "Suite Terrasse."

Example #10: Courses

In fall 2022, the University of Nicosia in Cyprus, Europe, organized the first course delivered on-chain and in the Metaverse on NFTs. Participants had to mint an NFT and hold it to access the course. Thereafter, the NFT becomes a digital item or artifact by which the university can engage the student community and holders—or ex-students—in diverse ways and maintain a relationship with them. They could even invite them to the university to network or give discounts on specific courses or other ways.

This is not only applicable to university courses but to any digital courses that can be given by a consultant or an expert on something. The NFT becomes the key by which the student or customer gets access to the course. Think of it as a digital badge that opens the door to the classroom of the digital course. Moreover, the students may use the NFT as an asset and trade it with or sell it to other potential and interested students, generating revenue for both the ex-student and the consultant/teacher. The students of his classes or courses can get a discount on his consulting services, which adds a perpetual value to the NFT beyond the course and may incentivize either holding it or selling it to someone who may not only be interested in the course but also the consulting services of the consultant generating further revenue to the consultant.

Example #11: Decentralized Digital Identity

One of the problems we have in the digital age is that of data brokers and companies stealing their customers' data and selling it to third-party companies for profit, which kills the notion of privacy for those at least who value it. Smart contracts can be used to tokenize that data and put it on the blockchain and allow the owners of that data to manage the data as they see fit by allowing access to someone, be that a medical professional, for the reason they decide to do that instead of having companies bludgeoning the data without many times the known consent of the customer. Moreover, the customer may sell his data to a company or companies. Still, at least the customer will benefit economically and decide to do so in the first place through their agency.

Example #12: Membership NFTs

In December 2021, Flyfish Club Restaurant issued two collections of NFTs for their restaurant, which can be accessed only by people who own one NFT from either collection. One collection allows access to the restaurant's main room, while the second NFT provides access to another room. The customers are free to sell their NFTs, which enables the restaurant to benefit from royalties.

This is a case of creating a restaurant membership through NFTs. Still, it can also be used for other businesses whose business models require memberships or are entirely based on membership, such as gyms.

DECENTRALIZED AUTONOMOUS ORGANIZATIONS

Decentralized autonomous organizations (DAOs) are organizations created through smart contracts. They have a decentralized type of governance powered by a predetermined codified smart contract(s), where the holders of the DAO's token can propose and vote on changes to the organization by calling functions that have been precoded. Chapter 13 discusses DAOs in depth.

The smart contracts of DAOs could be seen in a way as social contracts that we employ in our physical societies, such as laws, the constitution of a country, and how we govern ourselves with a representative democracy where we vote for our candidates. If our candidates gather enough votes, our ideas will have a place to be represented in our country's national parliament or senate. In principle, at least, we agreed to govern ourselves like that and are free to change what we do not like. Another social contract is the social structure of a business with its board of directors, CEO, and management. Fundamentally, these are societal (not smart yet) contracts we humans created and agreed upon mutually and collectively regarding how we will govern our society

DECENTRALIZED EXCHANGES

In the cryptocurrency industry, there are two types of exchanges: centralized exchanges (CEXs) such as Coinbase, Kraken, and Binance that are a bank's cryptocurrency equivalent; and

decentralized exchanges. Decentralized exchanges (DEXs) don't have a centralized leader such as a CEO. Instead, the token holders spread across the world can propose changes and vote upon them. If a proposal gets enough votes (say 51 percent or more, although it can be coded to be depending on what people want to do), the change is implemented. A DEX is an automated market maker that allows one to exchange one type of token for another through algorithms and through using price feed oracles. (You can find more about oracles in Chapter 8.)

Several decentralized exchanges, including Uniswap, built on Ethereum, allow users to exchange their cryptocurrency for another cryptocurrency in a centralized exchange. However, it is worth noting that Uniswap is currently allowing only the swapping of ERC-20 tokens and ERC-721 NFTs—more on these technical terms in later chapters. This means only tokens built on Ethereum and not on any other blockchain can be swapped and traded. For example, Bitcoin cannot be exchanged for ether. Still, ether can be swapped for UNI, the governance token of Uniswap, and vice versa. It is also worth noting that this is not because Uniswap does not want to but because of current technological limitations. To bring in a previous example of tokenized real estate, be it in fungible fractionalized ownership form of 100,000 tokens or a single NFT representing a piece of real estate. In the future, it would be entirely possible to have the real estate NFTs and fungible fractionalized tokens be on Uniswap and people swapping one for the other or even 1 NFT for the real estate NFT if they want.

In addition to helping with cryptocurrency swaps, Uniswap gives grants in cryptocurrency to expand the Ethereum network and enhances Uniswap. This can include building something that is required by the network, organizing an event, educating people, and other things. Uniswap also hires people for the jobs that cannot be automated by a DAO or a smart contract, such as community management, business development, and so forth. It is worth noting that many of these roles are not necessarily decision-making roles for the organization as the token holders determine this, and the people being recruited for a job are seen more in a “caretaker” role. It is common for them to have job titles such as Community Steward or Ecosystem Steward.

Lending/Borrowing: Aave

Another DAO built on Ethereum is Aave. Aave works similarly to Uniswap, hiring people and giving grants. Still, the difference between Aave and Uniswap is that Aave is a peer-to-peer lending and borrowing protocol that creates a global borrowing and lending market. One person in the United States could deposit a cryptocurrency in Aave's smart contract. A person from India or anywhere else worldwide could borrow this deposited cryptocurrency as quickly as sending an email from Japan or South Africa to the United States or Brazil.

Travala

Another DAO built on the Binance smart chain and not Ethereum is Travala. Travala is a decentralized traveling agency that allows its customers and community to buy flight tickets and book hotels with cryptocurrency. The AVA token allows for the protocol's governance and discount bookings if paid with the AVA token. Additionally, Travala is using NFTs for customer loyalty with discounts, customer engagement, rewards, and gifts.

VitaDAO

VitaDAO is a decentralized autonomous organization that funds research on human longevity technology and tokenizes its intellectual property. Most of VitaDAO's community comprises of academics, medical doctors, and scientists worldwide in longevity-related fields—although anyone can join the DAO. Vita token holders decide on what research proposals to invest in and, in exchange, negotiate with the scientist a percentage of the intellectual property to be owned by the DAO. The DAO then uses that research to launch longevity start-ups.

BeerDAO

BeerDAO is a decentralized autonomous organization that has tokenized a beer brand. Whoever worldwide owns the NFT of the DAO owns part of the beer brand and is free to produce and sell this beer wherever they are.

CityDAO

CityDAO is a DAO that has bought a plot of land in Wyoming, United States, and is building a “city” on it. In essence, the DAO collectively manages the land through proposals and votes. Each NFT represents a “citizenship” to the DAO, and each citizen has one vote regarding managing the land/city. The citizens of CityDAO are also currently experimenting with what is known as the Harberger tax, a new property tax idea proposed by Arnold Harberger, an American economist.

CRYPTOCURRENCIES AND SMART CONTRACTS: CONCLUSION

There are many more DAOs and smart contract applications, enough that a whole book could be written about them. Additionally, there are the societal and economic implications of each smart contract use case. But this book is about Solidity and how to develop these smart contracts, so the previous examples serve to showcase and educate about the potential uses of smart contracts and cryptocurrencies. This should help you understand what it is you are building when you're developing smart contracts and cryptocurrencies. However, later in the book there will be a deeper dive into decentralized finance to give a better understanding of the technicalities behind smart contracts.

As promised at the beginning of the chapter, here is a definition of money based on this chapter and its content:

Money is a complex technology and language humans use to communicate and facilitate the exchange of value governed by mutually agreed-upon protocols within or between different communities. It serves as a medium of exchange, a unit of account, and a store of value, representing the properties of durability, transportability, divisibility, fungibility, scarcity, and acceptability. Historically, money has gone through different evolutions, from barter to physical commodities to coins, paper, and digital forms of money. Cryptocurrencies and smart contracts reflect economic, social, political, and cultural dimensions. Money's purpose lies in its ability to represent and communicate the perceived value of goods and services between two or more parties, acting as a contract that organizes, stabilizes, and enables economic activities across different scales and eras.

Money further evolves from its traditional boundaries regarding cryptocurrencies and smart contracts. It now incorporates decentralization, transparency, and programmability principles, potentially reshaping economic, governance, and social contracts in the digital age.

In this chapter, we saw the history of money and contracts and their evolution throughout human history and various societies and how, through the evolution of money and contracts, humanity's political structures, as well as the structures that facilitate cooperation, changed, and how our economic system evolved to be what it is today and how cryptocurrencies hold the next evolution of money and potentially social and political structures. In a later chapter, we will see more examples of smart contracts and how they are being used in a specialized field of finance created by cryptocurrencies and smart contracts called decentralized finance. Chapter 2 will dive deeper into how Ethereum works under the hood before getting our hands dirty with Solidity.

CHAPTER 1 QUESTIONS

1. Explain bitcoin's fixed supply model and its halving schedule. How does this differ from traditional monetary policies?
2. Define smart contracts, and explain how they differ from traditional contracts. What are their key advantages?
3. What are the three main properties of money? For each property, explain how bitcoin and ether fulfill or fail to fulfill them.
4. Describe how asset tokenization works in real estate. What are the key benefits and challenges?
5. What is a DAO? Explain its governance structure and provide an example of a real-world DAO.
6. Compare and contrast centralized exchanges with decentralized exchanges. What are the key technological limitations of DEXs?
7. How do primitive forms of money like whale teeth and shells compare to modern cryptocurrencies in terms of the properties of money?
8. Explain how the Bretton Woods system worked and how its collapse led to the current fiat system.
9. What are the security features of the Bitcoin and Ethereum networks? How do they maintain network integrity?
10. Describe how fractional reserve banking emerged historically and its relationship to modern banking.
11. What role do NFTs play in digital identity and customer loyalty programs? Provide specific examples.

12. How does Aave's peer-to-peer lending system work, and how does it differ from traditional banking?

13. Explain the concept of fungibility in both traditional and crypto contexts. How do fungible and nonfungible tokens differ?

14. What were the limitations of the barter system, and how did they lead to the development of primitive money?

15. How have cultural and societal values historically influenced the acceptance and evolution of different forms of money? Provide examples from the text.
