Original or Fake?
How to Understand the Digital Artworks' Value in the Blockchain

Cognition: Interdisciplinary Foundations, Models and Applications

VIRTUAL EVENT organised by Nazarbayev University, Nur-Sultan, Kazakhstan, and the University of York, York, UK

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Art forgery history

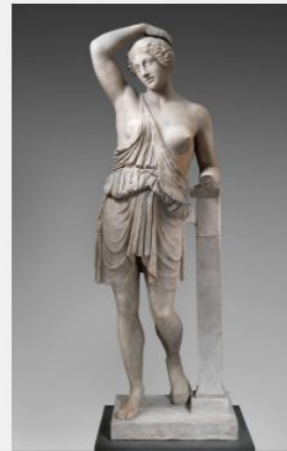Art forgery dates back more than two thousand years.

Impressed by the wealth, culture, and beauty of the Greek cities, Roman artists created marble and bronze copies of the famous Greek statues.

Marble head of Athena: The so-called Athena Medici

Rosso antico torso of a centaur

Marble statue of a wounded Amazon

Fragments of a marble statue of the Diadoumenos

Roman Copies of Greek Statues

Detecting possible artwork forgeries

Nowadays many scientific methods can be used for detecting forgery of physical artwork.

Shaun Greenhalgh claimed to be the author of "Beautiful Princess".

Using a multispectral camera, a fingerprint was identified which was then compared with other known ones by Leonardo.

A radiocarbon examination of the support was also carried out, which confirmed an antiquity of the artwork that could be circumscribed between 1440 and 1650, therefore compatible with Leonardo's production.
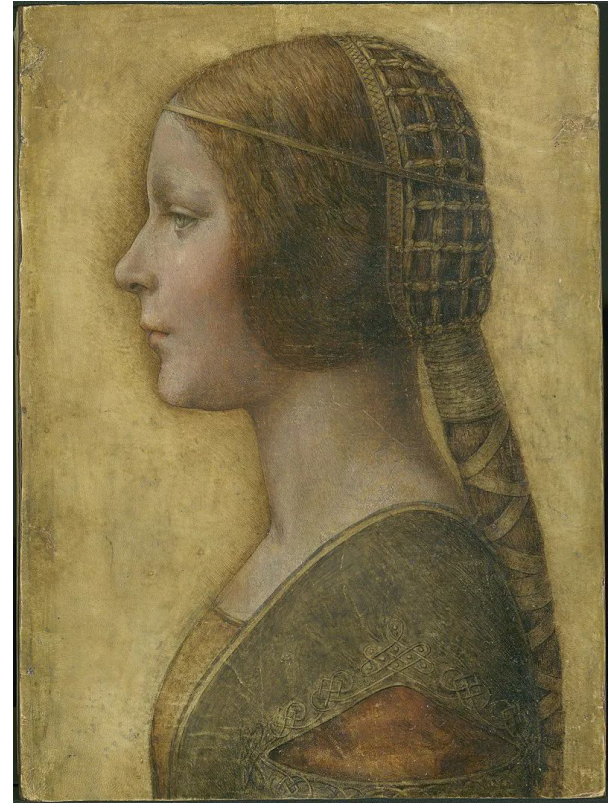
Ritratto di una Sforza - Leonardo da Vinci?

Non Physical Artwork

In recent months several non-physical artworks have been auctioned for millions of dollars.

$ 7M

$ 500K

$ 600K

$ 30M

$ 70M

$ 3M

$ 12M

Art forgery of non-physical artwork.

A non-physical artwork, unlike a physical artwork, is not unique because it can be copied and distributed effortlessly.

How to prove the original file when everyone has an identical copy of the file?

# Ownership and authorship have always been key in art

Authorship matters. People have paid considerable money for clothes or objects that belonged to famous people (Bloom, 2004, 2010; Frazier, Gelman, Wilson, & Hood,2009; Hood & Bloom, 2008)

Ownership matters. Even though there may be no tangible difference between a mug that one owns and another identical mug, the owned mug tends to be more valued — the so-called endowment effect (e.g., Kahneman, Knetsch, & Thaler, 1990; Thaler, 1980).

Art forgery in our time

Some non-physical artworks are being sold at tens of millions of dollars.

It is no surprise that malevolent users would try to sell non-physical artworks which are falsely credited to other, usually more famous artists (Mike Winklemann aka Beetle, Mario Klingemann aka Quasimond, …).
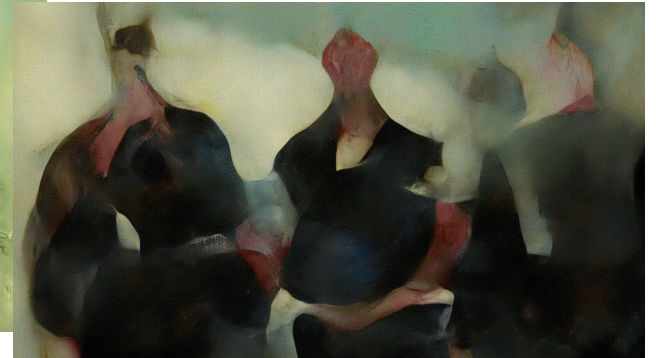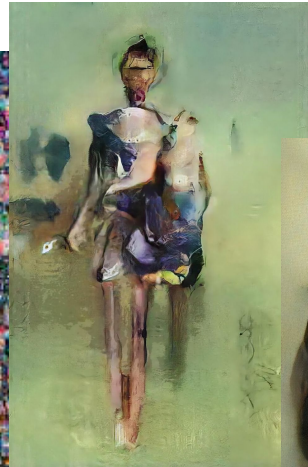
Research questions and hypothesis

R1 - Can the blockchain prevent the forgery of a digital artwork?

R2 - Can the blockchain help the user to have a more correct estimate of the value of the digital artwork itself?

H1 - In most cases the blockchain can be used as history of production (Goodman 1976) to prevent non-physical artwork forgery.

H2 - Data from the outside world are needed to make a more correct estimate of the value of digital works because the artwork value depends on the history of effects (Gadamer 1960).
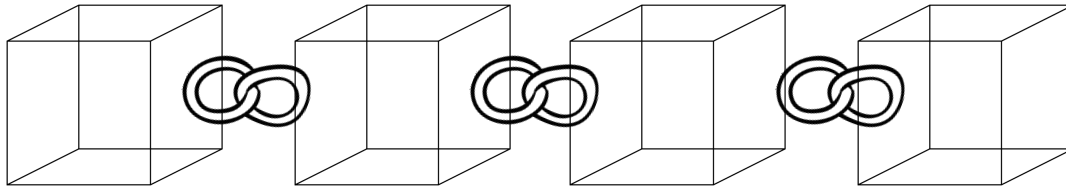
Background

What is the Blockchain?

The blockchain is a public digital ledger made of digital files (blocks) with certain properties.

The idea was presented for the first time in 1990 at a scientific conference by two researchers (Haber & Stornetta, LNCS, 1990).

The idea was adopted in 2008 to create the first blockchain: A Peer-to-Peer Electronic Cash System.

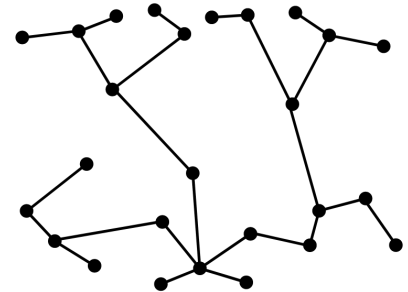# What are some properties of the blockchain?

Immutability: changing historical blocks is computationally infeasible because a huge computational and electrical power would be required.

Decentralized: the overall blockchain behaviour emerges from the computational work of lower level components (miners that receive a reward to verify transactions).
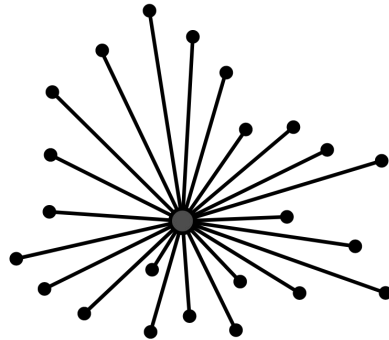
CENTRALIZED   DECENTRALIZED

What are some blockchain technology?

Blockchain technology extensively relies on hash functions.

An hash function is a procedure that maps an arbitrarily large number of bytes to a much shorter number of bytes, its fingerprint.

Usually hash functions are designed to have some properties: preimage resistance, easy of computation, collision resistance.

$$y = h(x)$$

0xok4…

0xsa2…

0x2ed…

easy

computationally infeasible
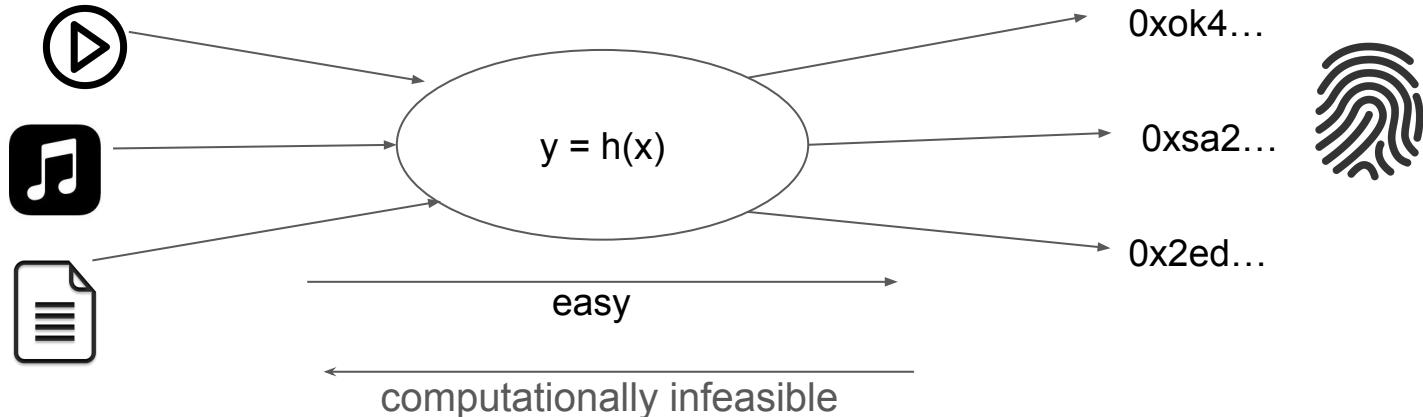
from	to	what?
0x1as...	0x4as…	token
0x5as…	0xbas…	cryptocurrency

Data
…

Hash
0x6trfdff13e…

Hash
0x1e77d8f126…

Hash of prev. block
0x6trfdff13e…

What is a smart contract?

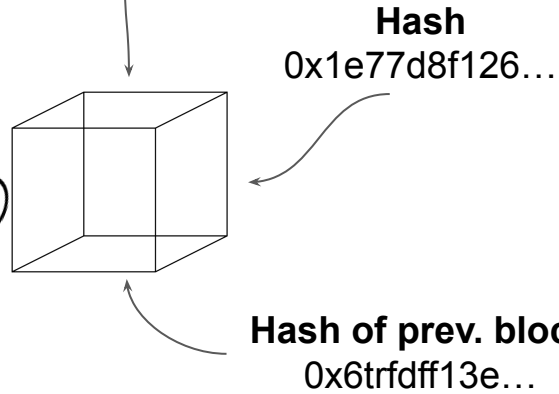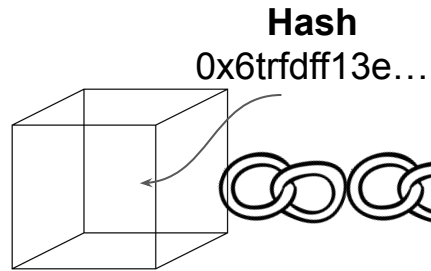A smart contract is a program stored in the blockchain.

In 1998 the idea was presented for the first time by Nick Szabo, a computer scientist and lawyer.

They are used to exchange coins based on certain conditions.

```solidity
1.  pragma solidity ^0.4.25;
2.
3.  contract A {
4.      address owner;
5.      uint256 public cost;
6.
7.      function sendMoney() public {
8.          msg.sender == owner
9.      }
10.     function setcost (uint256 newCost) public {
11.         cost = newCost;
12.     }
13. }
```

Why should you trust a smart contract?

As the smart contract is stored in the blockchain, it inherits some properties.

They are immutable and public.

When a smart contract is deployed on the blockchain, it cannot be changed.

Some smart contracts (ERC-721, ERC-1155, …) are used to create NFTs.

What does NFT mean?

NFT stands for Non Fungible Token.

Non Fungible means not easily interchangeable because it is unique or scarce.

Money is an example of a fungible commodity: if you have a one euro coin you don't mind exchanging it for someone else's one euro coin because it essentially makes no difference.

On the other hand, it might make a difference to exchange the Mona Lisa for a Mona Lisa copy.
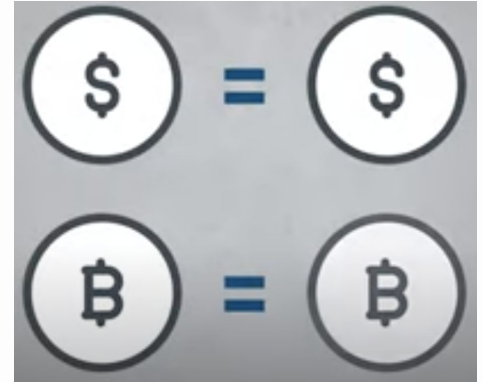
What is a Non Fungible Token?

A token is a digital file that has a unique identifier (token-id) that is directly linked to one Blockchain address, i.e. the owner ot the token.
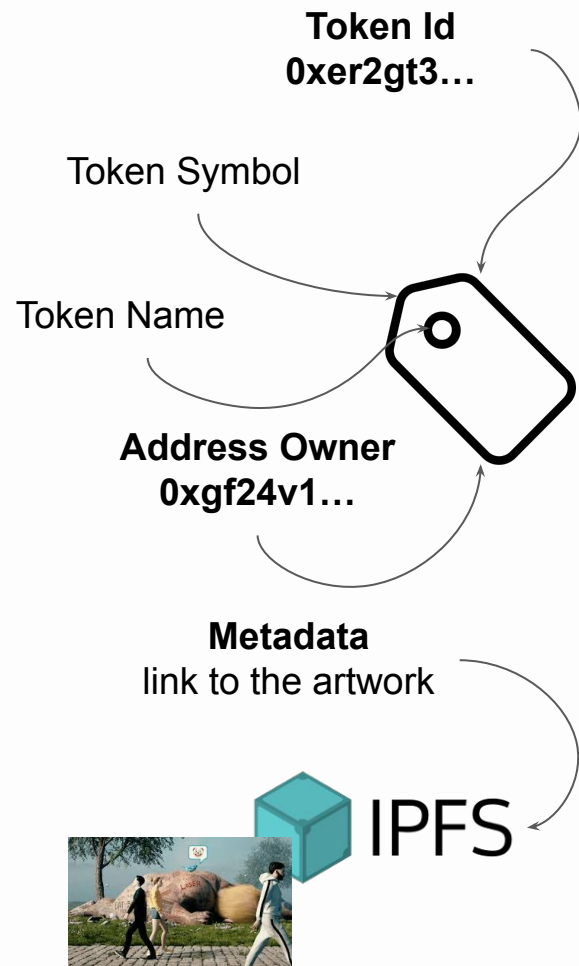
An NFT is a certificate of ownership and it is tamper-proof because it is stored in a blockchain.

The NFT can contain some metadata, such the characteristics of the non-physical artwork and a link the the original artwork, usually stored in a distributed file-sharing system such as IPFS (Interplanetary File System).

You can set a name and a symbol for an NFT, but this is not unique, that means that another smart contract made by another person may have the same name or symbol.

The blockchain makes sure that this information can never be tampered.

Block	Transaction
112_321_312	Token created by X
312_421_123	Token sold for 100 Ether User X -> User Y
412_421_123	Token sold for 200 Ether User Y -> User Z

Token Id 0xer2gt3…

Token Symbol

Token Name

Address Owner 0xgf24v1…

Metadata
link to the artwork

IPFS

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The Oracles

The blockchain characteristic of being isolated from the external world is mandatory to preserve the deterministic validation of blocks. The only way for a the blockchain to read real world data is via Oracles.

In the context of the blockchain, Oracles can be smart contracts or humans with a blockchain address that fetch both real world data or blockchain data, analyse them and write the information on the blockchain as transactions.

The Oracle allows other smart contracts or users to read Oracle's data and make decisions based on these data.

Can the Blockchain technology prevent the forgery of a digital artwork?

First case: the artwork's author has a recognized blockchain account.

The blockchain can easily be used as proof of authorship, because of the recognized author's public key (hash) (its "history of production", Goodman 1976).
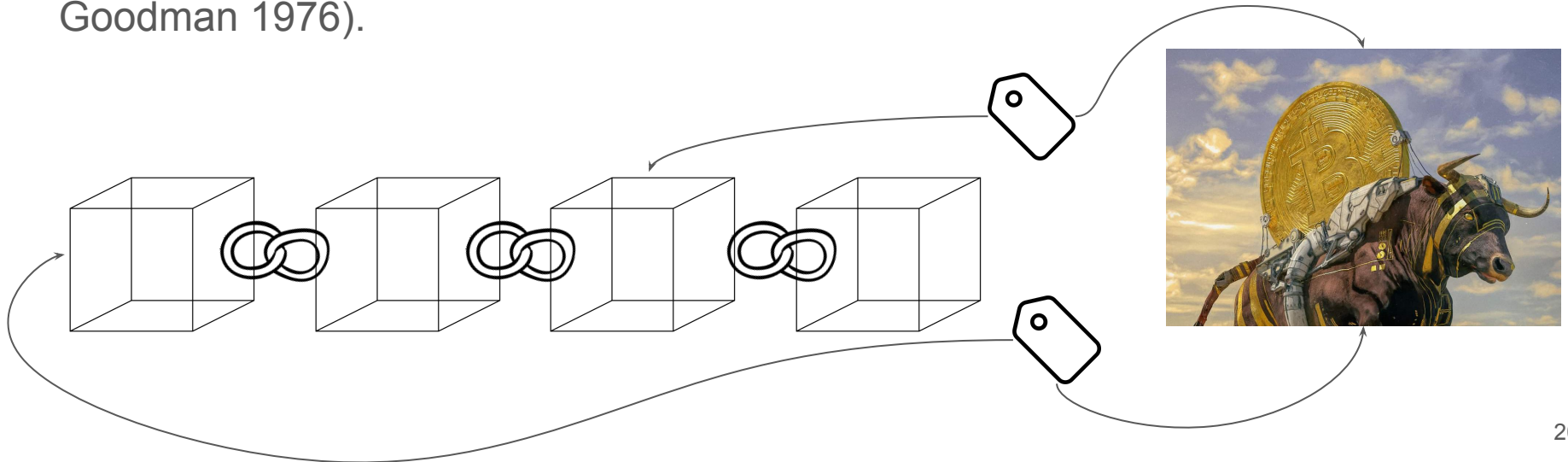
Can the Blockchain technology prevent the forgery of a digital artwork?

Second case: the artwork's author has never used the blockchain to create an NFT.

In this case is necessary to access the real world data to verify that the creator's address is the same of the person who sells the work.

External service can verify the identity of the person by checking the national identity card or passport (for example twitter shows a badge for all account of public interest to demonstrate that is authentic).

If the artwork's author has been identified by an external service, such as an NFT exchange, the buyer can be sure the authorship NFT is not a forgery.

Barack Obama

Barack Obama ✔
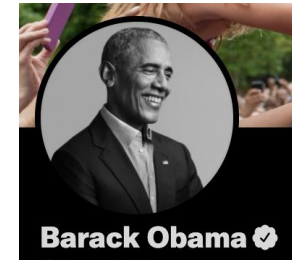
Can the Blockchain help the user to have a more correct estimate of the value of the artwork itself?

According to Gadamer (1960), the value of each human work is provided not very much by the work itself but rather by the (different) human interpretations and uses of the work itself.

We hypothesized that the non-physical artwork value depends on its history of effects, i.e. the net of valuable interactions that the original artwork spread within and outside the Blockchain in its lifespan.

History of effects: blockchain data

The price of NFTs can be predicted via some blockchain data:

- Copyright assignment to the owner. These NFTs are more valuable since the NFT owner is the only person authorized to expose the non-physical artwork in a public art exhibition .
- Tangibility. Some NFTs are tied to real-world objects, which give them value in terms of tangibility supported by the immutability of ownership/authorship.
- The Gas fee. That is the reward for the blockchain nodes to verify the transaction. A higher Gas fee means a bull market (Pierro et al. 2021)
- Fees to reward the authorship (usually 10% of NFT value exchanged).
- Historical stock price data of NFT with the same characteristics (Collectible Items).

History of effects: world data

There are many factors that can contribute to the history of a non-physical artwork:

- autorship reputation. An artwork by an already recognized artist has always more requests.
- Impact on the online communities. Before being sold as NFT, many artworks have a long history in the web community, that can be understood, for instance, via the number of views, downloads and citations (Disaster Girl, Nyan Cat, …).
- Effects on entertainment industry. Some NFTs can be used in games, like virtual lands, spells, or characters. This feature of NFTs gives them an added value, which accrues over time depending on the popularity of the underlying project.
- Art exhibition events. Recently, some art exhibition has shown NFTs in holographic form.
- Tangibility. Some NFTs are tied to real-world objects, which gives them value in terms of tangibility supported by the immutability of ownership/authorship.

Preliminary Results: Collectibles NFTs

In the short period of time (sep-nov 2021) we tested our model we saw that

- Collectibles NFT price with an history of over 2 months can be evaluated by using the time-weighted average price (TWAP) model.
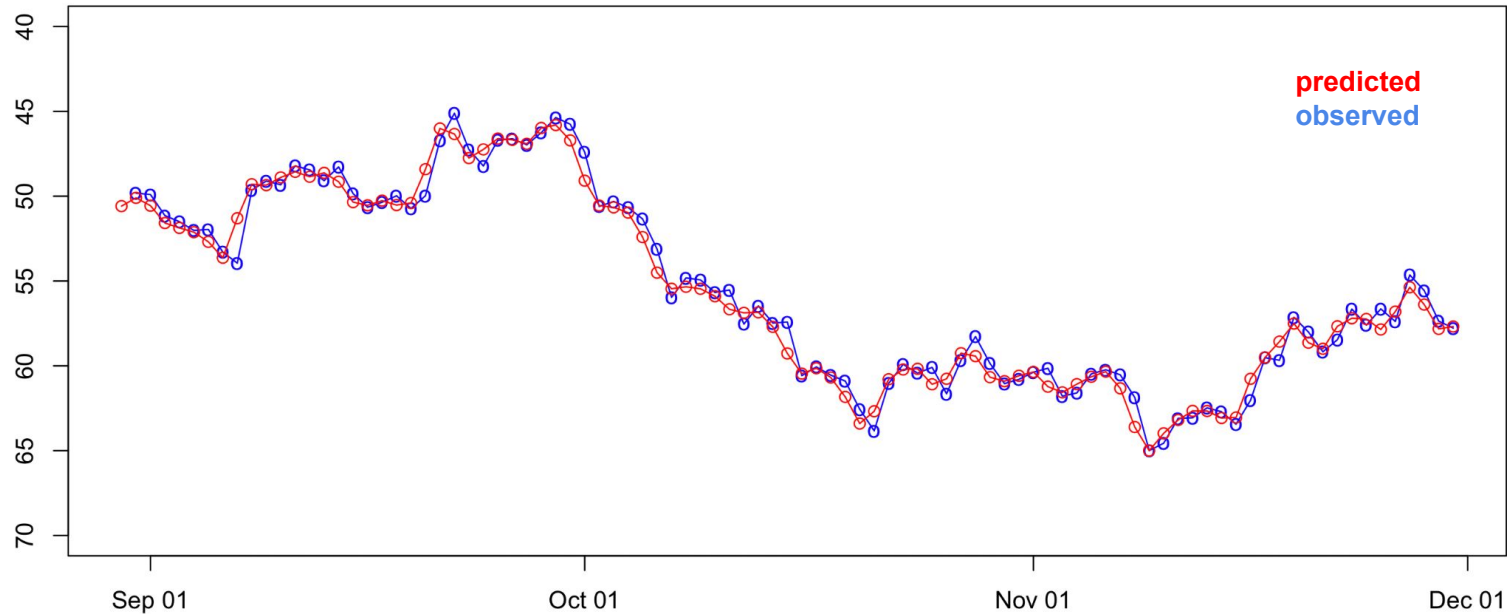
Future works

Recent research in the field of computational social science have shown how data coming from the widespread adoption and use of social media channels can be used to predict outcomes, such as movie revenues and election winners.

We might then predict the price of non-physical arts, such as "a Beeble", or a meme NFT, such as "Disaster Girl" or "Nyan Cat", by analyzing "social" data.

These NFTs had a long history before being sold as NFT by their creators:

- The "Nyan Cat" video has been ranked at number 5 on the list of most viewed YouTube videos in 2011.
- The "Disaster girl" photo has been published on educational material and has been widely shared from 2005 onward.

Conclusions

We proposed a model for an Oracle that can help to prevent that fake digital artworks are not paid as if they were original.

Our preliminary results suggest that the price of collectable NFTs with a price history of at least one month can be predicted by the model.

As a future work, on the basis of the history of effects and research in the field of computational social science, we might extend the model to predict the price of non-physical arts by analyzing "social" data.