

Object classification analysis



Consider artificial objects classified by two characteristics:

1. Reproducibility.
2. Distinguishability

I can think of three categories of objects depending on those characteristics:

Class 1. Hard to produce and reproduce, and distinguishable from each other - this basically corresponds to material objects such as a chair, which are hard to reproduce (they have to be built again) and can be distinguished from each other (given two chairs A and B, at a later time chair A is still chair A and chair B is still chair B).

Class 2. Hard to produce/reproduce but undistinguishable from each other - basically the property of energy, e.g. 1 Kwh is identical to another 1 Kwh, but if I want 2 Kwh I need to go through the production process again. It is not only about physical energy, e.g. money has the same property, \$1 is identical to another \$1, but if I want \$2 I need to put double the effort. Of course I mean "money" in the economy sense, not paper bills, which would be material and so belonging to class 1.

Class 3. Hard to produce but easy to reproduce and undistinguishable from each other - properties of information, e.g., it can take work to write a novel, but it is easy to copy it, and the copies are the same novel (as a story, the physical copies again would be class 1).

I would like to go deeper in the subject addressing the following issues:

1. Describe what I just said in a more rigorous way (it does not need to be long and very technical, just correctly explained). Are there appropriate terms to name those classes of objects?
2. Question: Is there a "class 4" of things that are easy to reproduce but distinguishable?

Feel free to propose also open questions for future discussion.

Below is a compact but rigorous formulation of your idea, followed by a discussion of whether a "Class 4" exists and some natural open questions.

1. A more rigorous formulation

Let us consider *artificial objects* as elements of a set X , each endowed with two independent attributes:

- **Reproducibility cost** $R(x)$: the effort, resources, or time required to create a new instance of x .
 - “Hard to reproduce” means $R(x)$ is high.
 - “Easy to reproduce” means $R(x)$ is negligible.
- **Distinguishability** $D(x)$: whether two instances x_1, x_2 can be told apart as *individuals* (not merely as types).
 - “Distinguishable” means that instances retain persistent identity markers.
 - “Indistinguishable” means that only the *type* matters, not its individual instantiation.

Under this interpretation:

Class 1: High reproduction cost + distinguishable instances

This corresponds to *material artifacts*.

Two chairs A and B remain distinct physical individuals; creating more requires labor and resources.

Existing terminology:

- *Rivalrous* in economics (only one person can use this chair).
- *Excludable* (ownership is restricted).
- *Individuated goods* in metaphysics.

Class 2: High reproduction cost + indistinguishable instances

This corresponds to *fungible commodities*.

A kilowatt-hour of electricity, a dollar, or a bushel of wheat is typically **fungible**: individual units do not matter, only quantity. Production still requires effort.

Appropriate terminology:

- *Fungible goods* (economics).
- *Homogeneous commodities*.
- *Extensive quantities* (physics).

Class 3: Low reproduction cost + indistinguishable instances

This corresponds to *information goods*.

Writing a novel or designing software has a high **creation cost**, but once created, copying it is nearly costless and all copies are equivalent at the informational level.

Appropriate terminology:

- *Non-rival goods* or *public goods* (economics).
- *Intangible informational artifacts*.
- *Digital goods with zero marginal cost*.

This class is well-studied in economics of information, intellectual property theory, and metaphysics of artifacts.

2. Is there a Class 4? (Easy to reproduce + distinguishable)

This is the interesting case. At first sight it seems paradoxical: if something is easy to reproduce, why should instances remain distinguishable?

But Class 4 *does* exist, though it is less common:

Examples of Class 4 objects

(a) Cryptographic keys / random identifiers

You can cheaply generate many keys, but each one is *unique* and must retain its identity.

Reproducibility: trivial (software generates keys instantly).

Distinguishability: required for functionality (a key is not interchangeable with another).

(b) Serial numbers, UUIDs, blockchain addresses

Again, cheap to produce, but each instance must be uniquely identifiable and is not fungible.

(c) NFTs (conceptually), if you ignore the underlying hype

Easy to create at negligible cost, but each is defined to be individually distinguishable.

(d) Some artworks in digital media

If an artist creates 10 numbered prints, copies *could* be indistinguishable, but the social/institutional system *assigns identity* to each print (Print #3 is not Print #7).

Reproduction cost: low (digital printing).

Distinguishability: deliberately imposed.

(e) Data logs

Each log line is cheaply generated, but is a unique historical record.

3. How to characterize Class 4 rigorously

Class 4 corresponds to:

- **Low reproduction cost:** $R(x)$ is negligible.
- **High distinguishability:** objects retain persistent identity $ID(x)$ not eliminated by copying.

Mathematically, these are objects where identity is **not determined by content**, but by:

- provenance,
- creation timestamp,
- institutional assignment,
- cryptographic randomness,
- serial number.

They are *tokens* that remain unique even when structurally identical.

Terminological candidates:

- *Non-fungible low-marginal-cost goods*
- *Distinguishable digital artifacts*
- *Individuated informational tokens*

None are standard, but these would be accurate.

4. Open questions for future discussion

(1) What determines “identity” in a digital object?

Two files with identical bits are informationally identical—yet digital signatures, timestamps, or metadata can individuate them. Where exactly does identity reside?

(2) Are distinguishability and ownership culturally constructed?

Money used to be distinguishable (gold coins with unique mint marks). Today digital dollars are fungible by social convention, not physical necessity.

(3) How does AI-generated content fit into this taxonomy?

When production cost approaches zero even for creative works, Class 3 might collapse or need subdivision.

(4) Can information ever be truly “non-fungible”?

Copying destroys scarcity. Attempts to create distinguishable digital objects (NFTs) rely on social or cryptographic layers, not physical ones.

(5) Should we add a third axis: *degradability* or *persistence*?

Objects differ not only in reproduction and identity, but in whether they decay over time (chairs do, digital files don't unless intentionally deleted).

Summary

Class	Reproduction cost	Distinguishability	Examples	Standard term
1	Hard	Distinguishable	Chairs, physical goods	Rivalrous goods
2	Hard	Indistinguishable	Energy, money, commodities	Fungible goods
3	Easy	Indistinguishable	Novels, software, data	Information goods
4	Easy	Distinguishable	Cryptographic keys, UUIDs, digital signatures	Individuated informational tokens (conceptually)

Class 4 exists and is important in cryptography, databases, and digital identity systems.

If you'd like, we can refine the classification further, turn it into a compact research note, or explore how this taxonomy interacts with copyright, blockchain, or metaphysics of identity.



Yes to all. Can you also produce an essay for public distribution? It should be easy to read, not a super-technical essay.

Below is an essay-style version written for a general audience. It keeps the ideas clear, intuitive, and approachable, while still conveying the conceptual depth of your classification.

Four Kinds of Artificial Things: A Simple Guide to Reproducibility, Uniqueness, and the Nature of What We Make

We live in a world filled with things humans create—chairs, novels, money, computer files, artworks, electricity, digital tokens, and more. These objects differ wildly, yet we often talk about them as if they all belonged to the same broad category of “stuff.” But if we look more closely, we can sort artificial objects into natural classes based on only two ideas:

1. How hard is it to reproduce the object?
2. Are individual instances of it distinguishable from one another?

This simple pairing leads to a surprisingly elegant four-class system that helps explain how physical goods, energy, money, and information behave—and why modern digital artifacts don't quite fit traditional categories.

Let's walk through the four kinds.

Class 1: Hard to reproduce, and individually distinguishable

Examples: a chair, a sculpture, a physical book, a house.

These are the familiar material objects around us. If you want a second chair just like the first one, you must build it again—there's no shortcut. And each chair is a unique individual: the one in your living room is not the one at the store.

Economists would call these *rival goods*: only one person can own or use a given instance.

Class 2: Hard to reproduce, but indistinguishable

Examples: kilowatt-hours of electricity, dollars in a bank account, liters of gasoline.

Here the *quantity* matters, not the individual units. One kilowatt-hour is the same as any other. One dollar is the same as any other dollar. You still have to produce them—electricity requires generation, money requires economic activity—but once produced, no one cares which particular unit you have.

Economists call these *fungible goods*. They are interchangeable by design.

Class 3: Easy to reproduce, and indistinguishable

Examples: novels, software, digital music, scientific formulas.

A novel might take years to write, but once written, every copy contains the same story. Producing the *first* one is expensive; producing the *second* one costs nearly nothing. This is why copyright exists: without some artificial protection, creators couldn't recoup the cost of producing the first copy.

These are *information goods*: they can be copied endlessly, and each copy is as good as the original.

Class 4: Easy to reproduce, but individually distinguishable

Examples: cryptographic keys, UUIDs, blockchain addresses, individually numbered prints.

This class is the least intuitive, but it absolutely exists in the digital world.

A computer can generate millions of unique cryptographic keys in seconds. Each key is easy to make, yet each is unique and cannot be swapped with another. The whole system depends on their individuality.

You can think of Class 4 objects as having *identity without substance*. They are not valuable because of what they contain, but because of their uniqueness and the rules built around them.

Even some art fits here: when an artist produces 50 “signed and numbered prints,” the prints may be physically identical, but Print #17 is still not Print #3. Their individuality is socially assigned.

Class 4 becomes increasingly important in modern technology—digital authentication, blockchain, distributed systems, even online voting.

Why does this classification matter?

This four-class view clarifies a number of modern puzzles:

Why do physical goods require property law?

Because Class 1 goods are unique and hard to reproduce.

Why can't you copyright energy or money?

Class 2 goods are indistinguishable; there is no "instance" to protect.

Why does copying digital information cause legal complications?

Class 3 goods are naturally non-scarce; the law must artificially impose scarcity through copyright.

Why are NFTs and cryptographic keys hard to explain?

Because they belong to Class 4: objects that are both trivially reproducible and yet meaningful only if treated as unique.

This classification helps us see where intuitive notions of ownership, value, identity, and scarcity come from—and why digital technology keeps forcing us to rethink them.

Open questions worth exploring

Here are a few natural follow-ups:

1. Where does the "identity" of a digital object come from?

Two files with identical bits are the same as information, but may have different identities in practice (different timestamps, creators, or cryptographic signatures).

2. Should we treat information as property at all?

Class 3 goods challenge our old models of ownership, since perfect copying makes scarcity unnatural.

3. Are NFTs and similar digital artifacts genuinely "unique," or only socially declared to be?

Class 4 goods sit on the boundary between technology, economics, and sociology.

4. Does this classification change as AI makes creation itself nearly costless?

If both *creation* and *reproduction* become easy, Class 3 may split into new subclasses.

Conclusion

With only two simple ideas—reproducibility and distinguishability—we can divide the world of artificial objects into four natural kinds. Doing so makes clear why chairs, money, energy, novels, cryptographic keys, and NFTs all behave so differently, even though they all ultimately come from human ingenuity.

This framework is easy to understand yet deep enough to raise interesting questions about economics, identity, digital technology, and intellectual property. And as we create ever more digital artifacts, Class 4 in particular will likely play a growing role in how we understand value and uniqueness in the digital age.

If you'd like, I can help produce a shorter op-ed version, a more philosophical version, or even a graphical schema for presentations.



Just give me the LaTeX source for a document with the essay you just made.

Here is the **complete LaTeX source** for a clean, standalone document containing the essay.

It uses only standard packages, so it should compile on any LaTeX system.

```
latex

\documentclass[12pt]{article}

\usepackage{lmodern}
\usepackage{setspace}
\usepackage{geometry}
\usepackage{hyperref}

\geometry{margin=1in}
\setstretch{1.15}

\title{Four Kinds of Artificial Things:\\
A Simple Guide to Reproducibility, Uniqueness, and What We Make}
\author{}
\date{}

\begin{document}

\maketitle
```

\section*{Introduction}

We live in a world filled with things humans create---chairs, novels, money, computer files, artworks, electricity, digital tokens, and more. These objects differ wildly, yet we often talk about them as if they all belonged to the same broad category of ``stuff.'' But if we look more closely, we can sort artificial objects into natural classes based on two simple ideas:

```
\begin{enumerate}
    \item How hard is it to reproduce the object?
    \item Are individual instances distinguishable from one another?
\end{enumerate}
```

This pairing leads to a surprisingly elegant four-class system that helps explain how physical goods, energy, money, and information behave, and why modern digital artifacts do not fit traditional categories.

\section*{Class 1: Hard to Reproduce and Individually Distinguishable}

Examples: a chair, a sculpture, a physical book, a house.

These are the familiar material objects around us. If you want a second chair just like the first one, you must build it again---there is no shortcut. And each chair is a unique individual: the one in your living room is not the one at the store.

Economists call these **rival goods**: only one person can own or use a given instance.

\section*{Class 2: Hard to Reproduce but Indistinguishable}

Examples: kilowatt-hours of electricity, dollars in a bank account, liters of gasoline.

Here the **quantity** matters, not the individual units. One kilowatt-hour is the same as any other. One dollar is the same as any other dollar. You still have to produce them---electricity requires generation, money requires economic activity---but once produced, no one cares which particular unit you have.

Economists call these **fungible goods**. They are interchangeable by design.

\section*{Class 3: Easy to Reproduce and Indistinguishable}

Examples: novels, software, digital music, scientific formulas.

A novel might take years to write, but once written, every copy contains the same story. Producing the first copy is expensive; producing the second one costs nearly nothing. This is why copyright exists: without some artificial protection, creators could not recoup the cost of the initial work.

These are **information goods**: they can be copied endlessly, and each copy is as good as the original.

\section*{Class 4: Easy to Reproduce but Individually Distinguishable}

Examples: cryptographic keys, UUIDs, blockchain addresses, individually numbered prints.

This class is less intuitive, but it definitely exists in the digital world.

A computer can generate millions of unique cryptographic keys in seconds. Each key is easy to make, yet each is unique and cannot be interchanged with another. The value comes from the individuality, not from physical substance.

Some art fits here as well: when an artist produces 50 ``signed and numbered'' prints, the prints may be physically identical, but Print^{#17} is still not Print^{#3}. Their individuality is socially assigned.

Class~4 is increasingly important in modern technology---digital authentication, blockchain, distributed systems, and online identity.

\section*{Why This Classification Matters}

This four-class view clarifies a number of modern puzzles:

```
\begin{itemize}
    \item \textbf{Why do physical goods require property law?} Because Class~1 goods are unique and hard to reproduce.
    \item \textbf{Why can't you copyright energy or money?} Class~2 goods are indistinguishable; there is no ``instance'' to protect.
    \item \textbf{Why does copying digital information cause legal complications?} Class~3 goods are naturally non-scarce, so the law must artificially impose scarcity.
    \item \textbf{Why are NFTs and cryptographic keys hard to explain?} Because they belong to Class~4: trivially reproducible yet meaningful only if treated as unique.
\end{itemize}
```

This classification helps us understand where notions of ownership, value, identity, and scarcity come from---and why digital technology forces us to rethink them.

\section*{Open Questions}

A few natural follow-up questions emerge:

```
\begin{enumerate}
    \item Where does the ``identity'' of a digital object come from?
    \item Should information be treated as property at all?
    \item Are NFTs genuinely ``unique,'' or only declared to be unique?
    \item How does this system change as AI reduces the cost of creation itself?
\end{enumerate}
```

These questions sit at the intersection of philosophy, economics, and technology.

\section*{Conclusion}

With only two simple ideas---reproducibility and distinguishability---we can divide artificial objects into four natural kinds. This makes clear why chairs, money, energy, novels, cryptographic keys, and NFTs all behave so differently, even though they all ultimately come from human ingenuity.

As digital technology advances, Class~4 in particular will play a growing role in how we understand value and uniqueness in a world where copying has virtually no cost.

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\end{document}
```

If you'd like, I can also create:

- a more formal academic-style version,
- a version with diagrams or tables,
- a shorter version suitable for a blog post or conference handout.