UNIVERSITY *of* NICOSIA

Session 1

Course Overview

META-511: Non-Fungible Tokens (NFTs) and the Metaverse

The course will combine reading material, live sessions and guests

o The course will run for **12 weeks**

o Each week there will be a **presentation**, which will include further reading material, a **live session** in the MetaCampus with the course instructors, and **one or more guest lecturers or panels**

o **All material will be recorded** and available to watch on-demand for those who cannot attend a live session (some guest lectures will be on-demand only)

o At the end of the course, your intended pathway will determine your form of assessment:

• Students who are pursuing an MSc at the University of Nicosia will need to take a qualitative assessment

• Students who simply would like a professional certificate will have to pass an online multiple-choice examination with a score of 60%+

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

2

Meet our team

Punk 6529
COURSE INSTRUCTOR

🐦 @punk6529
🎮 6529#4247

Dr George Giaglis
Professor, UNIC
COURSE INSTRUCTOR

🐦 @giaglis
🎮 George Giaglis#0515

Dr Klitos Christodoulou
Assistant Professor, UNIC

🐦 @klitoschr
🎮 _kl1t0s#8161

Dr Leonidas Katelaris
Post-Doctoral Researcher, UNIC

🐦 @katelarisL
🎮 katelarisl#9464

Noone0x
Teaching Assistant

🐦 @phon_ro
🎮 NooNe0x#1627

Manos Papangelou
Researcher, UNIC

🐦 @manos_pgl
🎮 manos-pgl.eth#9723

Lambis Dionysopoulos
Research Officer, UNIC

🐦 @lambisdion
🎮 LMBD#9070

Valentinos Theofilou
Project Officer, UNIC

🐦 @VTheofilou
🎮 VT#3384

Jakub Houser
Teaching Assistant, UNIC

🐦 @enkidub
🎮 Jakub Houser#8024

Aliki Ntouzgou
Research Assistant, UNIC

🐦 @ANtouzgou
🎮 AlikiNt#4481

Katerina Ramoutsaki
Community Manager, UNIC

🐦 @katerinaramm1
🎮 katerinaramm#7862

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

Largest English-speaking university in Southern Europe, top 3% globally

Source: Times Higher Education World University Rankings 2022

UNIC has always been a global pioneer in crypto

- First university in the world to accept Bitcoin for tuition and launch a crypto course
  - Free MOOC **Introduction to Digital Currencies** (2013), more than 80,000 students to date

- First to offer a full academic degree in the area
  - **MSc in Blockchain and Digital Currency** (2014)

- First to issue blockchain-verifiable certificates (2015 on Bitcoin, 2021 as Ethereum NFTs)

- Largest dedicated crypto team in academia (**Institute for the Future**)
  - Advisors to the European Commission, European Central Bank and many crypto projects

- **First university in the Metaverse**
  - First to launch an on-chain / in-metaverse course, in partnership with Punk 6529 (2022)
  - We aim to launch a full **MSc in Metaverse Systems** in 2023

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

5

A new learning experience for everybody

This is the first university course to be held on-chain and in-metaverse

This will be a learning experience for all. We expect some hiccups at the beginning of the course and are aiming to build the course and experience together with you, as we learn more, about what works well.

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

6

Make sure you use the most of your equipment

o Many expensive laptops have both an "integrated" graphics card and a dedicated graphics card

o Most laptops are set by default to use the integrated card for the web browser to conserve battery life

o You will get much better graphic performance in OM and with many generative art collections if you override this setting and use your dedicated GPU with your browser

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

7

You can use our work with attribution

- We are releasing the weekly course presentations under the **Creative Commons Attribution 4.0 International License**

- This means you are free to reuse the presentation materials so long as you attribute back to the University of Nicosia

- Please keep in mind that the presentations may contain intellectual property of other parties that is NOT released under this license
  - For example, the presentations may include NFTs for illustrative purposes
  - The University of Nicosia is not releasing the intellectual property of others under this license

- **All course presentations will be available on the University of Nicosia Github account and will be minted as NFTs**

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

8

This is an educational course only

o We will discuss various projects, individuals or NFTs in this course

o These projects, tokens or the individuals associated with them, are only referenced for educational purposes

o Nothing in this course should be taken as a recommendation to buy or sell an NFT or token or any other financial instrument or security

o More generally, cryptoassets are extraordinarily volatile investments. Please take care if you are buying cryptoassets

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

9

We are here

Week 1 ⟶

1. What is an NFT?
2. Copyright and provenance in NFTs
3. PFP NFTs
4. Art NFTs
5. Generative art
6. Key considerations in the NFT space
7. Gaming NFTs
8. What is a metaverse?
9. Trends in visualization technology
10. Financing models for NFTs and the metaverse
11. Off-chain objects and the broader environment
12. A vision for the future

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

10

UNIVERSITY *of* NICOSIA

Session 1

What is an NFT?

META-511: Non-Fungible Tokens (NFTs) and the Metaverse

Today's goal is to have a common language about NFTs

Technical Overview: Professor Giaglis

o Define Non-Fungible Tokens (NFTs)

o Discuss NFT standards on the Ethereum blockchain (ERC-721, ERC-1155)

General Overview: Punk 6529

o Explore types of NFTs

o Identify NFT uses

o Discuss examples of NFT collections

o Explore the NFT market size and structure
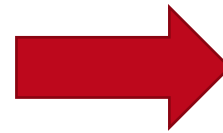
Today's material will be very straightforward for some students and very new for others.

The goal is to level set everyone on core definitional items today so that everyone can benefit from the future sessions and guest lectures

Session 1: What is an NFT?

1. Technical primer

A second-generation blockchain, capable of running applications

o **Bitcoin** is the archetypal first-generation blockchain

- Open, public & permissionless network

- Single-use: the Bitcoin blockchain secures the Bitcoin cryptocurrency (token) only

o **Ethereum** is a second-generation blockchain network

- Like Bitcoin, it is also an open, public and permissionless blockchain

- It also has its own (native) token, called Ether

o However, unlike Bitcoin, **all types of applications can be programmed and deployed on the Ethereum blockchain**

- Think of Ethereum as **the Internet of decentralized applications (dApps)**: a large global network of computers that **can run any application without the need for third-party service providers & platform owners** (like Google, Amazon, or Facebook/Meta)

Note: NFTs can be implemented on many blockchains – to avoid unnecessary complexity, we will limit our discussion here on Ethereum, which is currently the largest blockchain supporting NFTs. If you are interested in learning more about blockchains and crypto in general, please follow UNIC's free online course "Introduction to Digital Currencies" (https://www.unic.ac.cy/blockchain/free-mooc/)

Ethereum runs smart contracts

o Smart contracts are **immutable computer programs** that run deterministically on the Ethereum blockchain.

o **Immutability** is a novel and very powerful characteristic, the importance of which cannot be overstated:

   once deployed, the code of a smart contract cannot change or be stopped.

   • Unlike traditional software, the only way to modify a smart contract is to deploy a new instance.

o **The promise of smart contracts on open blockchains is nothing short of revolutionary**: in theory, every interaction between parties, which can be automated, can be programmed in a smart contract and be trusted to run as programmed, without intermediaries or censorship

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Ethereum is a multi-token network

o Like Bitcoin, Ethereum features its own native currency/token, called **Ether**

- Ether is the second largest cryptocurrency by market capitalization today

o However, unlike Bitcoin, Ethereum can also support the creation of additional tokens

- Some of these additional tokens are **fungible (ERC-20 tokens)**, while others are not **(ERC-721, ERC-1155 i.e., Non-Fungible Tokens – NFTs**)
- Fungible tokens (of the same type) are interchangeable. In other words, an ERC-20 token is of equal value to any other ERC20 token.
- NFTs are not generally interchangeable at the same value. In other words, one Cryptopunk may have significantly different market value from other tokens in the same collection (i.e., other Cryptopunks).
- You can think of NFTs as unique tokens

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

16

Ethereum tokens are governed by ERC standards

o **ERC-20:** Token Standard (2015)

- The most widely used standard for fungible tokens on the Ethereum blockchain

o **ERC-721:** Non-Fungible Token Standard (2018)

- The most widely used standard for NFTs on the Ethereum blockchain

o **ERC-1155:** Multi Token Standard (2018)

- A standard interface for smart contracts that manage multiple token types.

- A single deployed contract may include any combination of fungible tokens, non-fungible tokens or other configurations (e.g., semi-fungible tokens)

Note: ERC stands for "Ethereum Request for Comment". You can find a list of all ERC standards at https://eips.ethereum.org/erc.

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

17

ERC-20 Tokens Are Fungible Tokens On The Ethereum Network

ERC-20 tokens are used primarily for financial applications and are outside the scope of this course

If you are interested in Decentralized Finance, UNIC offers a dedicated free online course on the subject: **https://www.unic.ac.cy/blockchain/free-defi-mooc/**

18

ERC-721 is Ethereum's most popular NFT standard

o ERC-721 allows for the implementation of a standard API for NFTs within Ethereum smart contracts.

o The standard provides basic functionality to track and transfer NFTs.

o ERC-721 tokens are created by writing code in a smart contract programming language, like Solidity.

o In practice, most NFT collections today will be created through service providers and will require little or even no programming to create the token.

APIs (Application Programming Interfaces) define how computer applications communicate with each other, often using requests and responses

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

19

ERC-1155 is Ethereum's multi-token standard

o **ERC-1155** implements a standard interface for contracts that manage multiple token types.

- ERC-20 requires deployment of separate contracts per token type.

- ERC-721 groups a collection of non-fungible tokens in a single contract, with settings for the entire collection.

- In contrast, ERC-1155 allows for each token ID within a collection to represent a new configurable token type, which may have its own metadata, supply and other attributes.

o In other words, the innovation of ERC-1155 is that **multiple tokens can co-exist in the same smart contract** and can be managed together

- New functionality is possible, such as transferring multiple token types at once, thus saving on transaction costs.

- Trading of multiple tokens is also supported, thus removing the need to approve individual token contracts separately.

- Such functionality is particularly helpful, for example, in gaming applications, which may combine fungible and non-fungible items (e.g., currency and swords).

o Despite its flexibility, ERC-1155 is less popular in art applications than ERC-721, though it is expected to be popular in some gaming and other more complex applications

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

20

Different standards for different applications

	ERC-721	ERC-1155
Scope	Tokenize unique individual assets	Combine multiple token types
Fungibility	NFT only	FT, NFT, SFT
Application focus	Collectibles, art, digital assets, tokenized real-world assets	Gaming, complex applications involving multiple assets
Advantages	Standardizes how unique assets are securely stored and managed on the blockchain	Saves on computational burden by reducing the approval steps needed to transfer multiple tokens in a single transaction
Disadvantages	Tokens are indivisible. NFTs cannot be combined with fungible tokens.	The standard is not backward compatible, so it cannot handle ERC-20 or ERC-721 implementations
Gas consumption	Slightly lower, compared to ERC-20	Lower for transaction involving multiple token types in a batch transfer

Source: adapted from https://micobo.medium.com/security-tokens-an-erc-standards-comparison-919e7c379f37

Each token points to a URL with the information about the NFT

In most cases, due to the expense of storing data on a blockchain, the image of the NFT is not stored on the blockchain. Instead, just a "pointer" to the image is stored on the blockchain.

Where is the metadata?
(description, attributes, image, etc.)

| Token | → | URI (URL) | → | Decentralized Storage

OR

Centralized Server |

URI (Uniform Resource Identifier) uniquely identifies a resource by using data like name, location, etc. URL (Uniform Resource Locator) identifies the web address of a unique resource

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

22

IPFS and Arweave are the leading decentralized storage networks

o <u>IPFS</u> (InterPlanetary File System)

- Distributed storage protocol that allows the storage and distribution of uniquely identifiable files as part of a global peer-to-peer network

- Every computer in the world can choose to "pin" (host) and distribute any files they choose via downloading the IPFS software

o <u>Arweave</u>

- A distributed storage protocol with a different design philosophy

- The hosts are paid upfront for permanent storage under the theory that the cost of storage will drop fast enough over time to allow the upfront payment to cover the storage costs forever

In the NFT field, both IPFS and Arweave are considered good solutions for decentralized storage vs a centralized server

Source: 1.<u>IPFS</u>, 2. <u>Arweave</u>

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

23

Natively on-chain

o On-chain storage refers to the actual saving of the asset on the blockchain itself

o Projects that store all asset files on-chain are called "**natively on-chain**", as all the information associated with an NFT is stored on the blockchain (metadata and the actual asset)

o Saving the asset on-chain preserves all the first order features of the blockchain:

- Immutable
- Decentralized
- No single-point of failure, etc.

o This is only feasible / cost-effective for artwork that can be described in code.

o In other words, this is a popular design choice in generative art, but economically / technically infeasible for photography or videography
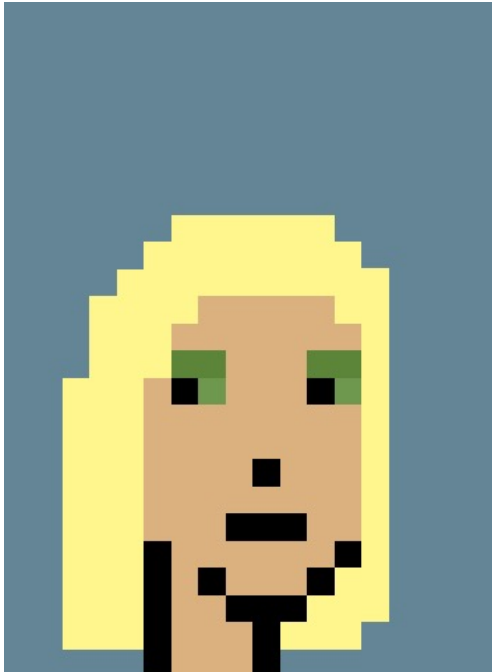
Source: 1.IPFS, 2. Arweave wiki

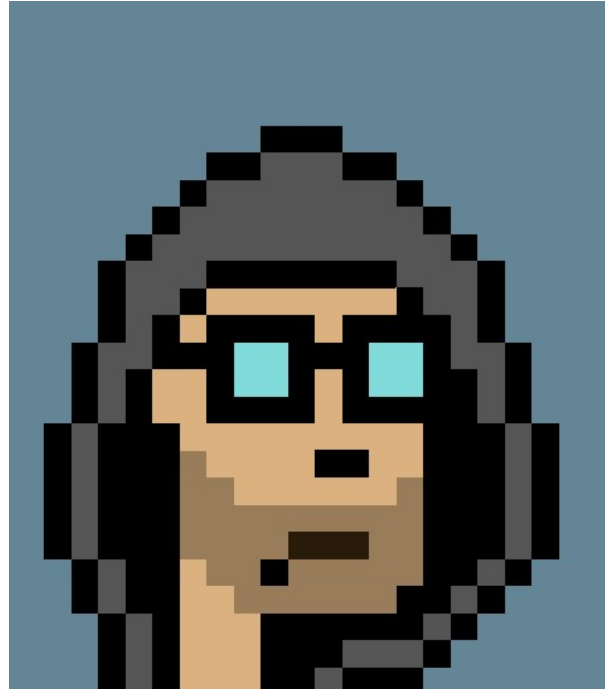UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Session 1: What is an NFT?

2. What Are NFTs?

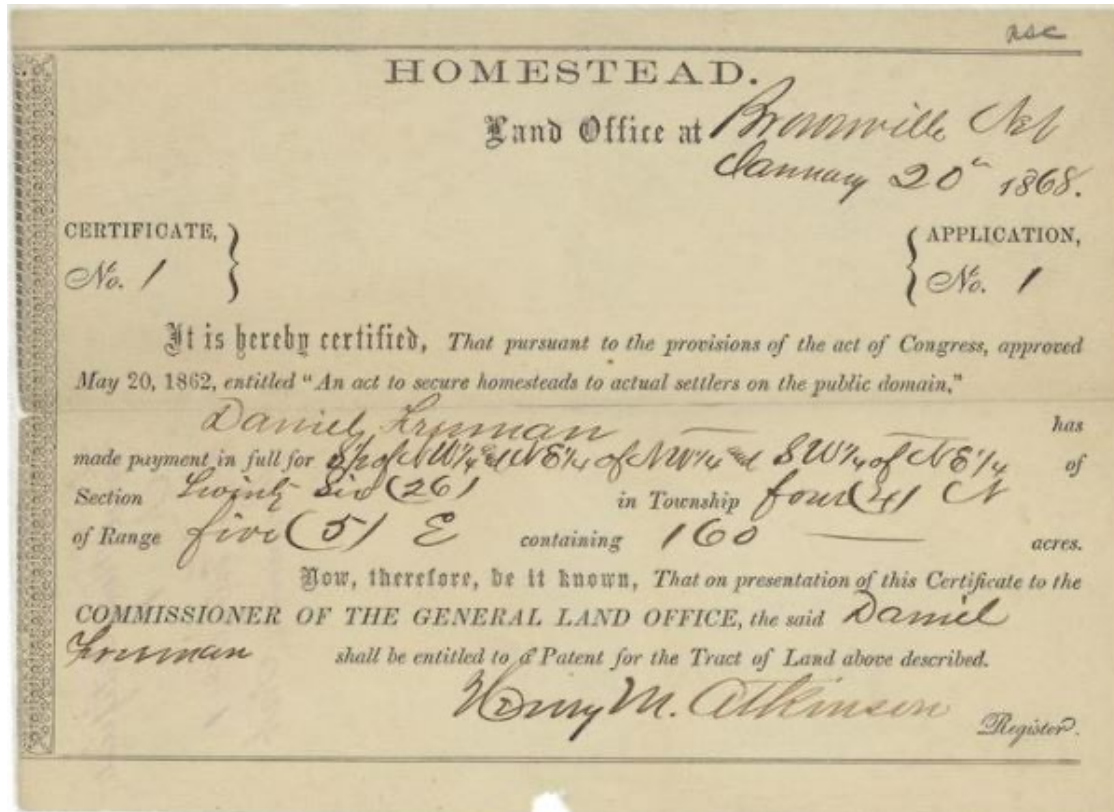# NFTs are a trivially simple idea (numbered tokens)…

CryptoPunk #6528

CryptoPunk #6529

CryptoPunk #6530

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

26
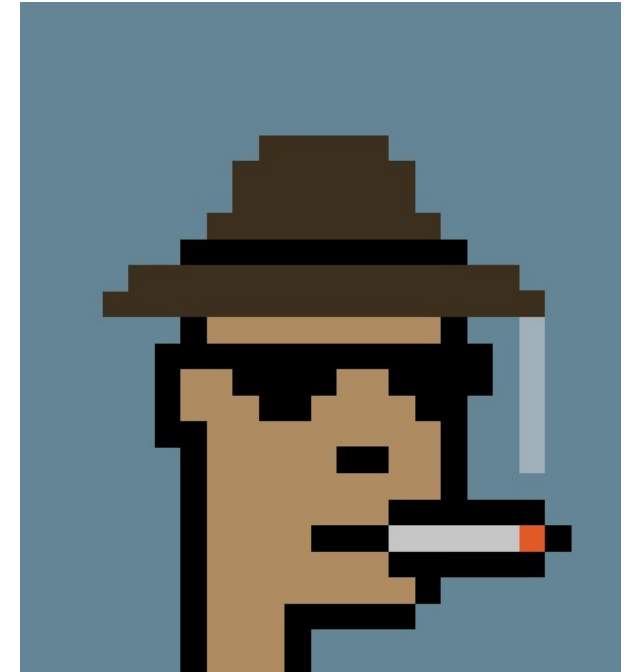
…plus a social convention analogous to a title deed…

**Homestead Entry Number 1, Brownsfield,
Nebraska Land Office, for Daniel Freeman, January 20, 1868.**

- This title deed is not a piece of land, but a pointer to a piece of land.
- When we buy and sell land, we do not buy and sell the land itself.
- We buy and sell the pointer to the land.

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

27

…in a global, digital, programmable, interoperable environment

Permissionless, programmable internet native money

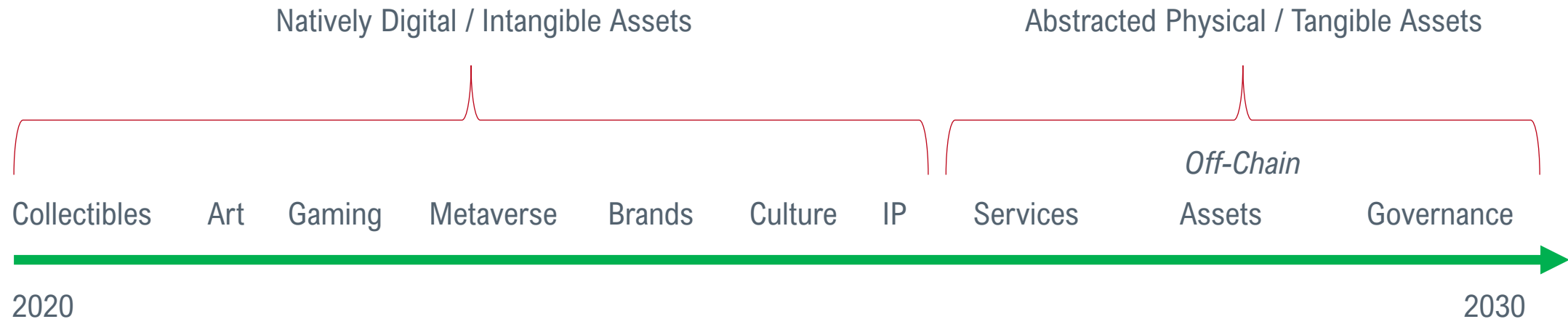Permissionless, programmable internet native financial instruments

ERC-721

Permissionless, programmable internet native **everything else**

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

NFTs are a standards-based, interoperable technology for direct internet-native ownership of intangible assets

The Adoption Pathway of NFTs

Natively Digital / Intangible Assets

Abstracted Physical / Tangible Assets

Off-Chain

| Collectibles | Art | Gaming | Metaverse | Brands | Culture | IP | Services | Assets | Governance |

2020   2030
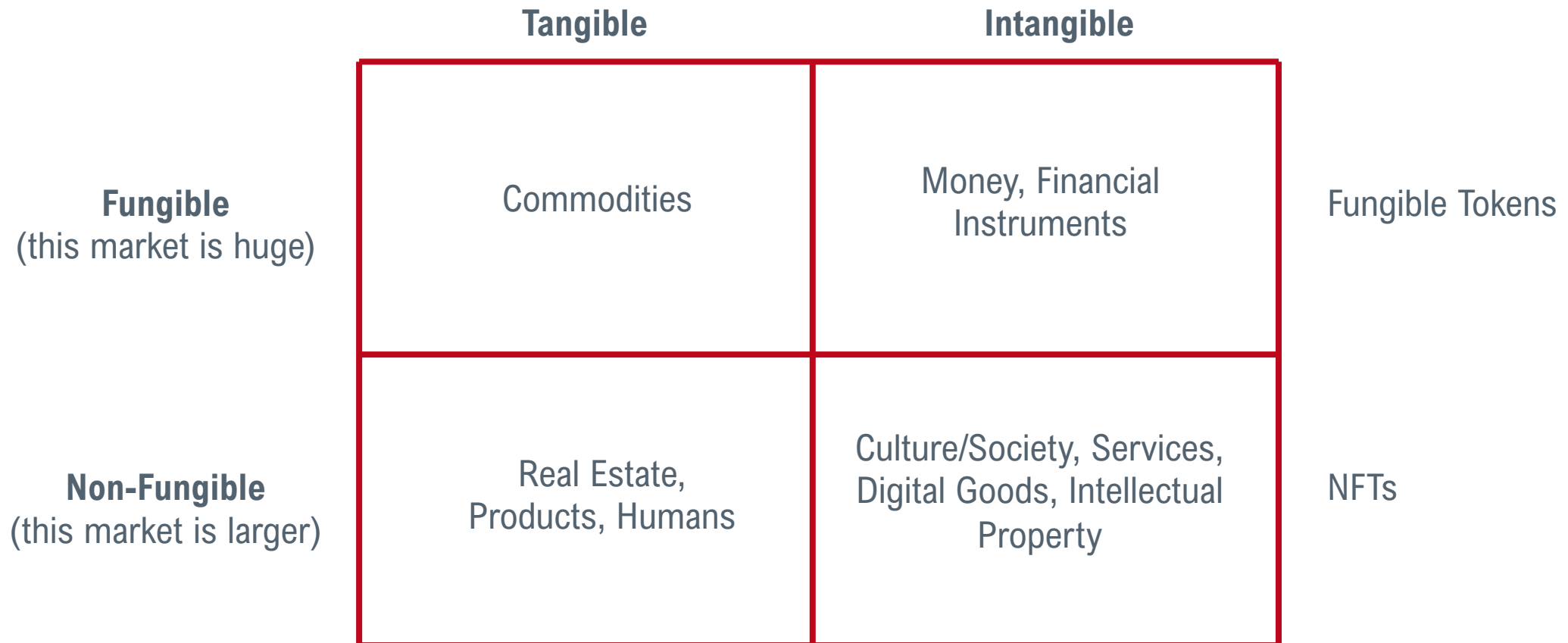
- >$75 trillion existing stock of intangibles
- The only "public commons" open database for the metaverse

- Physical world assets & services
- Needs regulatory bridges so will take some time

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

29

A mental model

	Tangible	**Intangible**	
Fungible (this market is huge)	Commodities	Money, Financial Instruments	Fungible Tokens
Non-Fungible (this market is larger)	Real Estate, Products, Humans	Culture/Society, Services, Digital Goods, Intellectual Property	NFTs

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

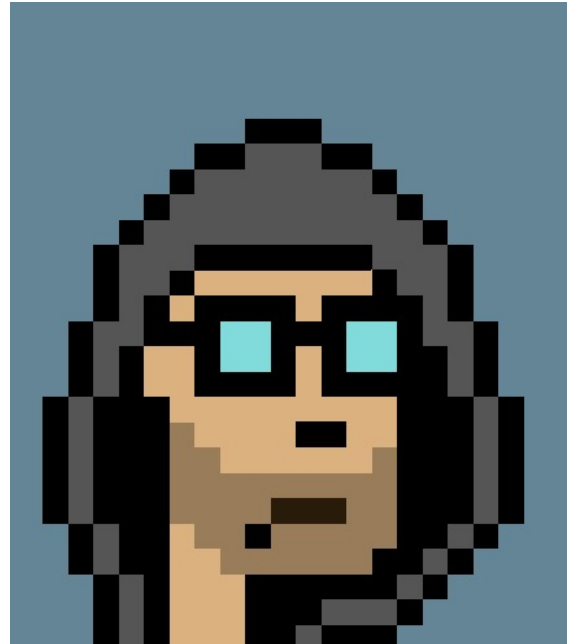## Another mental model. Intangible objects are the apex objects of societies

o I often say "Memes are the most important thing in the world"

o What do I mean? I mean that memes are Yuval Harari-style "intersubjective myths"

o In other words, stories (and implied values) that are commonly believed among groups of people

o Elections, politics, culture, brands, consumer behavior and the cash-flows from these activities are derivatives of the most powerful memes in society at any given point in time

o From "Just Do It" to "Digital Gold" to "Make America Great Again", those who control the best memes, control societal resources

o NFTs are meme-transport, ownership and financialization technology. It is, for me, the most fascinating development in technology and culture right now by a wide margin.

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain
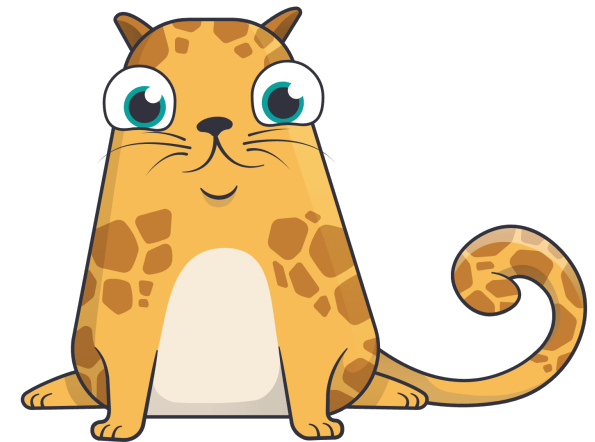
31

Successful early NFT collections had a collectible / gaming flavor

Nakamoto Rare Pepe
(Sept 2016)

CryptoPunk 6529
(June 2017)

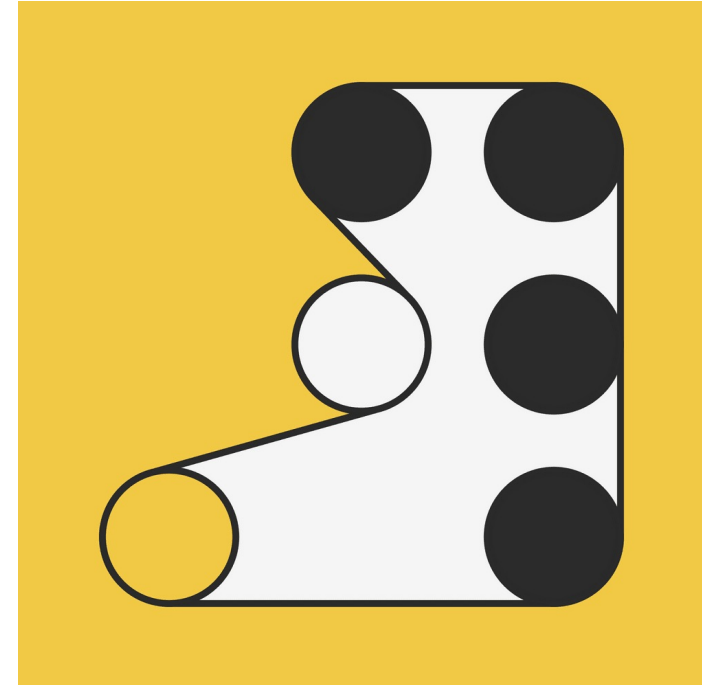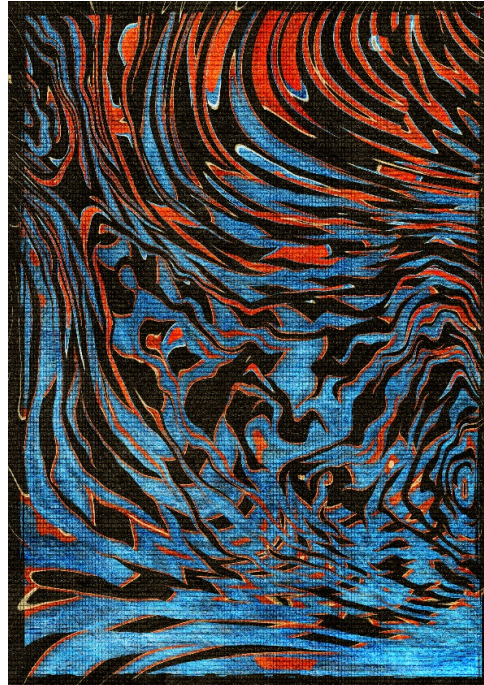Founder Cryptokitty 28
(November 2017)

PFPs (Profile Pictures) are the largest market category today

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

33

On-chain generative art is the largest art category in NFTs

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

34

1 of 1 art is an NFT category that most people would think of as "art"

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Gaming NFTs and metaverse land are expected to grow in impact

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

36
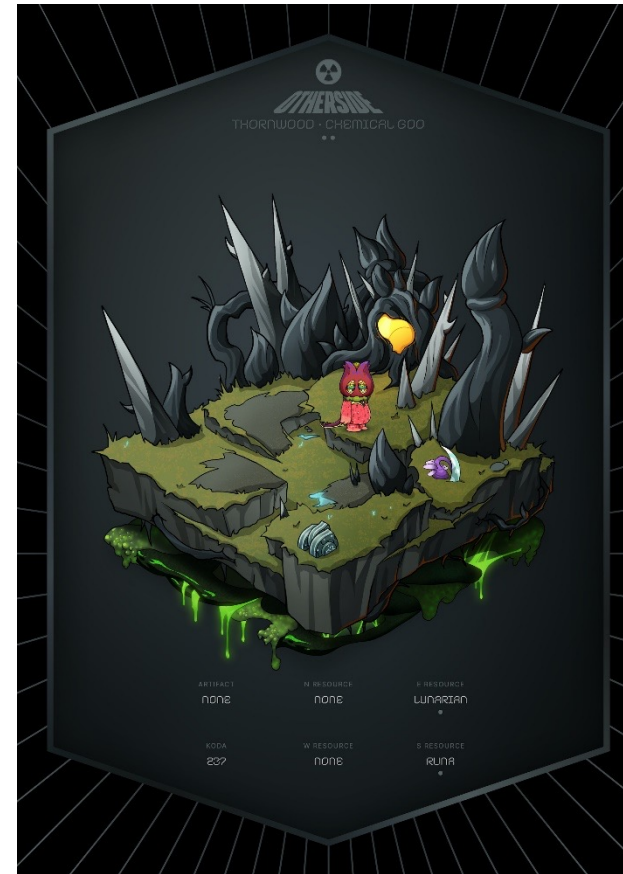
Utility based NFTs, like domain names and access passes are mostly unexplored
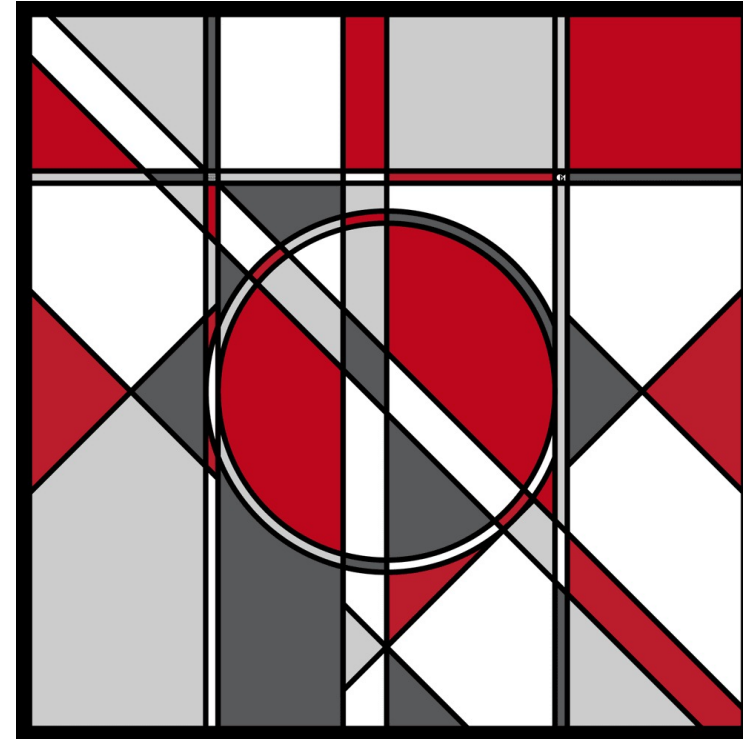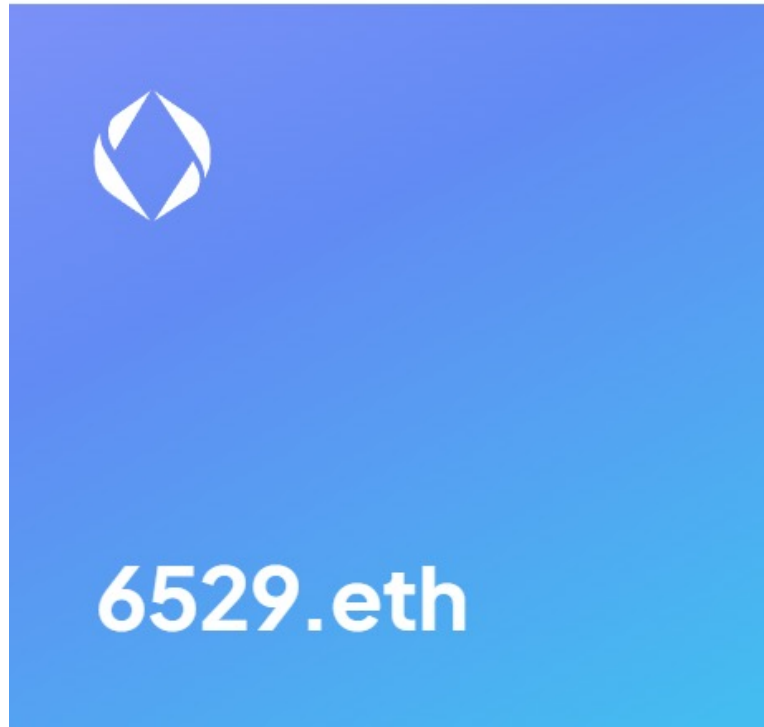
UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

37

This area is almost completely unexplored
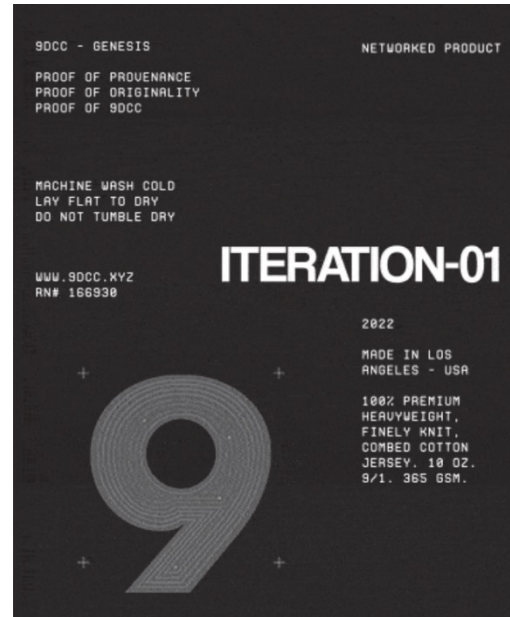
9DCC Tokenized T-Shirts

- Unlike purely digital objects, tokenized physical objects, whether t-shirts or houses have counterparty risk
- In other words, there must be a mechanism, private or public, to enforce the delivery of the physical good along with the NFT
- These "bridges" to the physical world will take time to evolve. I expect them to be more active in the second half of the 2020s

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Session 1: What is an NFT?

3. Market Structure

NFTs are primarily traded on on-chain marketplaces

OpenSea
Dominates in overall volume

SuperRare & Foundation
Focus on Fine Art

LooksRare
Tokenized Exchange

This is an illustrative set – there are other exchanges as well. Unlike fungible tokens, the vast majority of NFTs trade on-chain

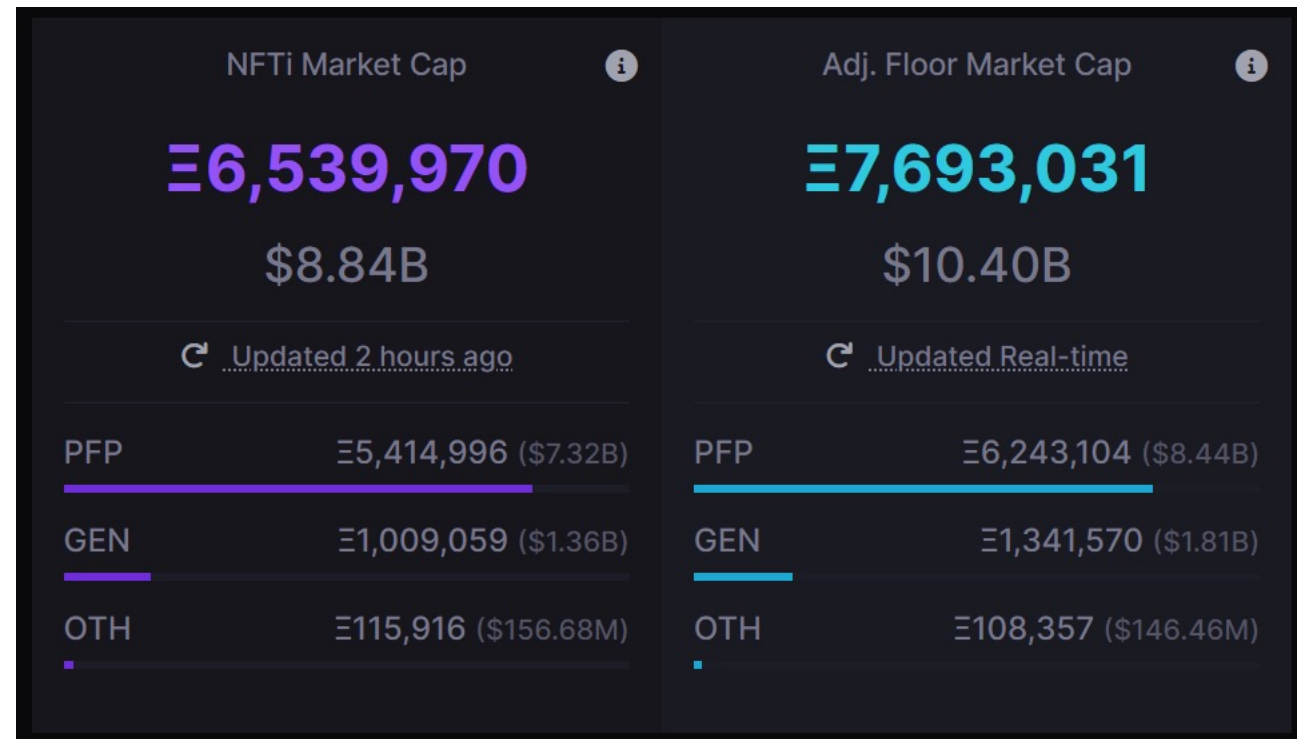UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

PFP and Generative Art Market Cap is about $10B (peaked close to $30B)

Source: NFTValuations.com

PFP collections are the majority of the market cap (no good estimates yet for 1 of 1 art and other categories but data is improving)

NFTi Market Cap		Adj. Floor Market Cap	
Ξ6,539,970		Ξ7,693,031	
$8.84B		$10.40B	
Updated 2 hours ago		Updated Real-time	
PFP	Ξ5,414,996 ($7.32B)	PFP	Ξ6,243,104 ($8.44B)
GEN	Ξ1,009,059 ($1.36B)	GEN	Ξ1,341,570 ($1.81B)
OTH	Ξ115,916 ($156.68M)	OTH	Ξ108,357 ($146.46M)

Source: NFTValuations.com

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

42

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Session 1: What is an NFT?

4. Conclusions

Main takeaways from week 1

- NFTs are unique tokens stored on smart contract blockchains, like the Ethereum blockchain.

- NFTs can represent an extraordinary range of intangible objects and, with appropriate bridges, tangible objects, too.

- The potential addressable market for NFTs is very large, but this is contingent on successful development and adoption.

- The NFT market is still immature and experimental. Initial progress has been made in collectibles and art, but most other categories are mostly unexplored.

UNIVERSITY of NICOSIA | DEPARTMENT OF DIGITAL INNOVATION

Non-Fungible Tokens (NFTs) and the Metaverse
Session 1: What is an NFT?

This work is released under a Creative Commons Attribution 4.0 International (CC BY 4.0) License © University of Nicosia, Institute for the Future, unic.ac.cy/blockchain

44

Further reading

o Technical Specifications

- https://ethereum.org/en/nft/#build-with-nfts

- https://ethereum.org/en/developers/docs/standards/tokens/erc-721/

- https://blog.enjincoin.io/erc-1155-the-crypto-item-standard-ac9cf1c5a226

- https://eips.ethereum.org/EIPS/eip-2309

o Punk 6529 Tweetstorms:

- https://twitter.com/punk6529/status/1429399888786333697

- Coming soon in easier-to-read format

o NFT markets

- The NFT Valuations Market Report:
https://static.nftvaluations.com/reports/20221005%20-%20NFT%20Market%20Report%20Teaser.pdf

Questions?

Contact Us:

Twitter: **@unicmetaverse**
Course Support (Discord): **discord.gg/joinUNIC**
Course Support (Email): **metaverse@unic.ac.cy**