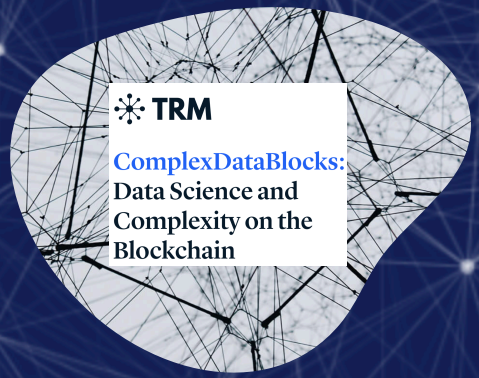
Clubs of wallets: a dive into the mesoscopic features of NFT transaction networks

Alessia Galdeman[1], Lucio La Cava[2],
Matteo Zignani[1], Andrea Tagarelli[2], And Sabrina Gaito[1]

[1] University of Milan [2] University of Calabria



Web3

RESEARCH GROUP WORKS

Network evolution

Graph evolution rules

Link/Transaction Prediction

Discrete choice models
Graph Neural Networks

User migration

Multilayer community detection
Influence of hubs on migration choices

Small world traits

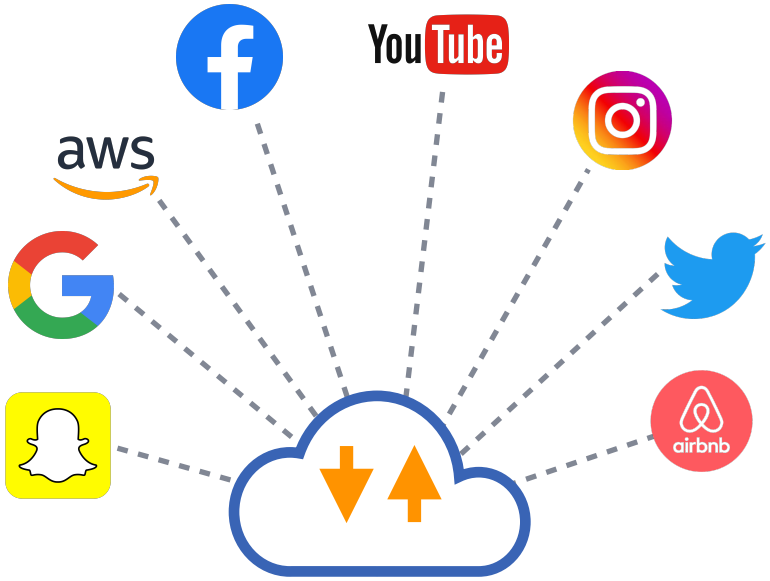
Community detection

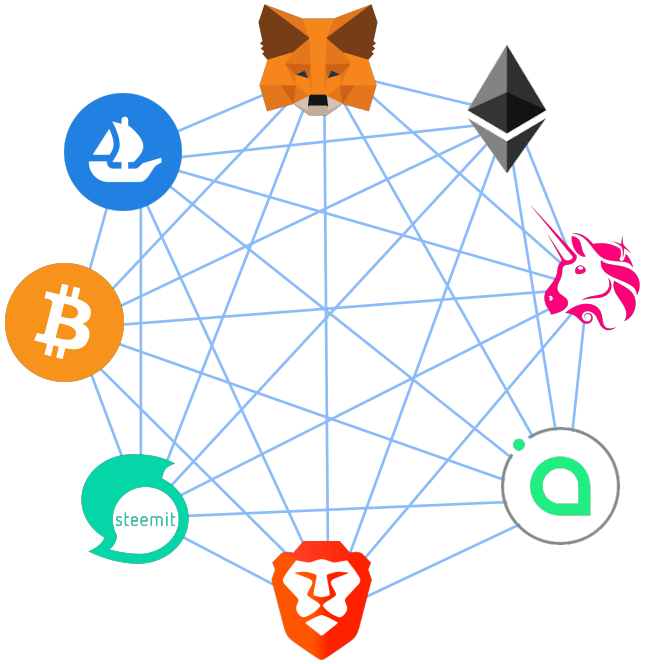
To see our works visit

https://connets.di.unimi.it/

Web3

A PARADIGM FOR A DECENTRALISED WEB





Web 2.0

Over-centralization

Web3

Decentralization by blockchains

Web3 data

- Huge volume of high resolution data
- Available and affordable by API
- Timestamped and validated
- Heterogeneous interactions

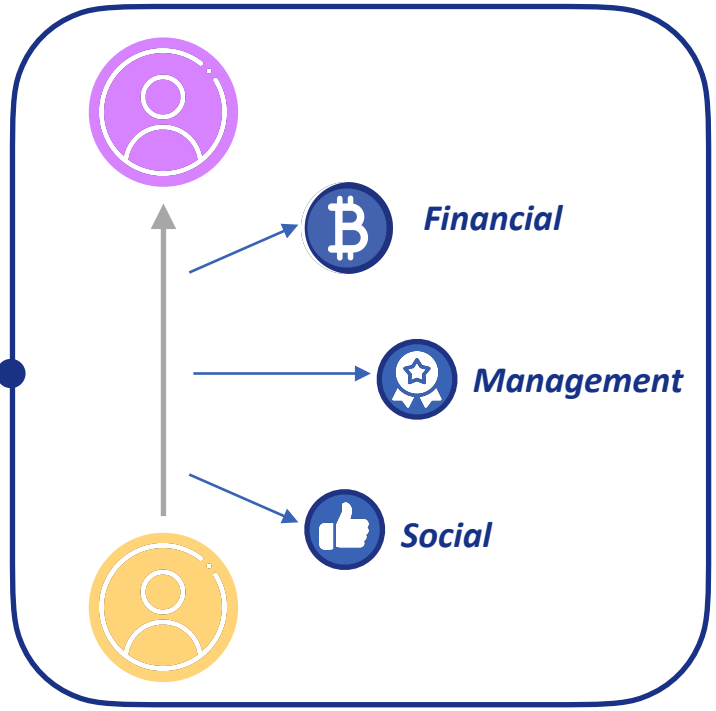
Web3

DATA

Steemit

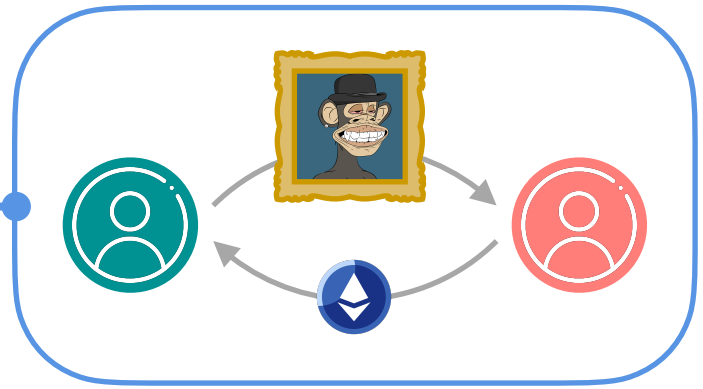
Hive

Blockchain-based online social networks



NFT trade collection

A collection of NFT trades from 5 different markets



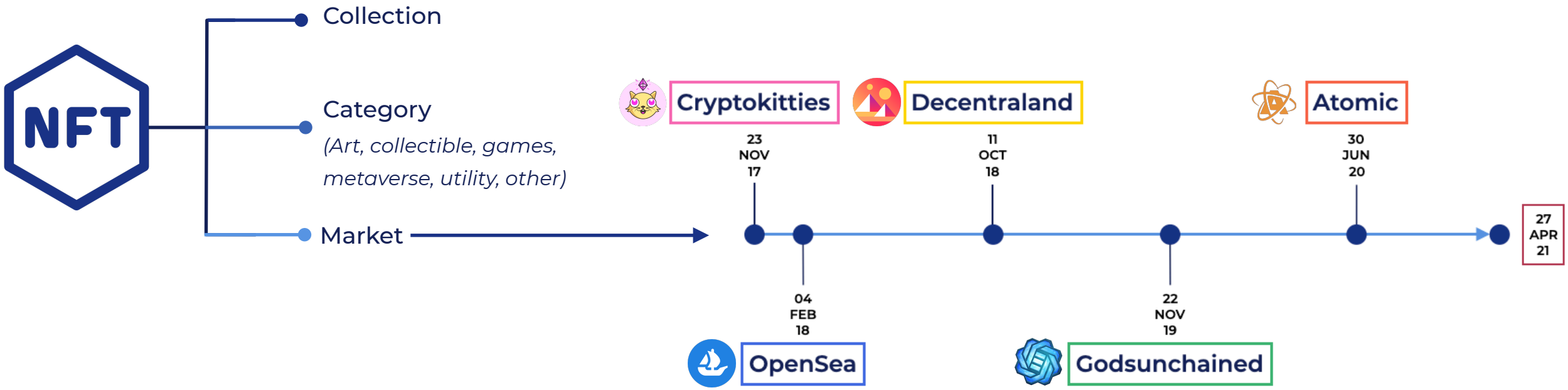
Non fungible tokens

NFTs:

- Ensure a unique certificate of ownership
- Guarantee uniqueness and non-transferability
- Track down the complete history of ownership of an object and check the authenticity

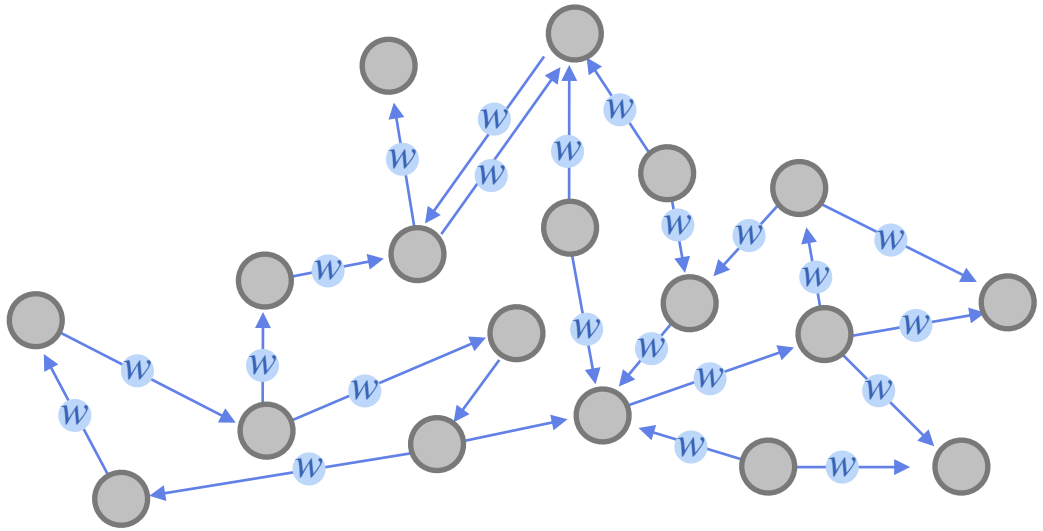
Everydays: the first 5000 days
Beeple

Dataset



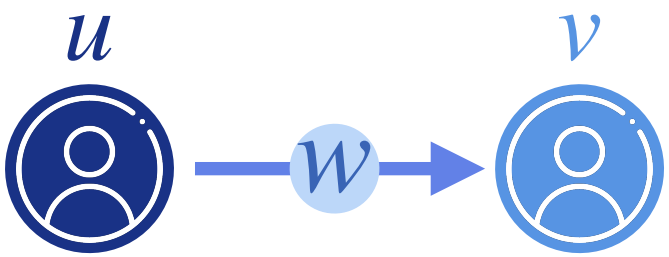
- Transaction dataset collected and analysed by Nadini et. al. [1]
- **6.1** million trades involving 4.7 million NFTs
- **4 years** of data on Ethereum and WAX blockchains
- Items exchanged on **five NFT market** are organised in **collections**: sets of NFTs that, in most cases, share some common features.
- Most collections can be categorised in **six categories**

Graph modeling



For each market m we define a directed weighted graph

$$G_m = (V_m, E_m, w_m)$$



The edge (u, v, w) denotes that the sale from user u to user v happened w times

Cryptokitties

$|V| = 99984$
$|E| = 481540$

OpenSea

$|V| = 214238$
$|E| = 965496$

Decentraland

$|V| = 4747$
$|E| = 11757$

Godsunchained

$|V| = 2535$
$|E| = 4085$

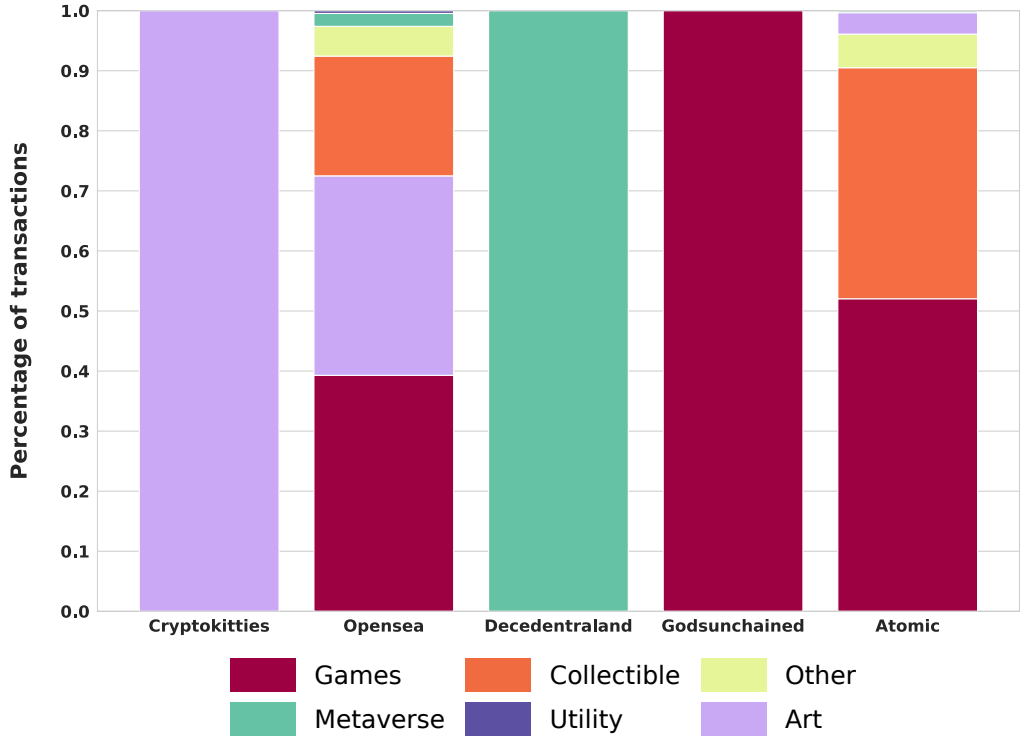
Atomic

$|V| = 263453$
$|E| = 1719458$

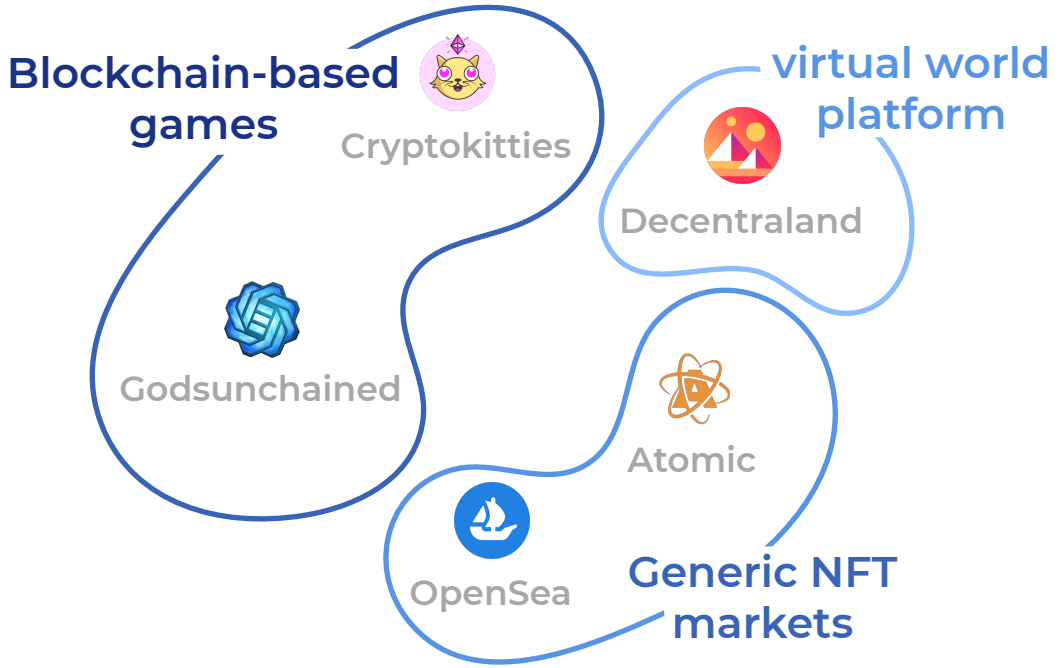
Difference of markets

Research question Despite their differences, do the markets' networks share common patterns?

Differences in the categories of the NFTs



Differences in the purposes



Communities

Method

- Obtain communities with Infomap algorithm
- Investigate to what extent traders are organised in tightly-knit communities

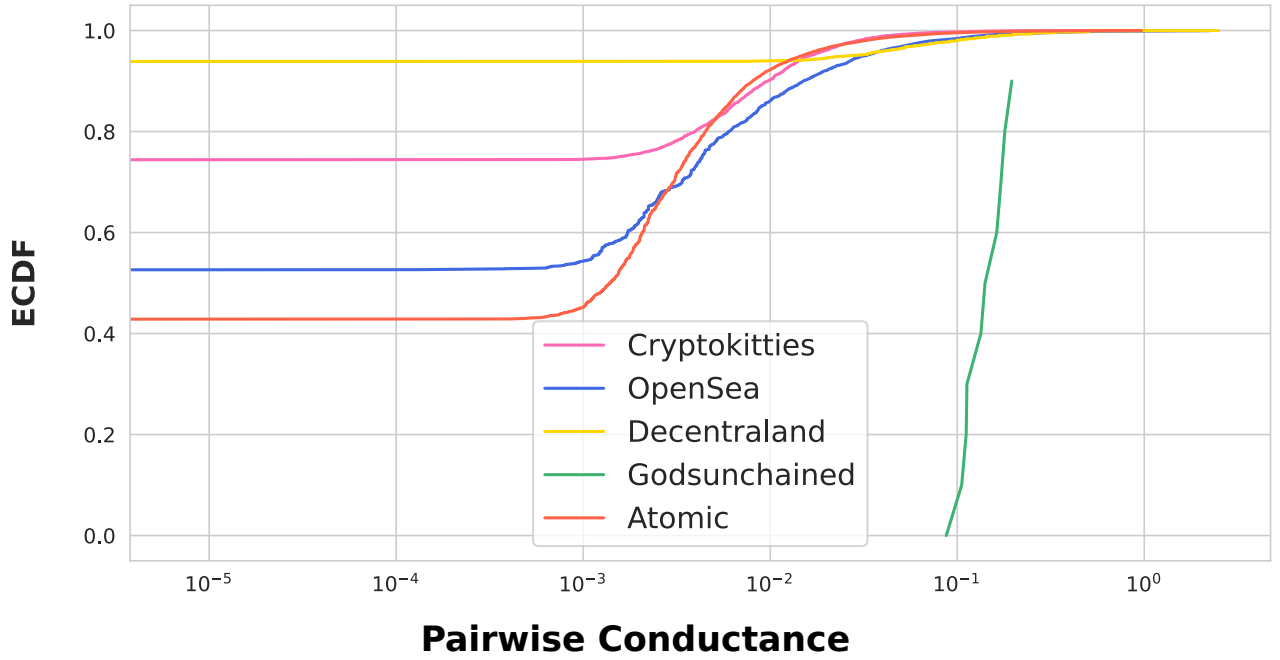
Number of communities pruning the ones having at most two nodes

Market	Total	Filtered	Conductance
Cryptokitties	7 757	5 751	686
OpenSea	12 876	7 621	115
Decentraland	570	370	370
Godsunchained	434	5	5
Atomic	10 373	7 858	300

Number of communities obtained applying Infomap

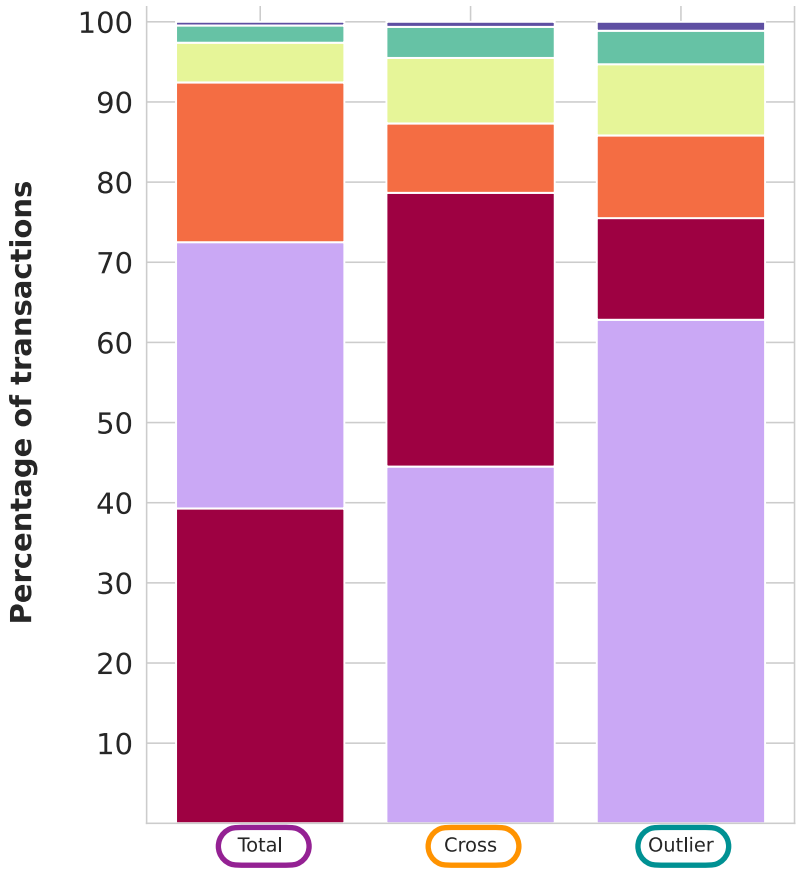
Number of communities needed to cover the 50 % of graph's users *

* The number of communities considered in the Godsunchained and Decentraland cases corresponds to the total number of filtered communities



Categories

OpenSea



Total

Category distribution over all the transactions in the market

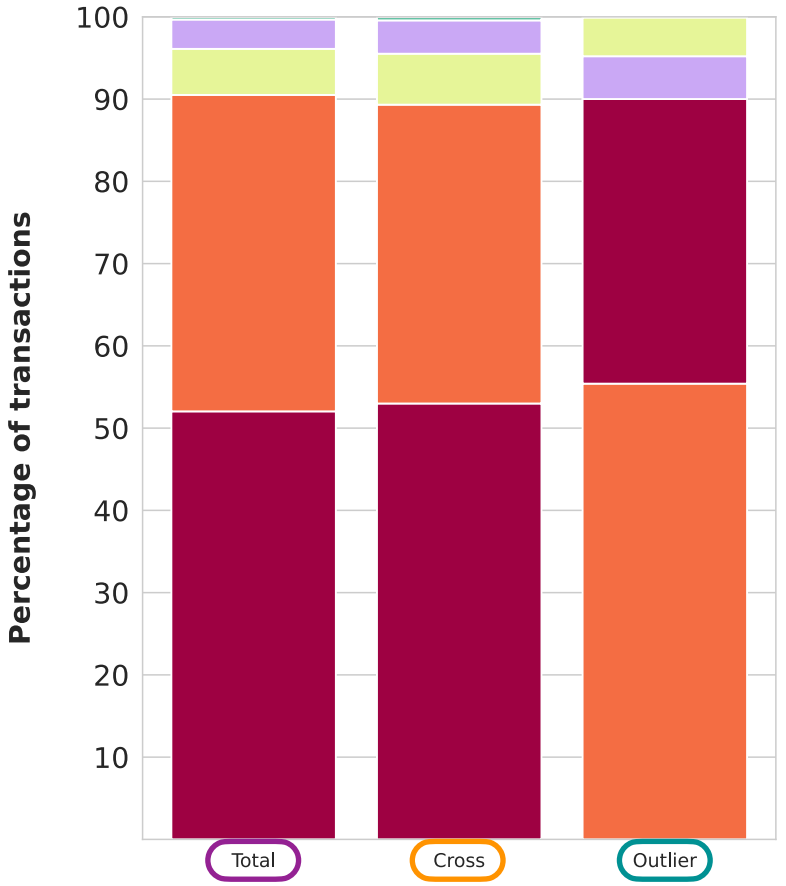
Cross

Category distribution over all the inter-community transactions

Outlier

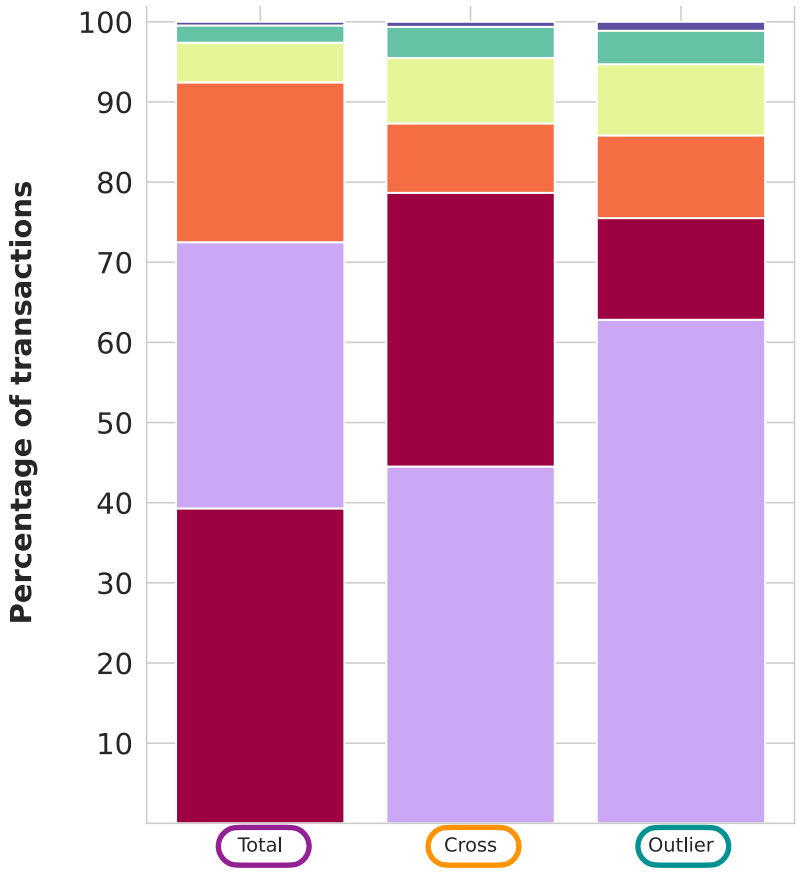
Category distribution over all the inter-community transaction with an outlier expense outside the community

Atomic



Categories

OpenSea

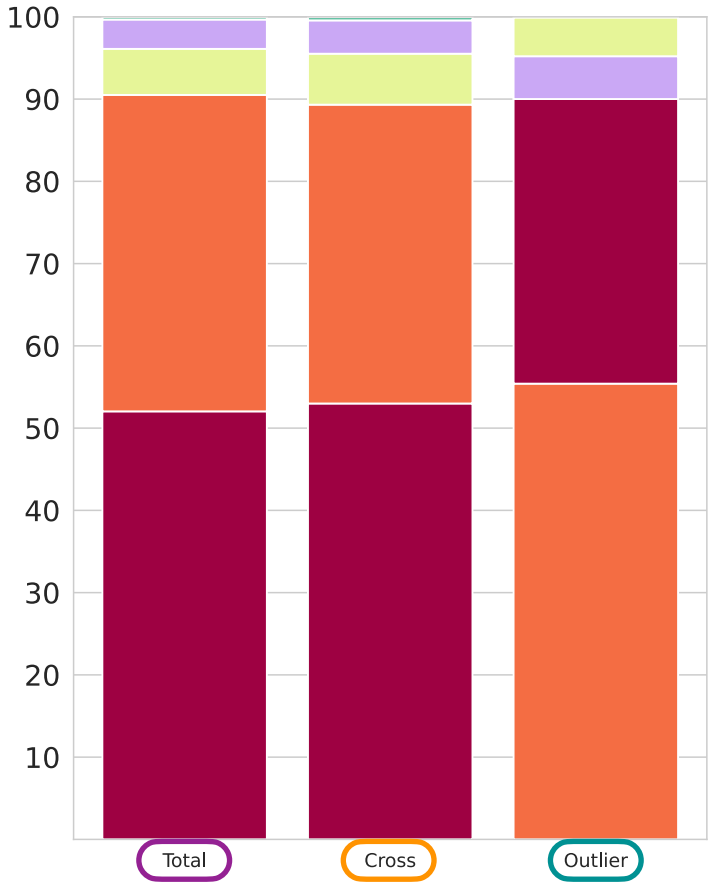


The art category gains importance when considering the cross-community transactions, especially in the outliers ones

The outlier transactions present a different category distribution

Games
Collectible
Other
Metaverse
Utility
Art

Atomic



Categories

CORE VS PERIPHERY

1 **Rank nodes**

2 **Select top nodes**

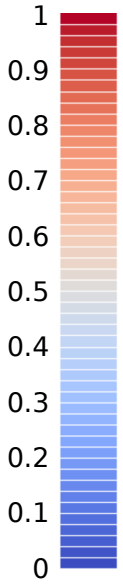
3 **Extract category distribution**

4 **Compare distributions**

Edges from node v to nodes outside the community c

$$r_c(v) = \frac{|edges_{out}|}{|edges|}$$

All incident edges



Top periphery

10 nodes with highest $r_C(v)$

*Category distribution over all the transactions where **top periphery nodes** are involved*

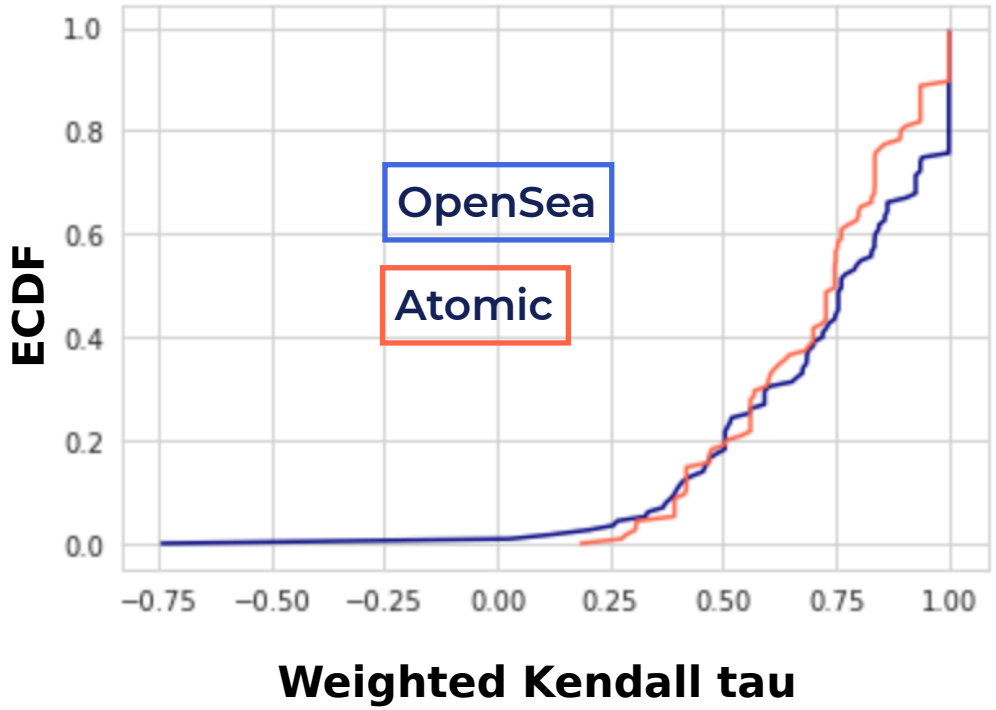
*Category distribution over all the transactions where **top core nodes** are involved*

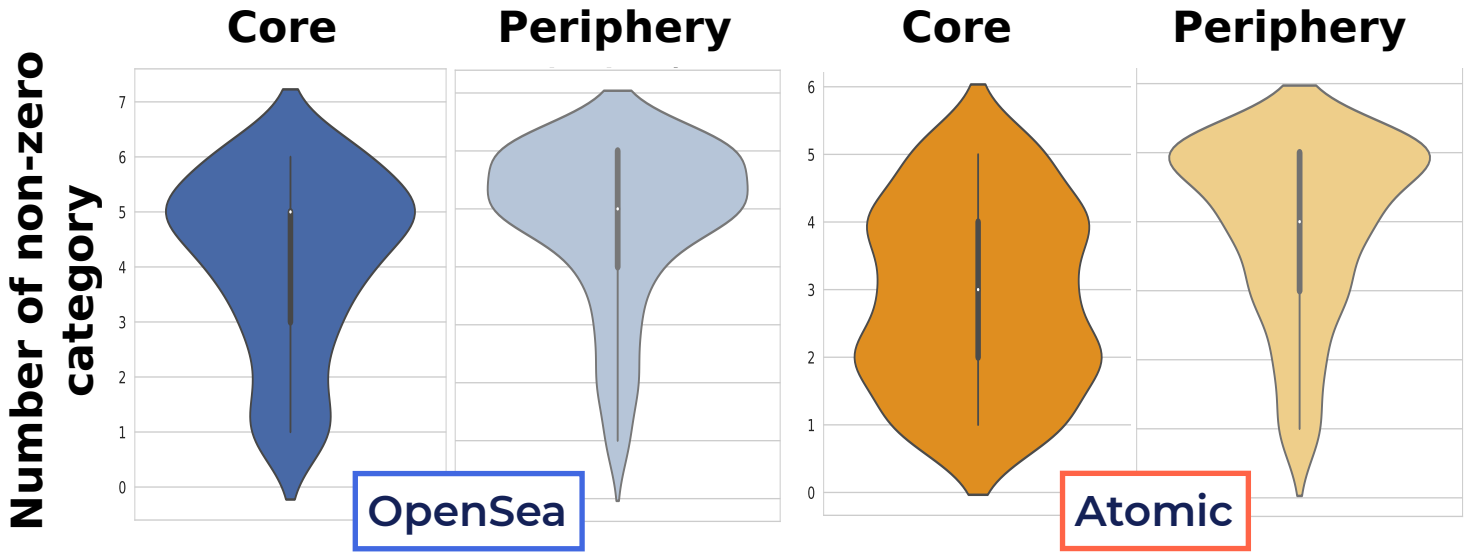
Top core

10 nodes with lowest $r_C(v)$

Categories

CORE VS PERIPHERY





Observations

- The ranking coefficient between the category distributions of top core and top periphery nodes is quite high
- The core nodes tend to focus their trades on fewer categories.

Conclusion and future work

Research question

Do NFT traders concentrate their exchanges within the same group?

Method

- Obtain communities with Infomap algorithm
- Investigate to what extent traders are organised in tightly-knit communities

Preliminary results

Results suggest the existence of small world traits

Future works

More robust techniques to analyse the NFT exchange network from a mesoscopic perspective

Thanks for your attention

To see our works visit

https://connets.di.unimi.it/