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How NFTs Qualify As Historical Artifacts

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Historical artifacts are important to humanity. They provide the evidence scientists need to understand our past.

These artifacts have traditionally been physical objects – and with good reason. Physical objects are verifiably unique, and contain data that can be extracted to authenticate their historical significance.

However, humanity has moved beyond the physical world. History is being written digitally.

Markets are digital.

Relationships are digital.

Even war is digital.

And as the world transforms from pen+paper into ones+zeroes, major events fail to be documented and preserved with the integrity of a physical artifact.

Digital archives can be corrupted, manipulated, or erased entirely.

Inevitably, future generations will need a data store more reliable than Wikipedia when trying to understand events of the past.

Fortunately, the digital realm now offers a solution.

Blockchains have provided us with a new data storage mechanism – NFTs. These specialised data structures facilitate the production of verifiably unique digital objects, complete with tamper-proof protection and long-term redundancy.

This paper will show how NFTs can be created in such a way that they qualify as legitimate historical artifacts.

And with a concerted effort to produce NFT artifacts for all major historical events, as they happen, the blockchain will become the foundation for humanity's most reliable and accessible historical record, allowing scientists to confidently study the events of the 21st century and beyond.

Discovered in 1799, the Rosetta Stone transformed our understanding of human history.

The one-ton granodiorite stele tablet was found with a decryption key carved into its surface.

The key was used to decipher Egyptian hieroglyphs – unlocking 14 centuries of ancient Egyptian secrets.

The key also made explicit references to historical events, including the crowning of King Ptolemy V in 196 BC (Hölbl 171).

Historical artifacts like the Rosetta Stone often contain such data, explicitly referencing key moments throughout history. Uncovering this data is tremendously valuable to archeologists and historians.

However, scientists don't just take the data at face value. They must first verify its authenticity.

To do this, they look at other data sources contained within the object. With careful analysis, researchers are able to extract data from the chemical composition of the stone itself.

The chemistry of the Rosetta Stone implies the object originated from an ancient Egyptian quarry, dating back about 2000 years (Middleton and Klemm). This data, considered implicit data, is consistent with the explicit references carved into its surface.

> **Explicit data** is information stated directly, typically in some form of human language. For instance: the Egyptian hieroglyphs on the Rosetta Stone, the text on the Declaration of Independence, and the dates carved into the Mayan Calendar, are all examples of explicit data.

> **Implicit data** is information available via the interpretation of other data, such as by examining the levels of carbon-14 within an object to calculate its age. An object's age is rarely stated explicitly on an artifact but is often provided implicitly via other data sources.

'Consistency between implicit and explicit data increases our confidence in the stone's historical legitimacy.'

Further increasing our confidence is the credibility of the data. Implicit data, like the kind found within the chemical composition of the object, is often produced by natural processes over a long period of time. This makes it almost impossible to produce a perfectly identical copy of the object.

Even with modern technology, it is prohibitively difficult to replicate an object so that all the data contained within its physical composition are consistent with what one expects to find when studying an object purporting to originate from ancient Egypt.

Replicas might fool the layperson, but they cannot fool the scientists. With sufficient scientific analysis, every physical object can be uniquely identified – no two are the same.

It is this property of absolute uniqueness that archeologists rely upon. The technical term for an object that is verifiably unique is “non-fungible”.

Conversely, when two or more objects are 100% identical with each other, they are considered fungible. A fungible object is mutually interchangeable with copies of itself. You can replace one fungible object with another, and nobody would be able to determine that they were swapped.

> Fungibility is a little complex to grasp at first, but we rely on it every day. Money is a good example of something fungible.
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> Suppose you have $100 in your bank account. Your friend, Alice, electronically wires you $10. You now have $110 in your bank. Then you go to an ATM and you withdraw $10. Did you withdraw the exact $10 that Alice sent you, or did you withdraw $10 from the money you had originally? Which $10 do you have?
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> This question is meaningless because you cannot uniquely identify money in this way. Money is fungible. The moment you received $10 from Alice, the concept of “Alice’s $10” disappeared. It makes no sense to ask: “out of my $110, which $10 came from Alice?”
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> To get a little more technical - only the buying power of money is fungible. And when it comes to digital money, only the buying power is ever represented.
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> However, physical tokens, such as coins and banknotes, are both fungible and non-fungible. The buying power that a $20 note represents is fungible. The physical papers, with symbols like “$20” printed on them, are non-fungible.
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> Under analysis, two different $20 notes can be uniquely identified, but only the portion of the object, the physical note itself, can be distinguished. The buying power that the notes represent cannot be uniquely identified.
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> Another example of fungibility is pure data and information (without the aid of a blockchain). A file on your computer or the text of an email are examples of data objects that are fungible.
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> If Alice emails you a file, and you email the same file back, did you send Alice the exact same file that she sent you? You might have sent her the same data, but you can still see the file Alice sent you in your inbox. Did you duplicate it? Which is the original? Can you even send back the exact same file Alice sent you? These questions are meaningless.
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> In just its pure data form, the text on the Rosetta Stone would also be considered fungible, while the stone and the specific grooves made by the text are non-fungible.
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> Coupling something fungible, such as data describing the coronation of an ancient King, with something non-fungible, such as a one-ton granodiorite stele tablet, secures the origins of the fungible data within something non-fungible.

There is no chemical analysis to be performed that would distinguish one fungible object from another. When you have two identical objects, all available data, implicit and explicit, would consistently tell the same story, no matter which objects from the fungible set are examined.

But since physical objects contain data that cannot be artificially reproduced, physical objects are considered non-fungible.

And this is why historical artifacts are always physical objects. It's not because artifacts must be physical by definition, but rather, they must be verifiably unique. They must be non-fungible.

Until the invention of blockchains, we need not bother distinguishing between objects that are physical and those that are non-fungible, because nothing yet existed that was both non-fungible and non-physical.

With few exceptions, digital-only objects have been entirely fungible. Uniqueness in the physical sense has not translated to the digital realm where immaterial objects are subject to theoretically infinite levels of reproduction and dissemination.

On top of untracked duplication, it's also very easy to tamper with digital information (implicit and explicit) in such a way that its origins cannot be verified.

This has made it impossible to determine if a non-physical object is truly unique. This applied to nearly all digital-only data objects right up until the invention of a technology that was designed to track not just digital ownership, but digital uniqueness – blockchains.

But before we explore the technology, we need to look at one critical property that distinguishes objects from artifacts – their *Genesis Event*.

A Genesis Event is the process by which an object was caused to exist – a defining feature of an artifact. Without sufficient evidence for a Genesis Event, an object cannot be considered an "artifact".

An artifact is always an *artifact-of-<some event>*.

> The boundary defining <some event> is dependent on the context in which the artifact is being discussed. For instance, suppose you had a bullet with evidence that it was fired on the beaches of Normandy on June 6, 1944. When discussing specific moments of the war, you might label the object an Artifact of the Normandy Landings, but in other conversations, it might be sufficient to simply label it an Artifact of World War 2. Both are correct.
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> Sometimes, the resolution of the boundary is constrained by the data. In the case of the Rosetta Stone, we don't know which day of the week it was dug from the quarry - the best we can do with the data is narrow the boundary to around 2000 years ago.

The Rosetta Stone contains sufficient evidence (implicit and explicit) to verify its authenticity as an *artifact-of* Ancient Egypt. Its Genesis Event was when ancient Egyptians dug the stone from their quarry and carved a decryption key into its surface.

However, it's not always obvious which event should be considered the Genesis Event of an artifact.

Why is the Genesis Event not the thousands of years it took nature to produce the stone?

Because the stone had no historical significance until it was inscribed with the decryption key. So its Genesis Event (as an artifact that we care about) was when ancient Egyptians sat down to chisel away at its surface.

Suppose a person produces a replica of the Rosetta Stone in their basement. While the replica is technically an artifact, it isn't an artifact of ancient Egypt. It is an artifact of the process the person went through in their basement to produce the object – that would be its Genesis Event.

And the implicit data would support this. Chemical analysis would reveal that the replica did not originate from an ancient Egyptian quarry.

It's also important not to confuse the contents of the data with the Genesis Event itself. While the Rosetta Stone makes explicit reference to the coronation of King Ptolemy V, and we can learn much from this information, this is unlikely to be the event that caused the artifact to exist.

This is an important distinction. If the carving of the stone was an inevitable, automatic consequence of the coronation, then we could consider the stone an artifact of the coronation itself. But because the stone was carved separately, at somebody's discretion, then it is closer to being an artifact of the decision to document the coronation, rather than the actual coronation.

This is an interesting feature of artifacts.

Suppose we wanted to produce an artifact of some major historical event, such as an earthquake. If we were to hear about an earthquake on the news, and then take a pen and paper (or chisel and stone), and write down the earthquake's location, time, and magnitude – indeed, we would have produced an artifact – but not of the earthquake. It would be an artifact of the decision to document the earthquake. And that decision is only very loosely associated with the event itself. The causal links between the earthquake and the decision to write about it are extremely weak.

Subsequently, its historical value would be highly suspect. What motivated the decision to write down the information? And how can we ensure the information was reliably copied?

The explicit data would not be a reliable record of history, and the implicit data would provide no evidence to support its claims.

Unlike computers, humans are prone to making errors, especially when they record data rapidly and without sufficient error correction procedures in place. However, suppose we installed an instrument (such as a seismometer) that automatically recorded the seismic waves of the earthquake onto a paper drum as the ground shook beneath it – removing the human element entirely. This would produce a physical record of the earthquake itself, as it happened in real-time. There would be no decision-making process. No risk of human error.

The Genesis Event for the paper drum, complete with the seismographic data inscribed upon it would be the earthquake itself, qualifying it as a legitimate artifact of that earthquake. And provided it could be preserved, the implicit data contained within

the physical composition of the drum would provide sufficient evidence to verify its authenticity over time.

Now is a good time to summarize the properties of artifacts:

Artifacts
Artifacts need not be physical but they must be non-fungible
Artifacts must contain sufficient implicit data to ensure they can be uniquely identified, even when compared with the most sophisticated replicas
All data, implicit and explicit, must be free of contradictions - consistently telling the same story
The data should provide sufficient evidence for its genesis event

Now that we've established the properties of an artifact, we can look at NFTs and how they can be transformed into artifacts that fit these criteria.

Firstly, what are NFTs?

NFT stands for "Non-Fungible Token". Put simply, NFTs are digital objects that are verifiably unique and for which the owner is reliably tracked by a blockchain.

NFTs can be filled with all kinds of explicit data, such as images, videos, sounds, and text.

Once an NFT is created, the data inside it cannot be edited. By design, blockchains have no "edit" or "delete" function. In technical terms, this means the data is "immutable". You can only ever add more data to a blockchain. It is impossible to edit something on a blockchain once it has been inserted. This includes data within NFTs.

> While NFTs hold data themselves, they can also reference data located elsewhere on the Internet. The blockchain cannot control how referenced data changes over time, but it can validate the referenced data using a technique known as hashing.

Unlike banks and private companies, blockchains employ an interesting security feature – total transparency. Every NFT is visible to any member of the public. This means the data within an NFT can be downloaded and copied by anyone, at any time, without limit.

However, even if you copy the data within an NFT, you cannot actually copy the NFT itself. The NFT can only ever exist on the blockchain.

In addition, the owner and any rights attributed to ownership are carefully tracked by the blockchain – precisely what the technology was designed to do.

Suppose you downloaded the Coca-Cola logo from the internet and printed it out on your printer at home. While you're technically in possession of the logo, you do not own the rights to the image. In fact, if you attempt to commercialize that logo without

permission, you will be pursued legally with support from the United States Patent and Trademark Office (USPTO).

Blockchains ensure each NFT remains verifiably unique while carefully managing the ownership of the NFT without the need for central authorities such as banks or the USPTO.

In other words, NFTs are both non-physical (digital) and non-fungible (unique).

While NFTs typically contain explicit data (text, pictures, sounds), there is also implicit data to be found on the blockchain itself – namely, the creation time of the NFT.

Similar to Carbon-14 levels measured in physical objects, the blockchain makes implicit information available to support the claim it is an artifact.

For NFTs to be considered a legitimate artifact of a historical event, the historical event itself must cause the NFT to come into existence. The historical event must be the Genesis Event. If someone manually produces an NFT, the genesis event is the decision to produce it, not the historical event described in the explicit data.

One way to increase confidence that the Genesis Event and the historical event are the same is to ensure the NFT is produced automatically at the time of the event.

Automatic production of an NFT is essential to protect the causal link to its genesis event.

Evidence in support of the NFT being automatically produced as part of the causal chain of events originating from the historical event would be the time between the NFT creation time (implicit on the blockchain) and the event time recorded explicitly within the NFT.

If the window between the event time and the NFT's creation time is small, the possibility that a human artificially produced the NFT outside the causal chain is very low.

In fact, the closer the NFT creation time is to the event time, the more likely the Genesis Event and the historical event are one and the same.

So what can we now say about NFTs with respect to artifacts?

Artifacts	NFTs
Artifacts need not be physical but they must be non-fungible	NFTs are non-fungible
Artifacts must contain sufficient implicit data to ensure they can be uniquely identified, even when compared with the most sophisticated replicas	NFTs contain sufficient data to ensure they can be uniquely identified, even when compared with the most sophisticated replicas
All data, implicit and explicit, must be free of contradictions - consistently telling the same story	NFTs contain both implicit and explicit data that can be tested for consistency
The data should provide sufficient evidence for its genesis event	NFTs contain data in support of specific Genesis Events

And with this, we can confidently make the claim that NFTs qualify, under certain conditions, as legitimate artifacts of historical events.

So long as the existence of the NFT, and the data contained within it are directly caused by a historically significant event, without the need for a human to intervene in the production process, we have a legitimate digital artifact.

> We've shown how NFTs qualify as historical artifacts by examining and comparing their defining features. But let's zoom out for a moment, and look at how artifacts have evolved throughout history.
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> Artifacts dating back 6000 years are often made of stone, hence that period is known as the Stone Age. And of course, the Bronze and Iron Ages produced bronze and iron artifacts.
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> Today, humanity races through a Digital Age, where history is being written not in stone, bronze or iron, but in ones and zeroes. And so, just as history changed the way it communicates with the present, we must again change the way we listen to the past. The Digital Age will be recorded within digital artifacts.

And that is what we do here at the Data History Museum. We have built technology that allows historical events to causally produce an NFT on the Algorand blockchain.

As of March 2022, our systems are connected to data feeds stemming from seismometers located all around the world. These seismometers release data in response to earthquakes – vibrations originating deep below the surface of the Earth. That data is disseminated live via the Internet, which automatically triggers our NFT production systems, ensuring an NFT is produced on the blockchain as soon as the earthquake is detected.

But the data does more than just trigger the production of an NFT, it is also used

to populate the explicit data contained within the NFT itself. This includes the geo-coordinates, magnitude, depth, and importantly the “event time”.

And since all of this happens automatically, this all happens very fast. Automation ensures any space between the (explicit) event time and the (implicit) NFT creation time is sufficiently small, so any risk a human may have intervened in the production process is negligible.

The result is that we are producing legitimate historical artifacts in a purely digital format, and storing them in a highly secure, publicly accessible location.

But we don’t intend to stop with earthquakes. The Data History Museum will go on to establish causal links with other major historical events, including hurricanes, volcanic eruptions, and solar flares. We will also capture societal events, such as scientific discoveries, election results and UN resolutions.

We are building the world’s first digital museum curated with all kinds of legitimate historical artifacts, for all of humanity to enjoy.

Perhaps digital artifacts will someday have as much impact on our understanding of humanity as The Rosetta Stone.

References

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