Proof-of-Reputation

as a Liquid Democracy for Distributed Systems

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Facebook: akolonin

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SingularityNET

AIGENTS

Novosibirsk State University

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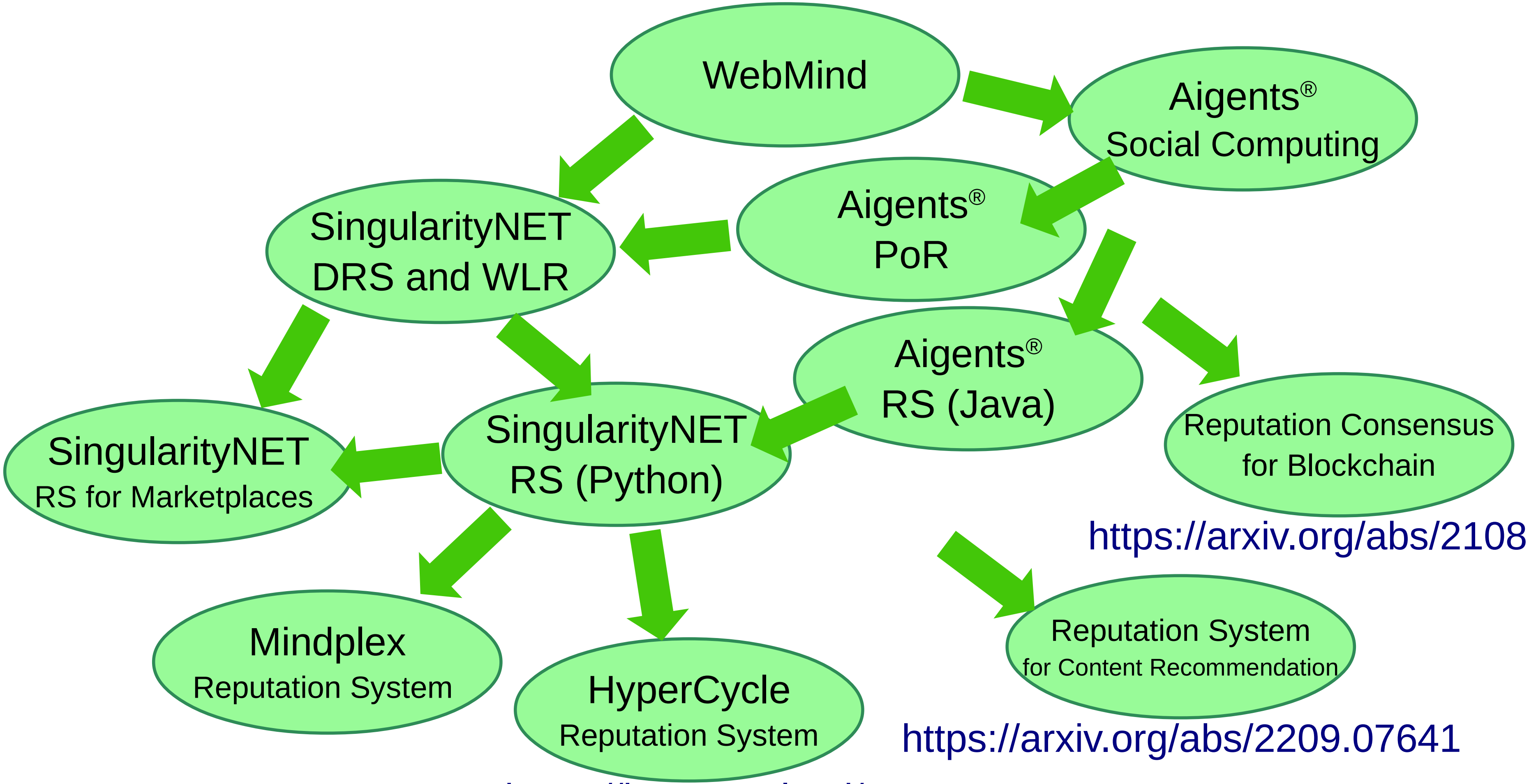
https://aigents.com

Reputation System and Applications 1999-2022



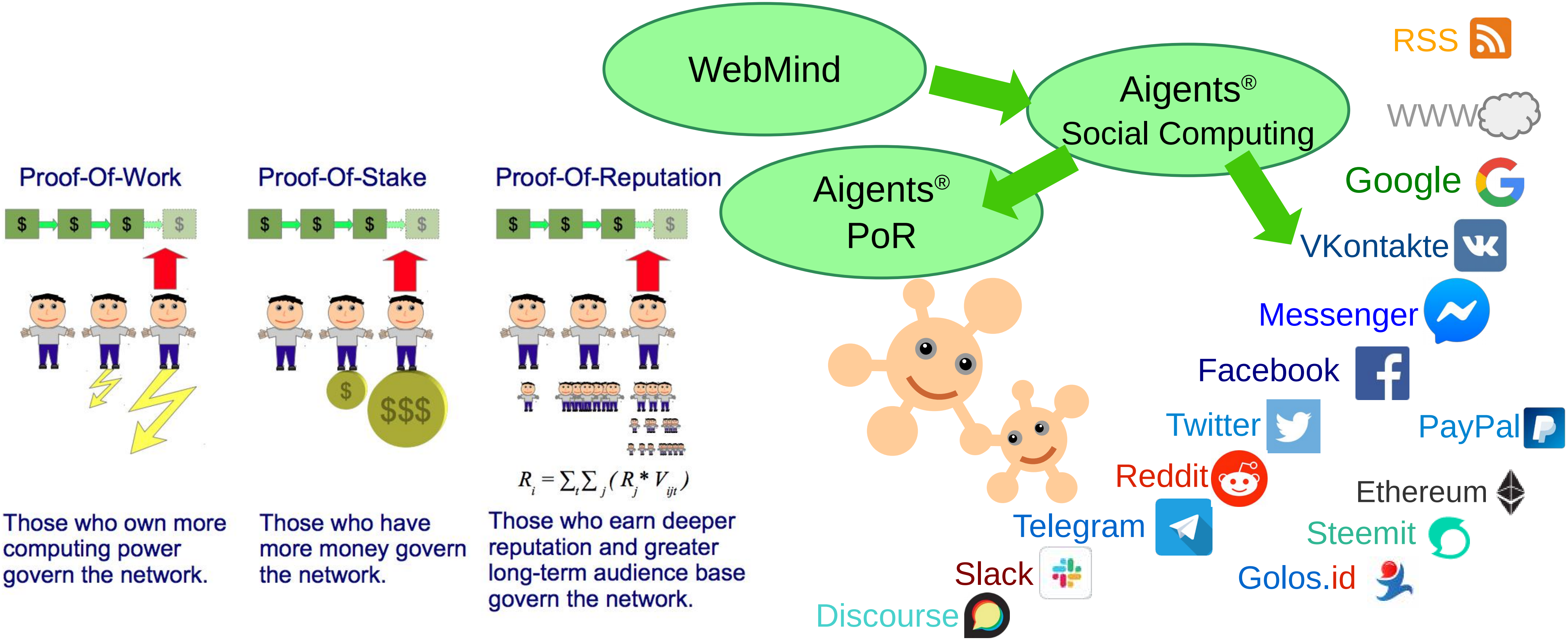
WebMind
Aigents® Social Computing
Aigents® PoR
SingularityNET DRS and WLR
Aigents® RS (Java)
SingularityNET RS (Python)
SingularityNET RS for Marketplaces
Reputation Consensus for Blockchain
Mindplex Reputation System
HyperCycle Reputation System
Reputation System for Content Recommendation

https://arxiv.org/abs/2108.03542

https://arxiv.org/abs/2209.07641

https://hypercycle.ai/

Reputation Consensus as a Liquid Democracy 1999-2017



Proof-Of-Work

Those who own more computing power govern the network.

Proof-Of-Stake

Those who have more money govern the network.

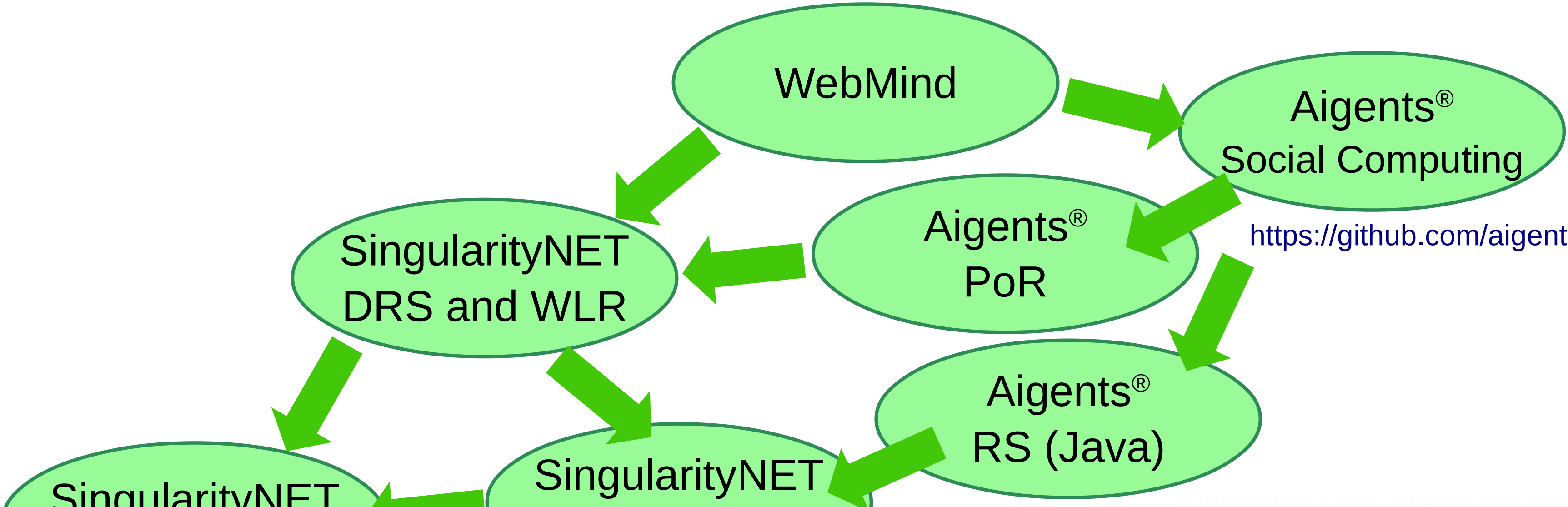
Proof-Of-Reputation

$$R_i = \sum_t \sum_j (R_j * V_{ijt})$$

Those who earn deeper reputation and greater long-term audience base govern the network.

https://steemit.com/blockchain/@aigents/proof-of-reputation-as-liquid-democracy-for-blockchain
https://research.nsu.ru/en/publications/reputation-systems-for-human-computer-environments
https://ieeexplore.ieee.org/document/8109887

“Weighted Liquid Rank” for Fraud Resistance 1999-2019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SingularityNET RS for Marketplaces
SingularityNET RS (Python)

https://github.com/aigents/aigents-java

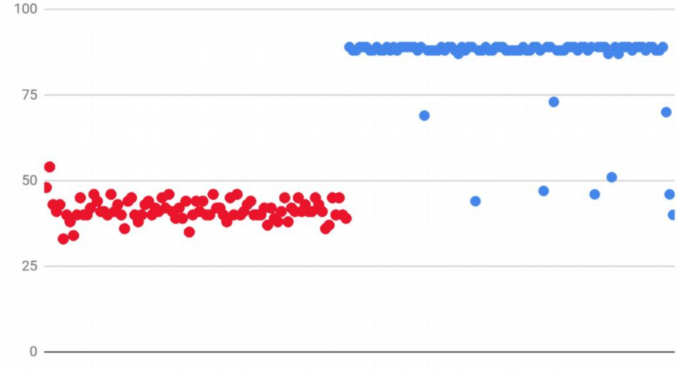
https://github.com/singnet/reputation/

Using Reputation System for protection from scam identifying dishonest suppliers on online marketplaces

https://arxiv.org/pdf/1905.08036.pdf

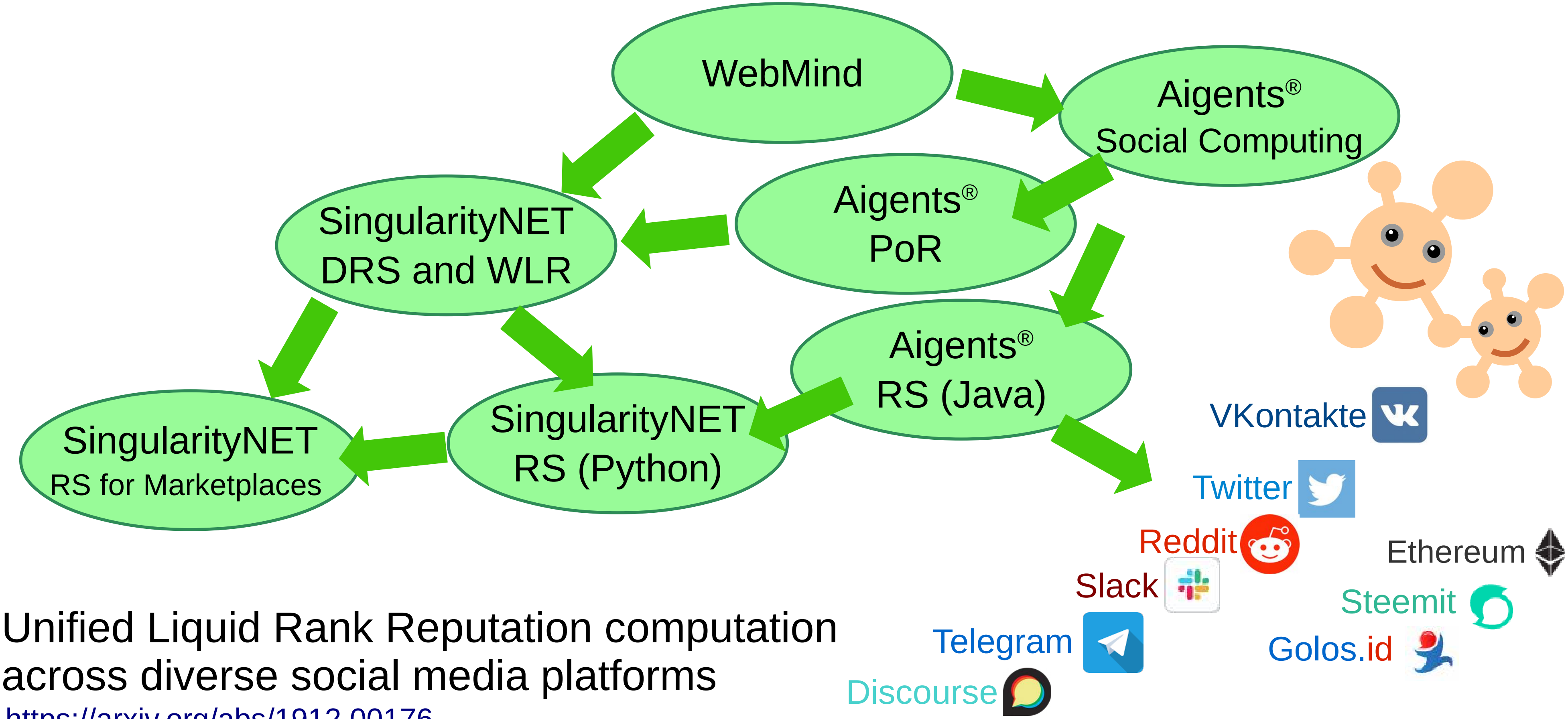
https://blog.singularitynet.io/minimizing-recommendation-fraud-7dabbee8fc00

https://aiforgood2019.github.io/papers/IJCAI19-AI4SG_paper_28.pdf



Ranks of Suppliers, dishonest Supplier (including alias) in red and honest suppliers in blue

Reputation System for Social Platforms 1999-2020



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SingularityNET RS for Marketplaces
VKontakte
Twitter
Reddit
Slack
Ethereum
Steemit
Telegram
Golos.id
Discourse

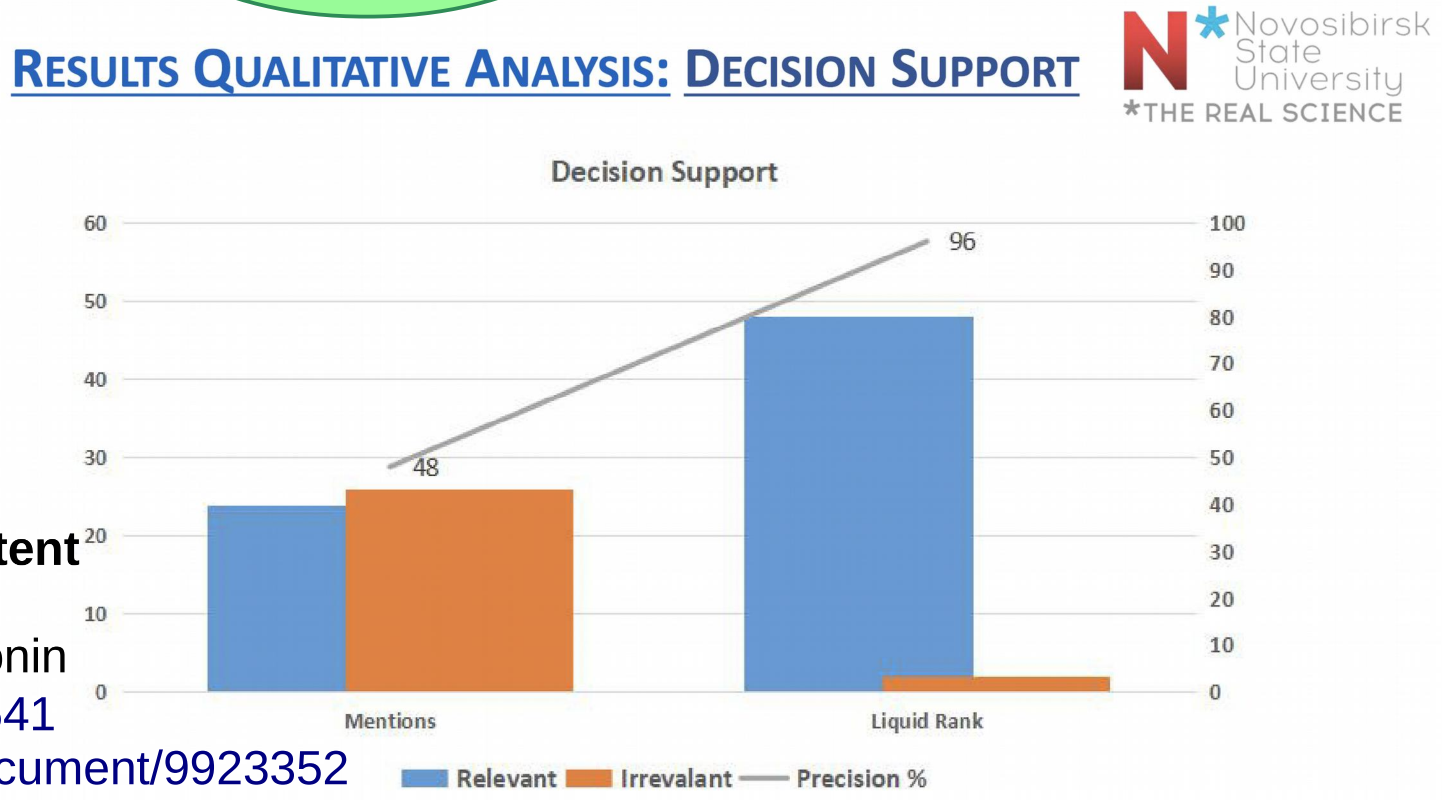
Unified Liquid Rank Reputation computation across diverse social media platforms

https://arxiv.org/abs/1912.00176

https://aigents.medium.com/aigents-bot-for-telegram-groups-1dba32140047

Reputation System for Recommendation 2017-2022

Reputation System
for Content Recommendation



RESULTS QUALITATIVE ANALYSIS: DECISION SUPPORT

Novosibirsk State University *THE REAL SCIENCE

Application of Liquid Rank Reputation System for Content Recommendation
Abhishek Saxena, Anton Kolonin
https://arxiv.org/abs/2209.07641
https://ieeexplore.ieee.org/document/9923352

Reputation Consensus for Distributed Ledger 2017-2021

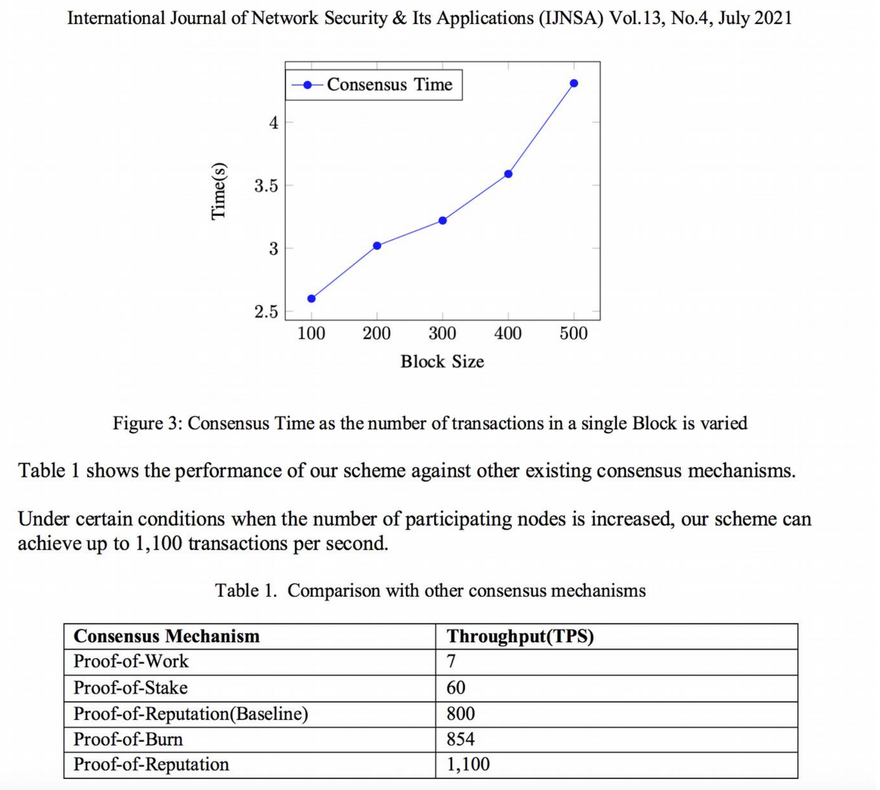
Reputation Consensus for Blockchain

Proof-of-Reputation: An Alternative Consensus Mechanism for Blockchain Systems

Oladotun Aluko, Anton Kolonin

https://arxiv.org/abs/2108.03542

https://aircconline.com/ijnsa/V13N4/13421ijnsa03.pdf



International Journal of Network Security & Its Applications (IJNSA) Vol.13, No.4, July 2021

Figure 3: Consensus Time as the number of transactions in a single Block is varied

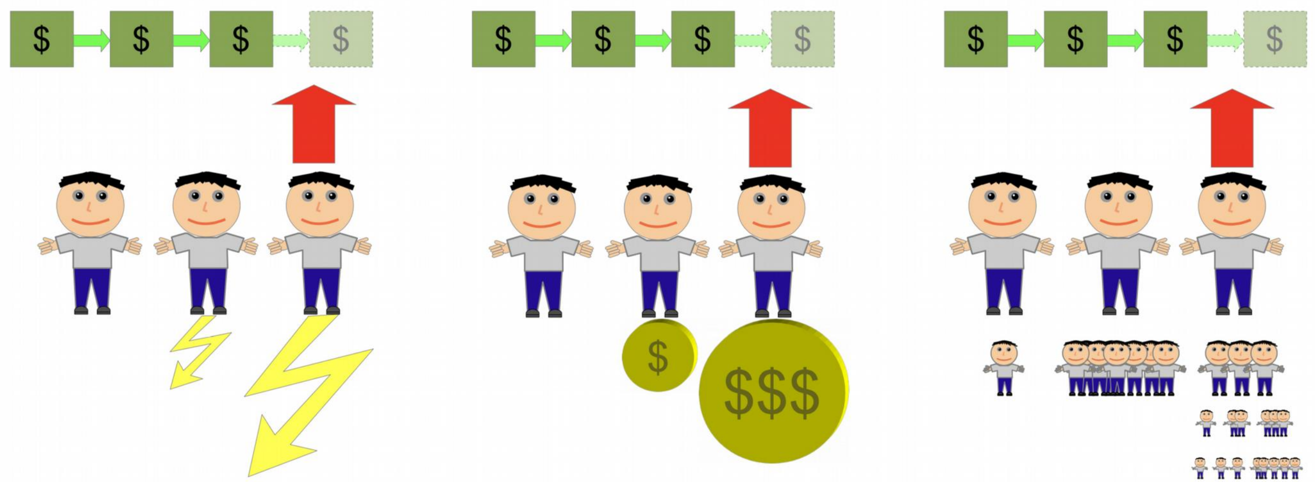
Table 1 shows the performance of our scheme against other existing consensus mechanisms.

Under certain conditions when the number of participating nodes is increased, our scheme can achieve up to 1,100 transactions per second.

Table 1. Comparison with other consensus mechanisms

Consensus Mechanism	Throughput(TPS)
Proof-of-Work	7
Proof-of-Stake	60
Proof-of-Reputation(Baseline)	800
Proof-of-Burn	854
Proof-of-Reputation	1,100

Reputation Consensus for Blockchain



Proof-Of-Work

Force is Power:
Those who own more computing resources govern the network.

Proof-Of-Stake

Money is Power:
Those who have more money govern the network.

Proof-Of-Reputation

$$R_i = \sum_t \sum_j (R_j * V_{ijt})$$

Reputation is Power:
Those who earn a better reputation and a greater long-term audience base govern the network.

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https://ieeexplore.ieee.org/document/8109887

Reputation Consensus for Blockchain - Experiments

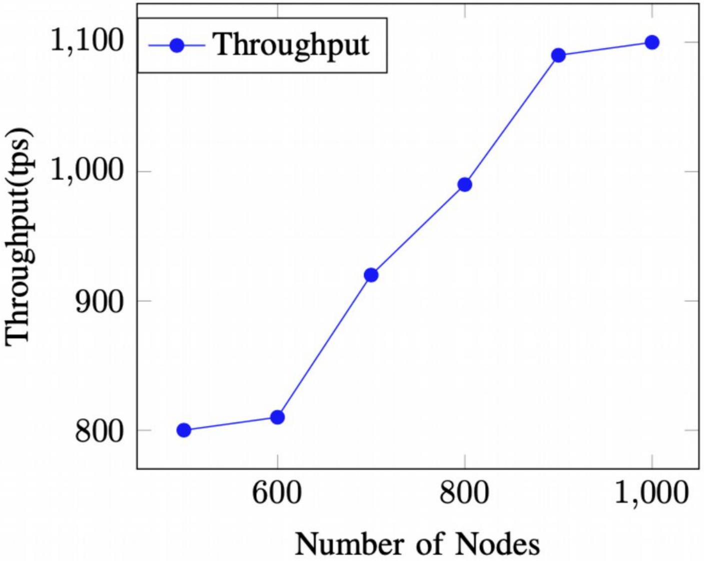

Figure 1: Throughput vs Number of network nodes

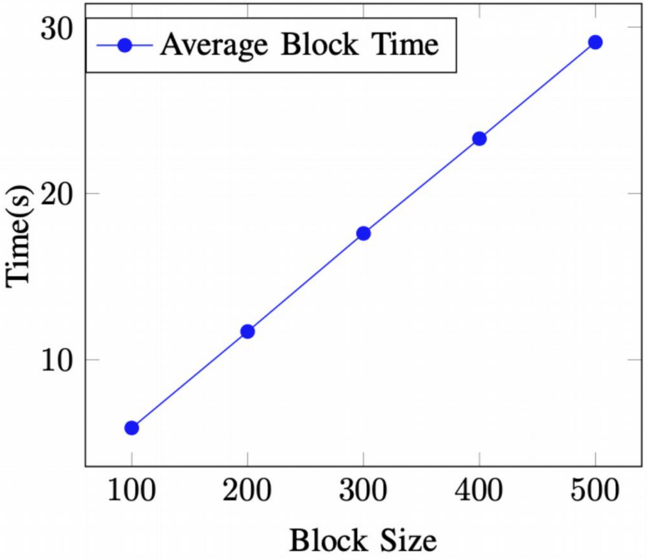

Figure 2: Average Block Time as the number of transactions in a single Block is varied

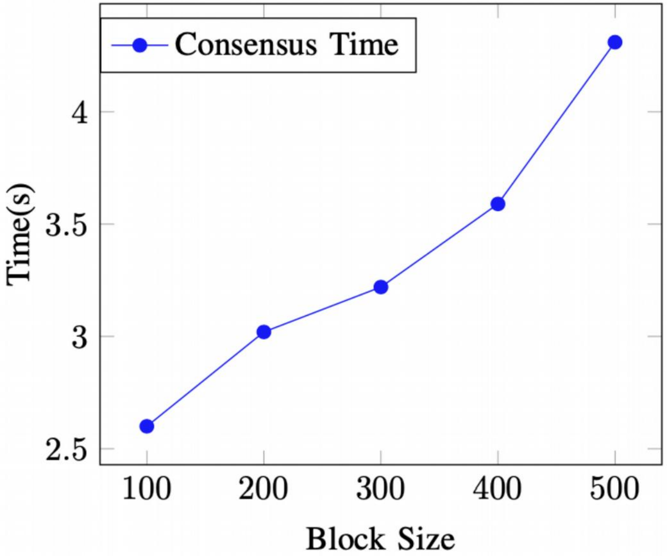

Figure 3: Consensus Time as the number of transactions in a single Block is varied

Proof-of-Reputation: An Alternative Consensus Mechanism for Blockchain Systems

Oladotun Aluko, Anton Kolonin

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Reputation Consensus – Throughput / Performance

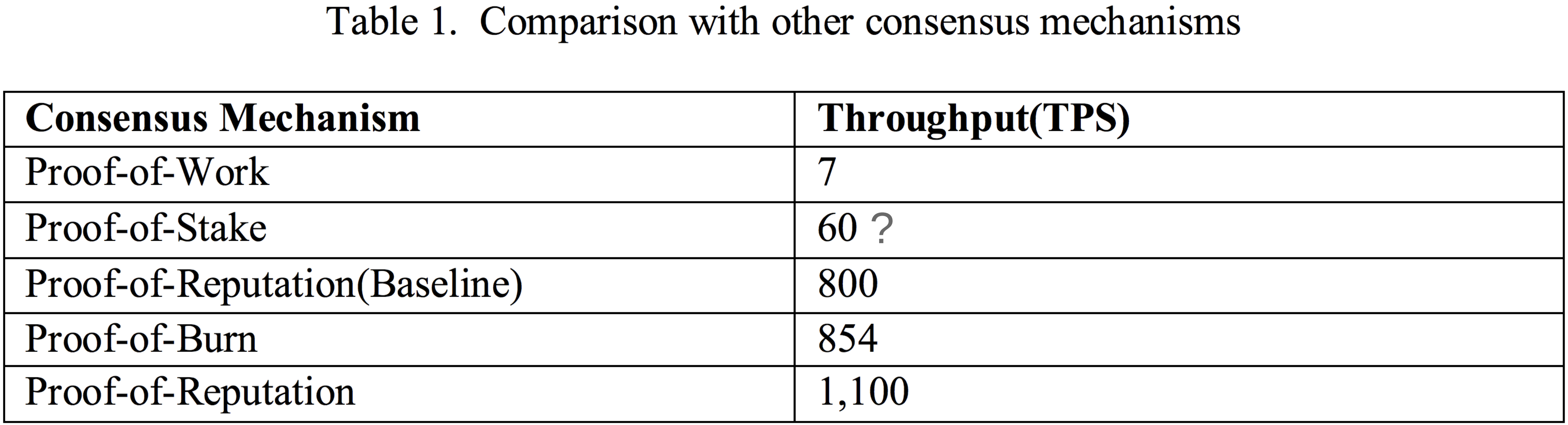

Table 1. Comparison with other consensus mechanisms

Consensus Mechanism	**Throughput(TPS)**
Proof-of-Work	7
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Reputation Consensus – Attack Resilience

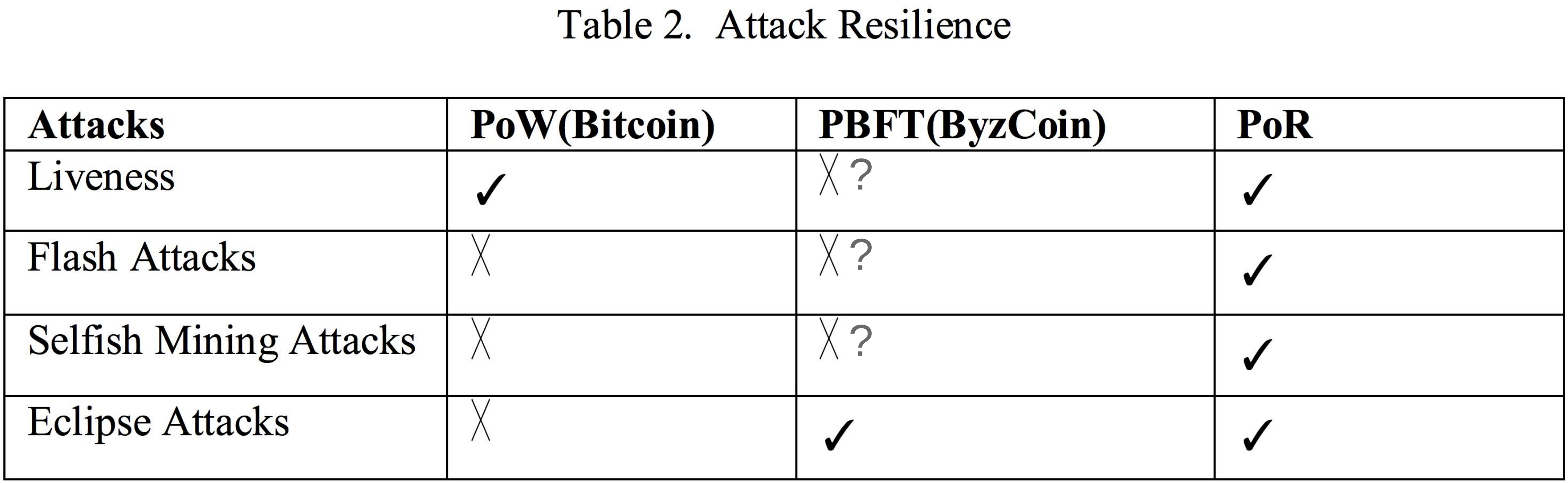

Table 2. Attack Resilience

Attacks	PoW(Bitcoin)	PBFT(ByzCoin)	PoR
Liveness	✓	╳ ?	✓
Flash Attacks	╳	╳ ?	✓
Selfish Mining Attacks	╳	╳ ?	✓
Eclipse Attacks	╳	✓	✓

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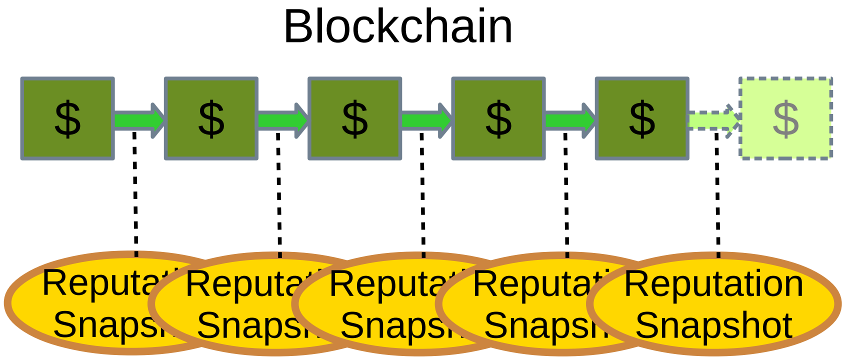
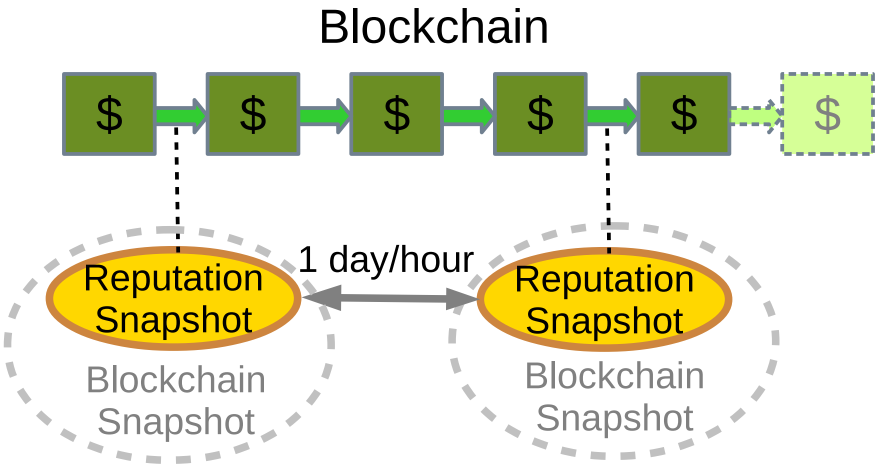
PBFT:
https://pmg.csail.mit.edu/papers/osdi99.pdf

Reputation Consensus – Synchronization Options



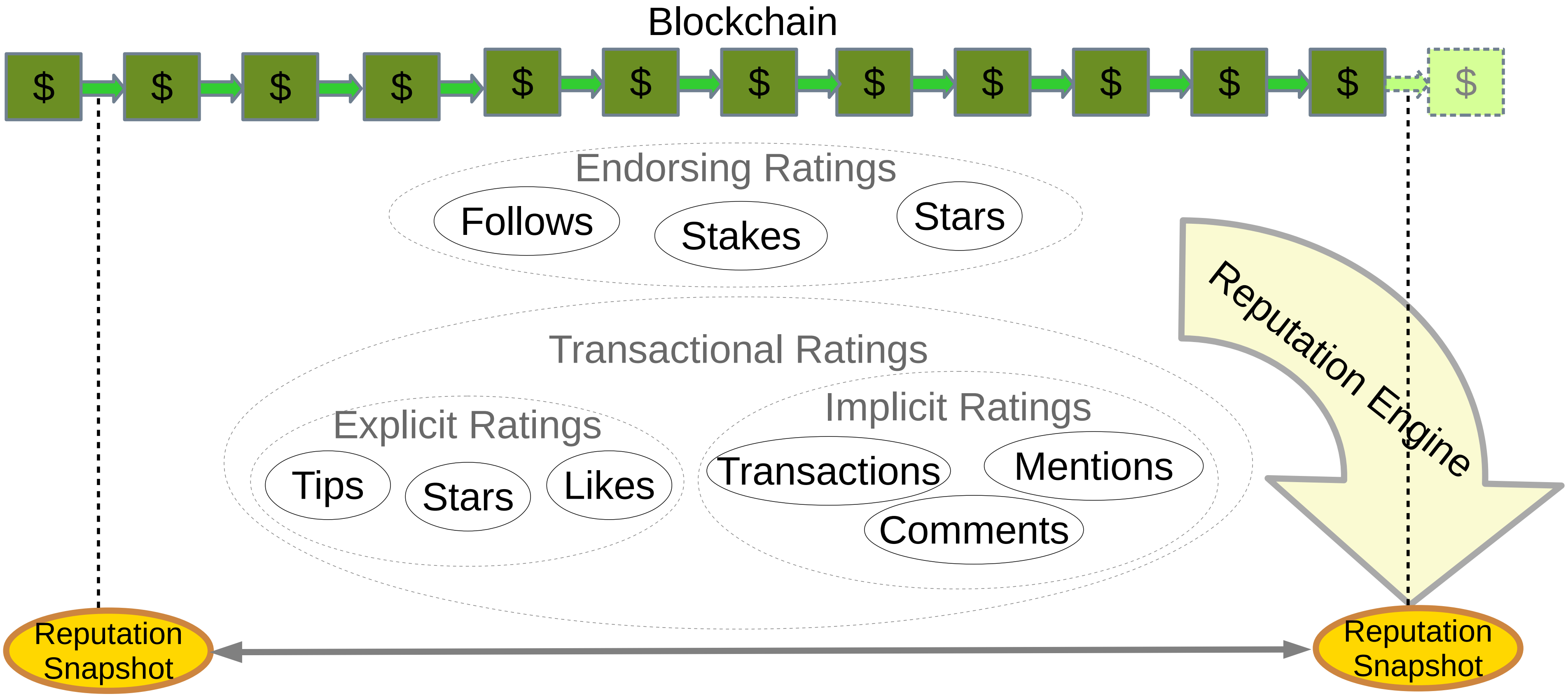
Block-wise
(expensive)



Periodic
(optimal)

A Reputation System for Artificial Societies
Anton Kolonin, Ben Goertzel, Deborah Duong, Matt Ikle
https://arxiv.org/pdf/1806.07342.pdf

Reputation Consensus – Rating Sources



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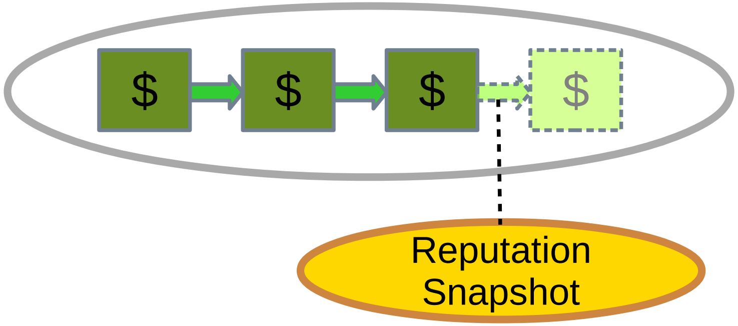
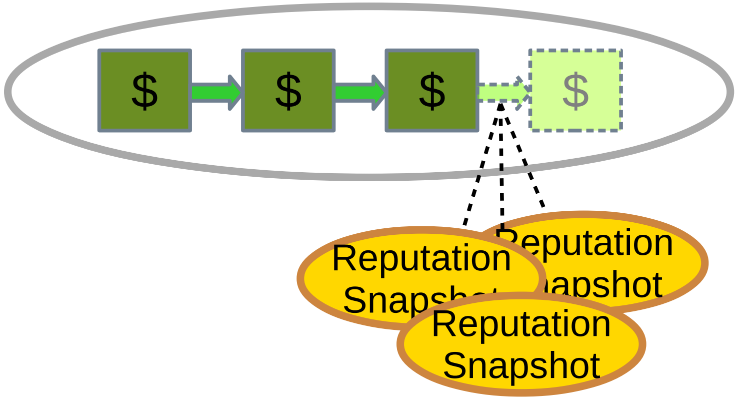
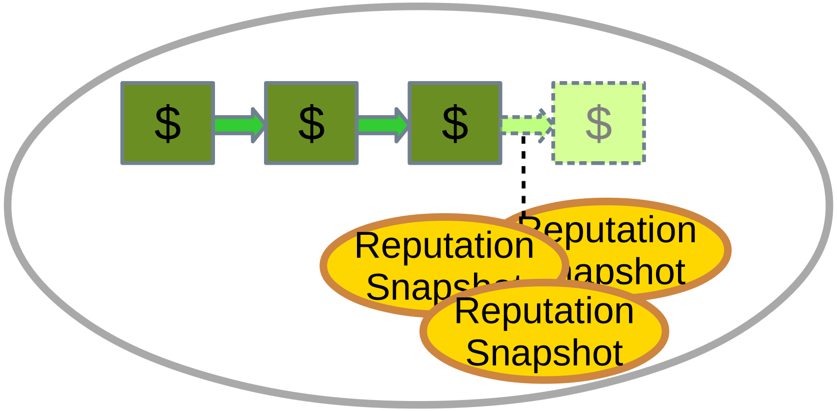
Reputation Consensus – Engine Design Options



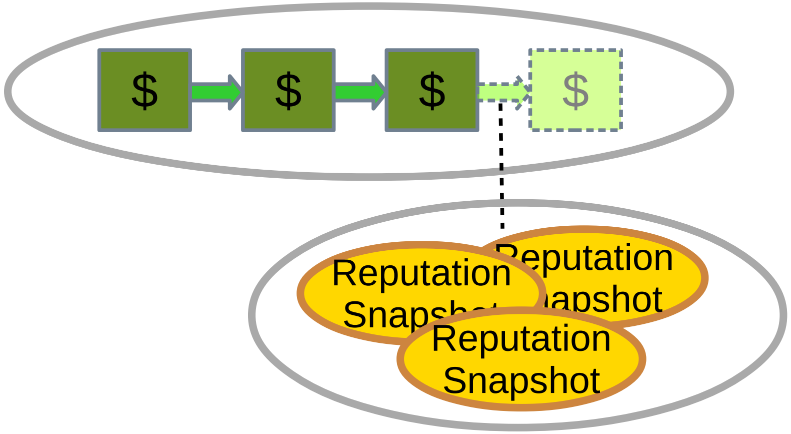
Centralized off-chain



Decentralized off-chain



Decentralized on-chain (reputation mining)



Decentralized side-chain (reputation consensus)

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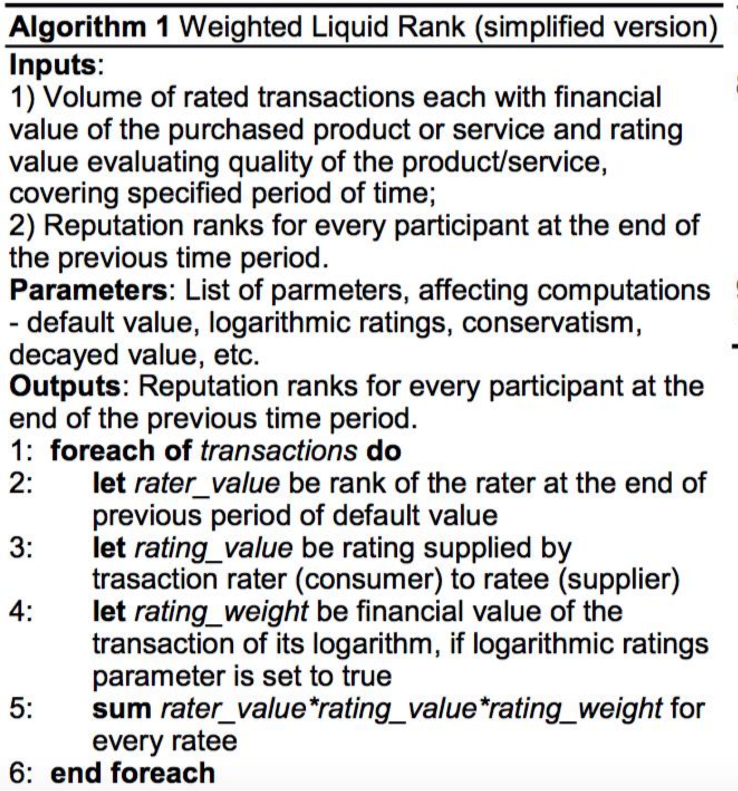
Reputation Engine



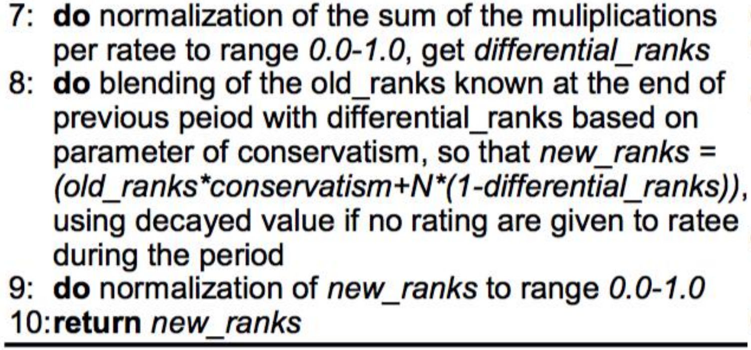
Algorithm 1 Weighted Liquid Rank (simplified version)

Inputs:
1) Volume of rated transactions each with financial value of the purchased product or service and rating value evaluating quality of the product/service, covering specified period of time;
2) Reputation ranks for every participant at the end of the previous time period.

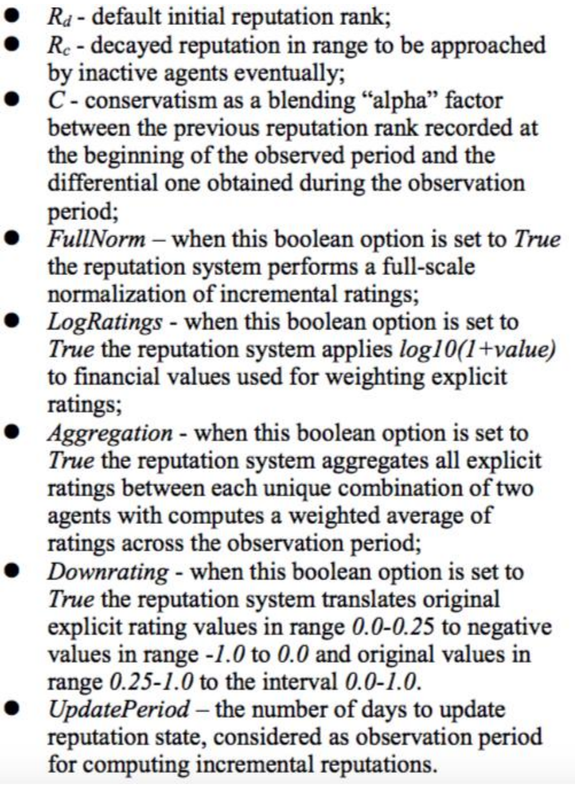
Parameters: List of parmeters, affecting computations - default value, logarithmic ratings, conservatism, decayed value, etc.

Outputs: Reputation ranks for every participant at the end of the previous time period.

```
foreach of transactions do
    let rater_value be rank of the rater at the end of
    previous period of default value
    let rating_value be rating supplied by
    trasaction rater (consumer) to ratee (supplier)
    let rating_weight be financial value of the
    transaction of its logarithm, if logarithmic ratings
    parameter is set to true
    sum rater_value*rating_value*rating_weight for
    every ratee
end foreach
```



```
do normalization of the sum of the muliplications
per ratee to range 0.0-1.0, get differential_ranks
do blending of the old_ranks known at the end of
previous peiod with differential_ranks based on
parameter of conservatism, so that new_ranks =
(old_ranks*conservatism+N*(1-differential_ranks)),
using decayed value if no rating are given to ratee
during the period
do normalization of new_ranks to range 0.0-1.0
return new_ranks
```



- R_d - default initial reputation rank;
- R_c - decayed reputation in range to be approached by inactive agents eventually;
- *C* - conservatism as a blending "alpha" factor between the previous reputation rank recorded at the beginning of the observed period and the differential one obtained during the observation period;
- *FullNorm* – when this boolean option is set to *True* the reputation system performs a full-scale normalization of incremental ratings;
- *LogRatings* - when this boolean option is set to *True* the reputation system applies *log10(1+value)* to financial values used for weighting explicit ratings;
- *Aggregation* - when this boolean option is set to *True* the reputation system aggregates all explicit ratings between each unique combination of two agents with computes a weighted average of ratings across the observation period;
- *Downrating* - when this boolean option is set to *True* the reputation system translates original explicit rating values in range *0.0-0.25* to negative values in range *-1.0* to *0.0* and original values in range *0.25-1.0* to the interval *0.0-1.0*.
- *UpdatePeriod* – the number of days to update reputation state, considered as observation period for computing incremental reputations.

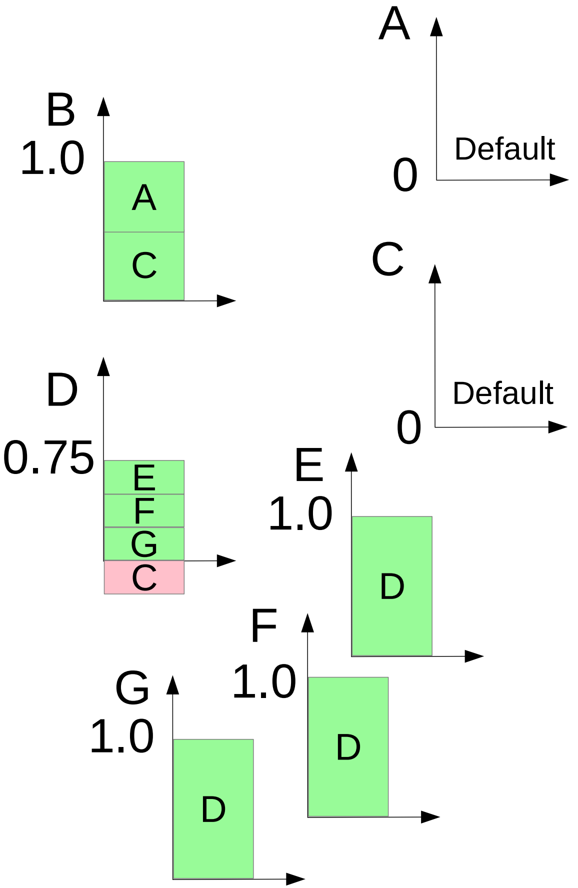
A Reputation System for Multi-Agent Marketplaces

Anton Kolonin, Ben Goertzel, Cassio Pennachin, Deborah Duong, Matt Iklé , Nejc Znidar, Marco Argentieri

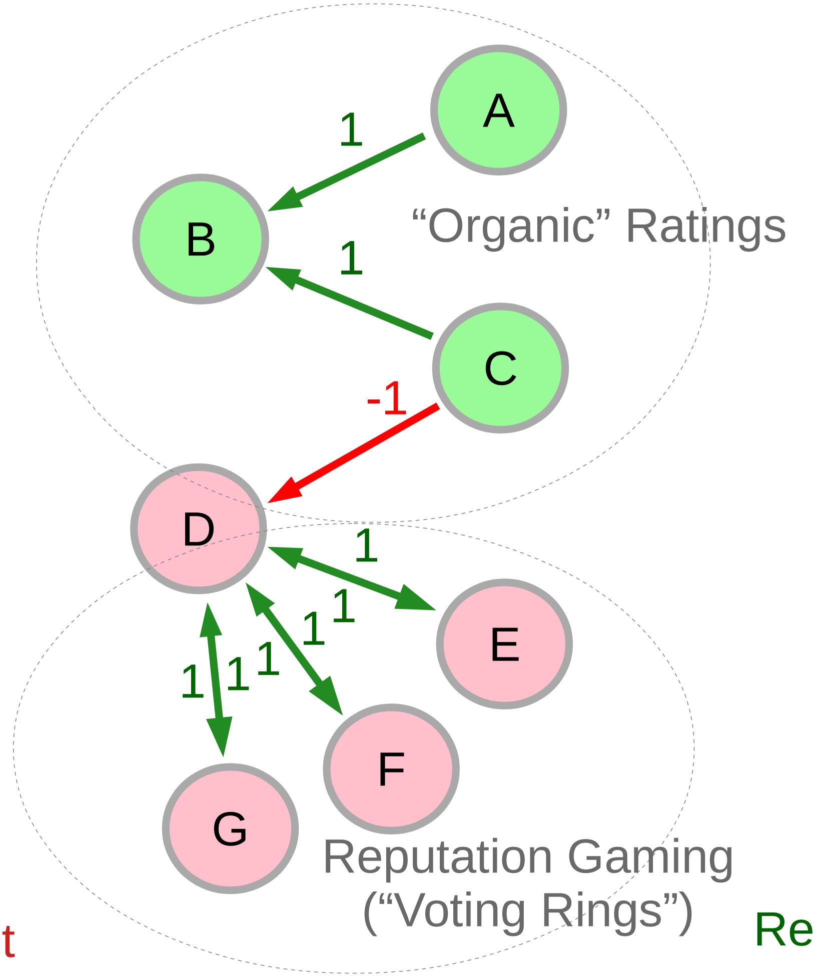
https://arxiv.org/pdf/1905.08036.pdf

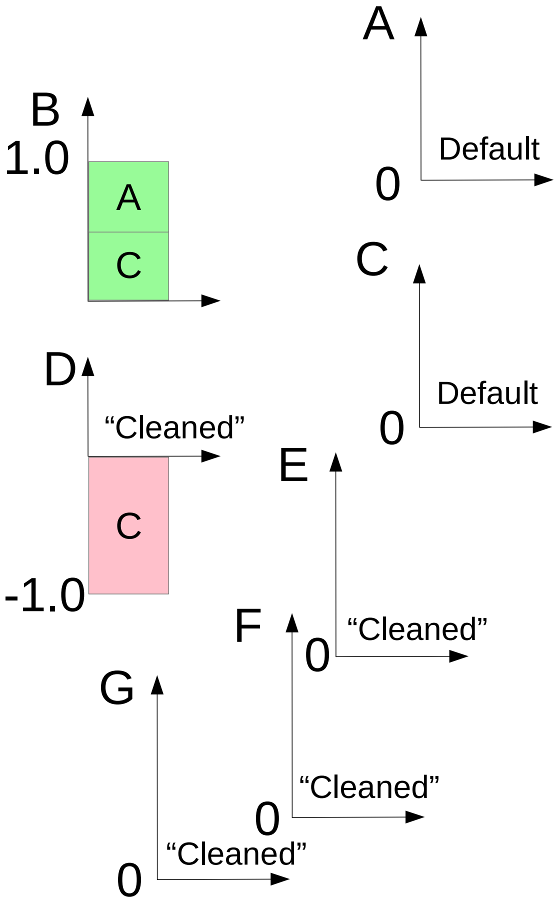
https://github.com/singnet/reputation
https://github.com/aigents/aigents-java/blob/master/src/main/java/net/webstructor/peer/Reputationer.java

Next: Resisting Reputation Gaming (Churning) [1.0..-1.0]



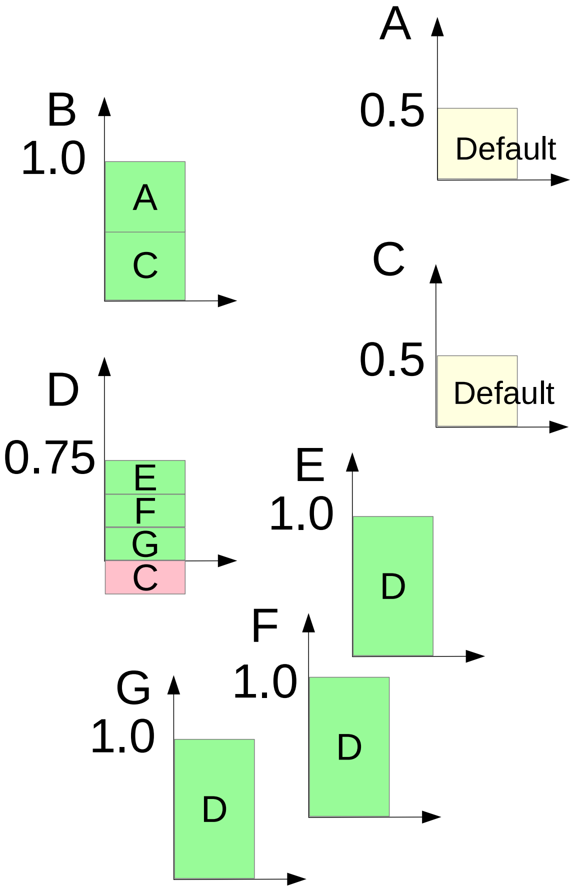
Abused Reputation Snapshot





Rescued Reputation Snapshot

Next: Resisting Reputation Gaming (Churning)



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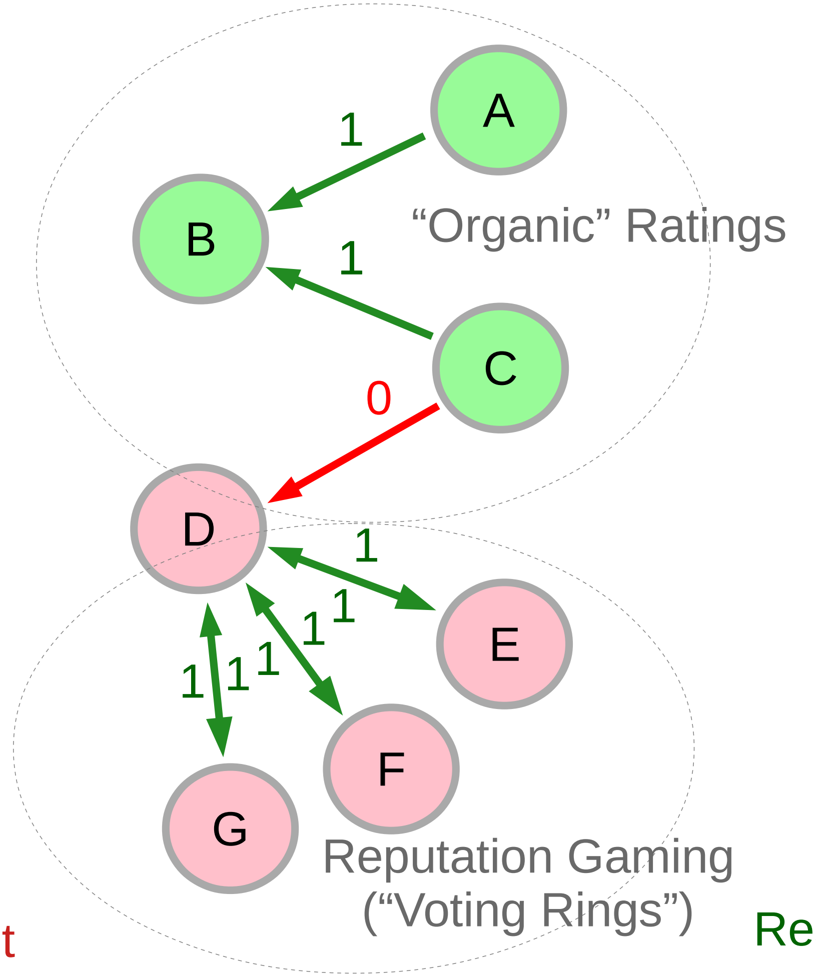

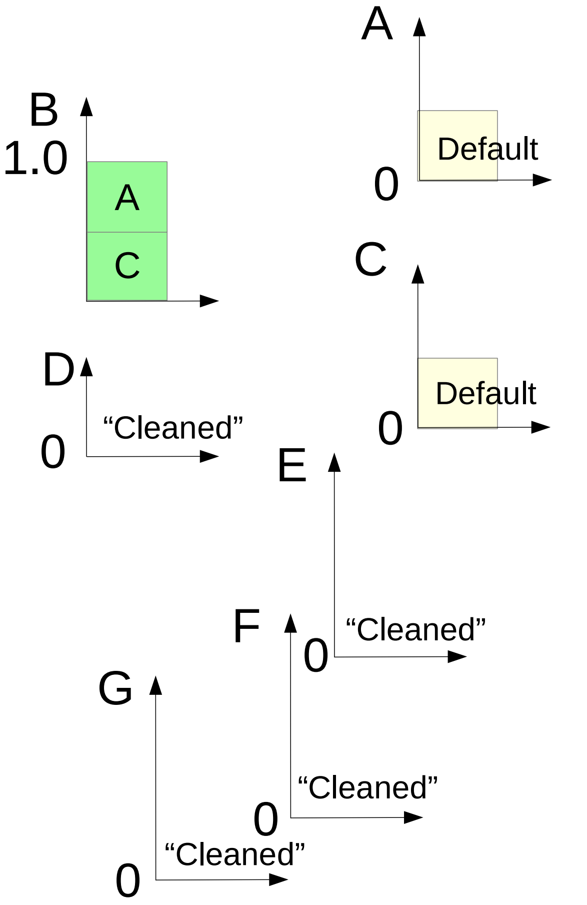

Rescued Reputation Snapshot

Thank You and Welcome!

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