Predicting Popularity of Twitter Accounts through the Discovery of Link-Propagating Early Adopters

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BACKGROUND

In social media, such as 

- New useful users frequently appears.
- We want to detect such new useful users.
- Popularity-based methods, e.g. , HITS and PageRank, do not work well for new users that have not established their reputation yet.

We propose a method of estimating prospective popularity of new users.

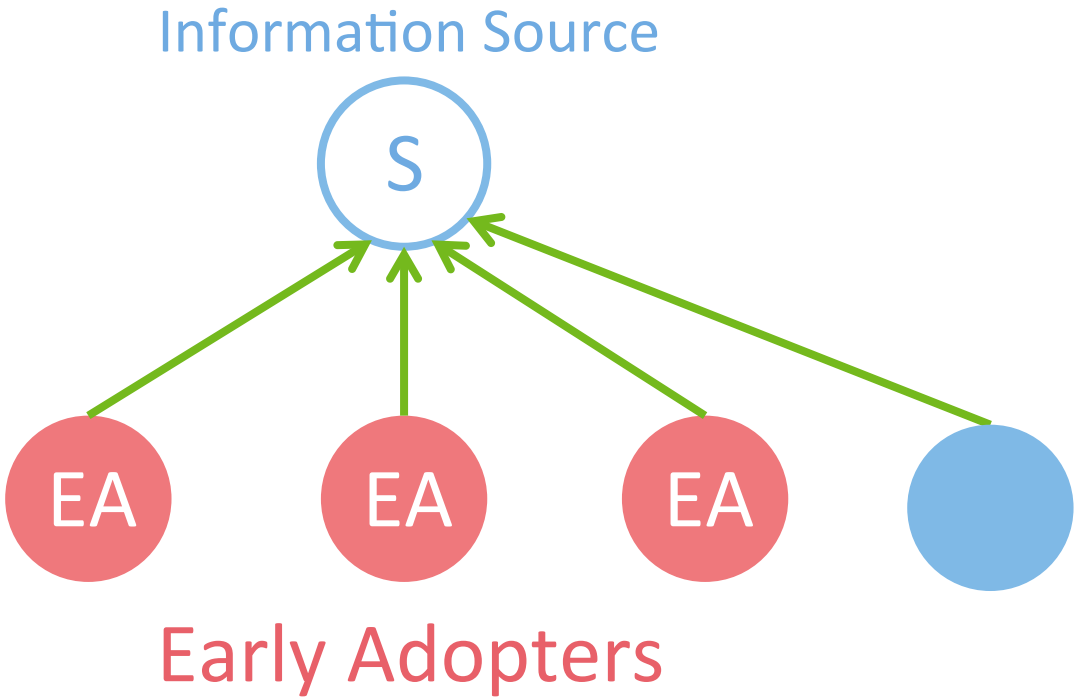
OUR APPROACH

We first detect early adopters

※ Early adopters = The users who are good at finding new good information sources earlier than others.

- The new users followed by early adopters are probably good information sources even if they have few followers at this point.
- We can find good information sources by detecting early adopters.

OUR APPROACH



DETECTION OF EARLY ADOPTERS

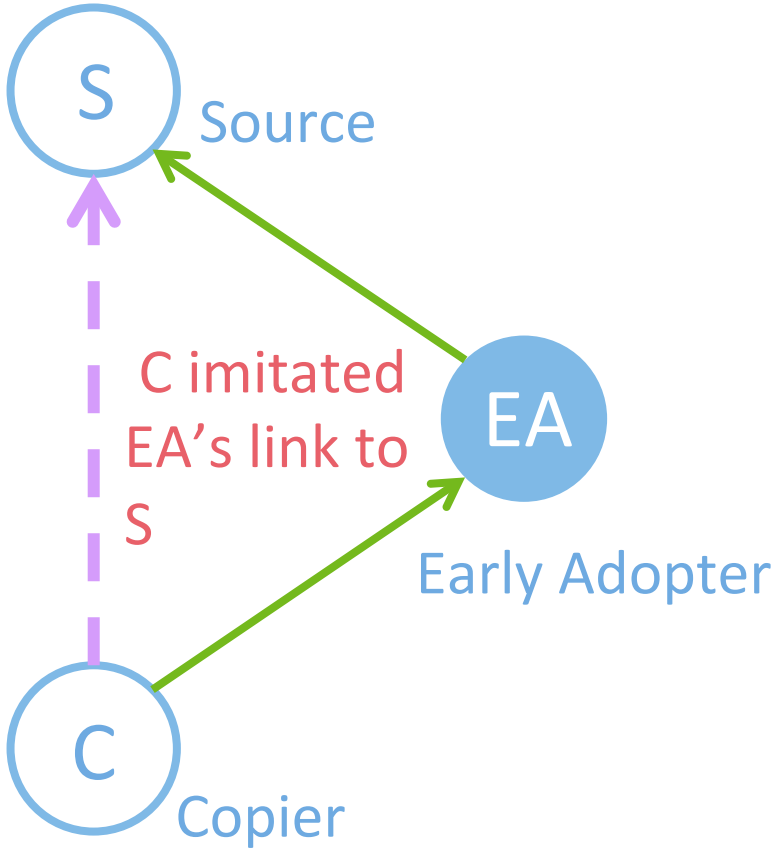
How do we detect early adopters?

Assumption

Early adopters

↕

The users whose follow links are imitated by many followers.



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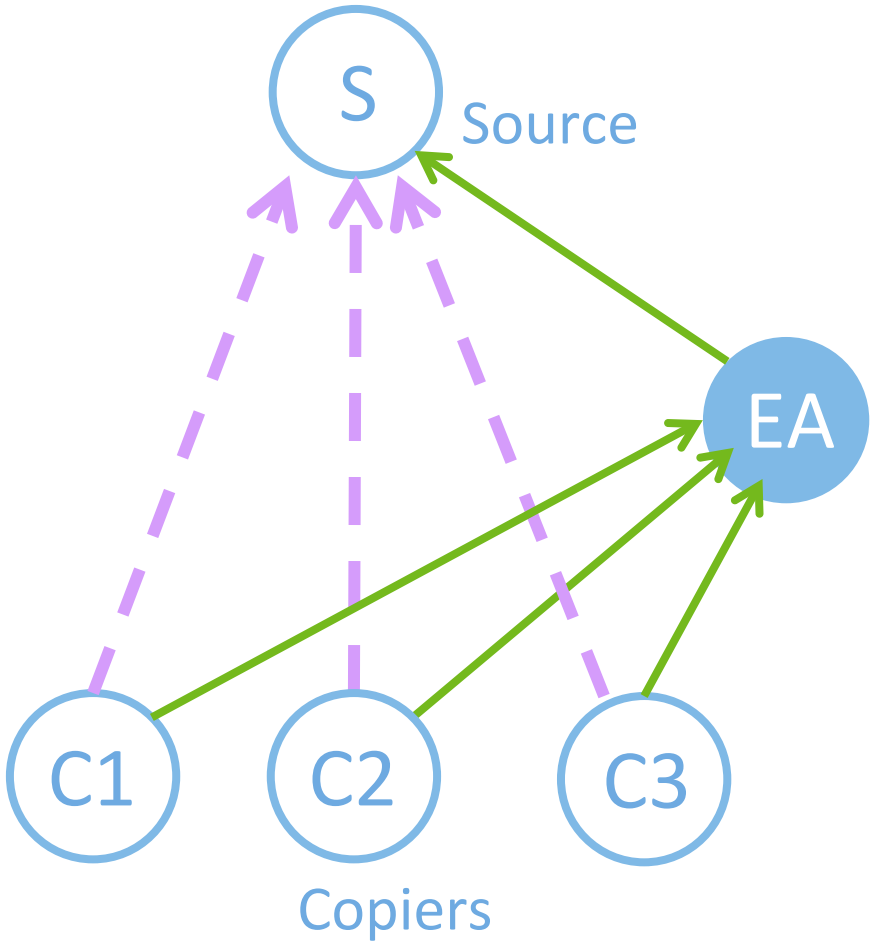
We can detect early adopters based on the frequency of link imitation.



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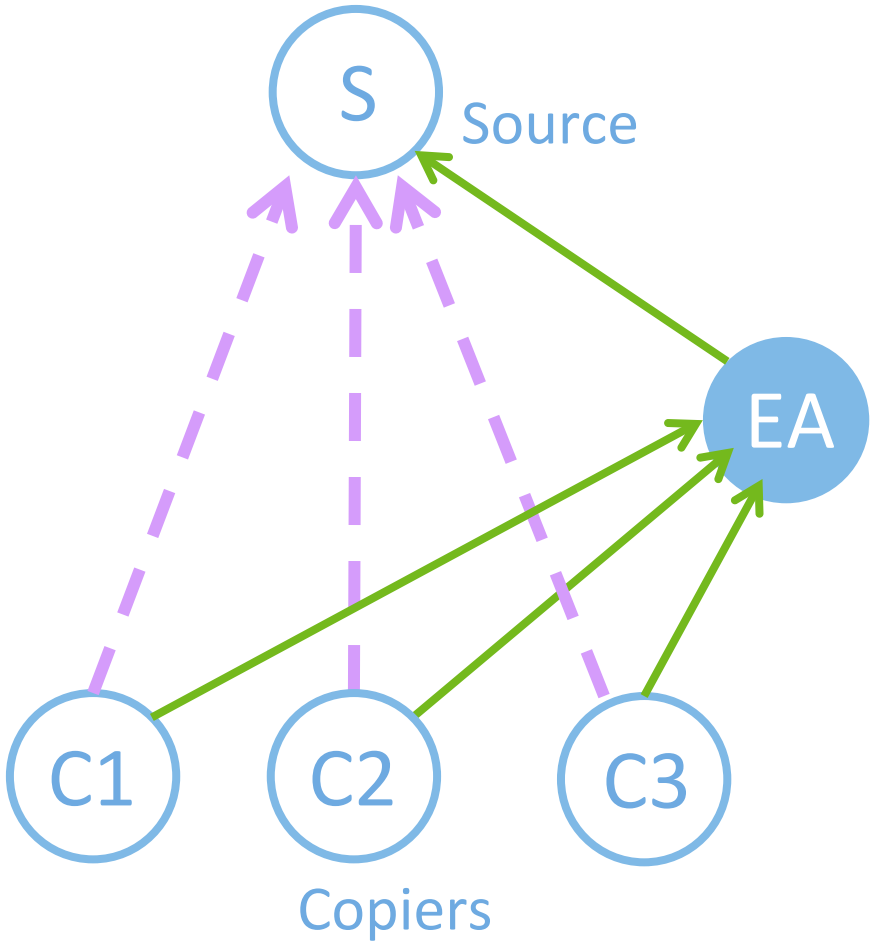
2. Count number of link imitation.

3. Calculate ***early adopter score*** from the number of link imitation.



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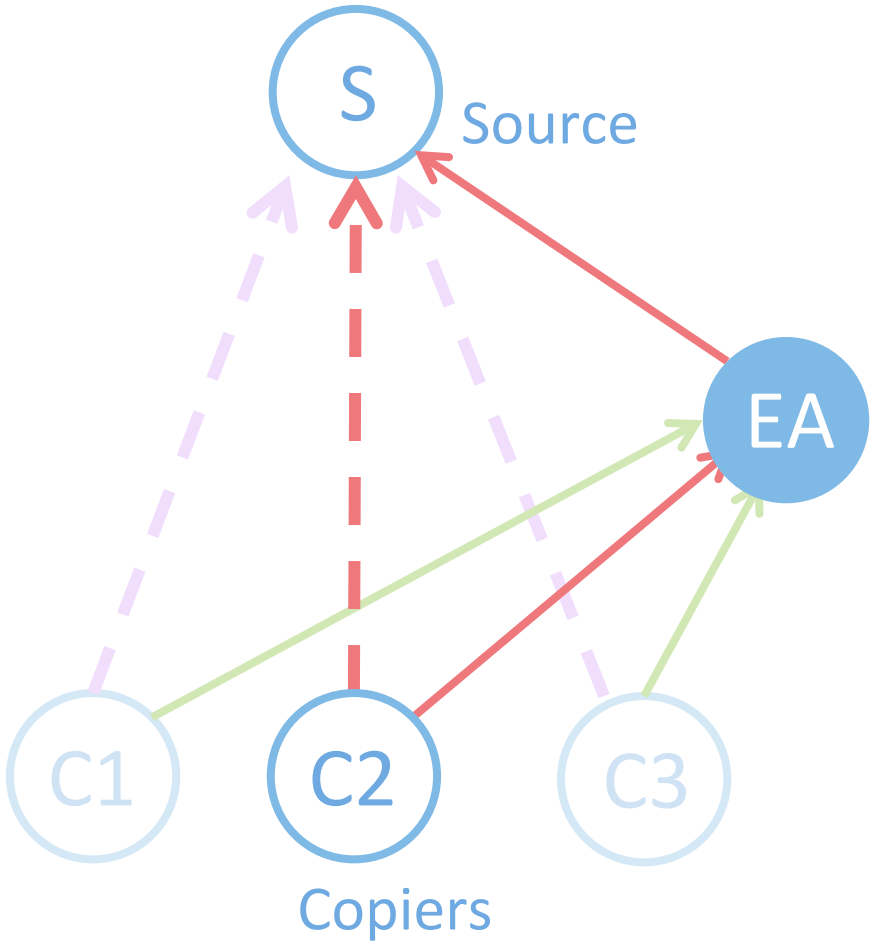

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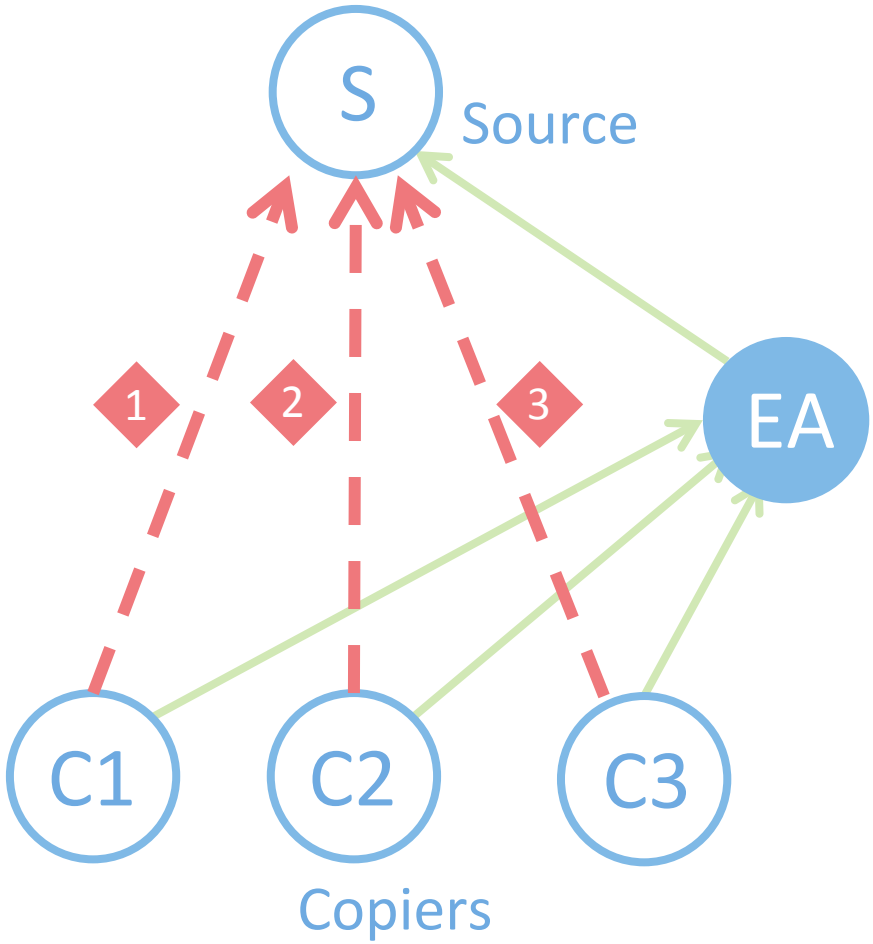

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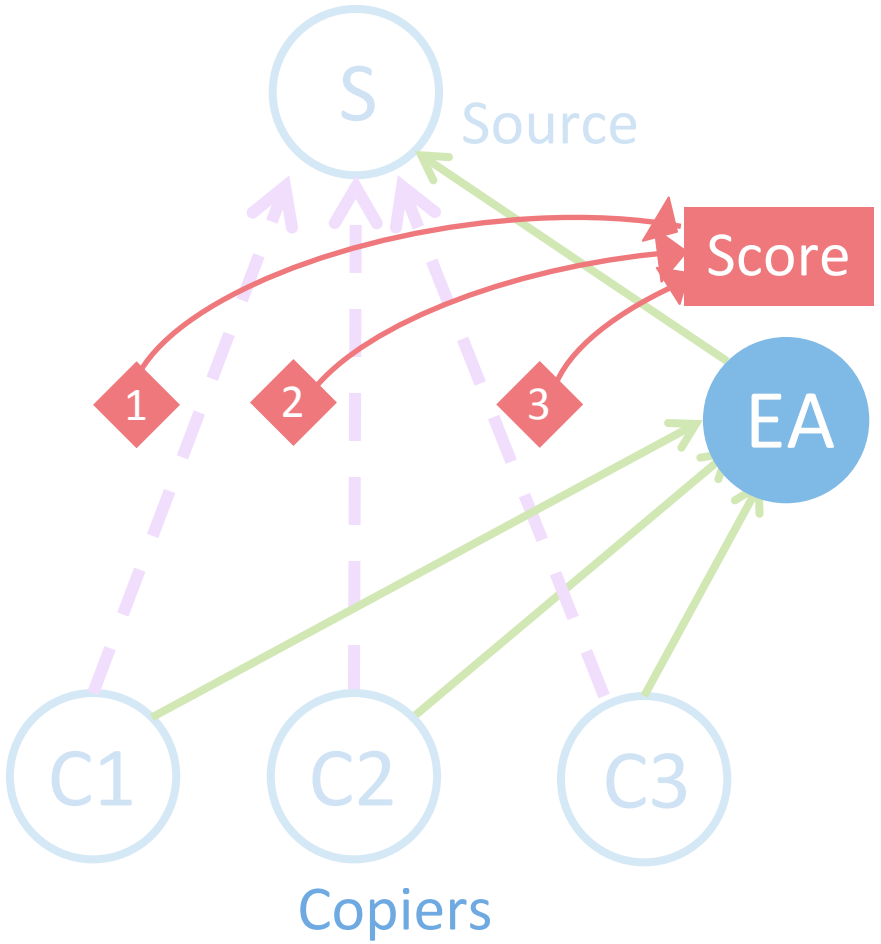

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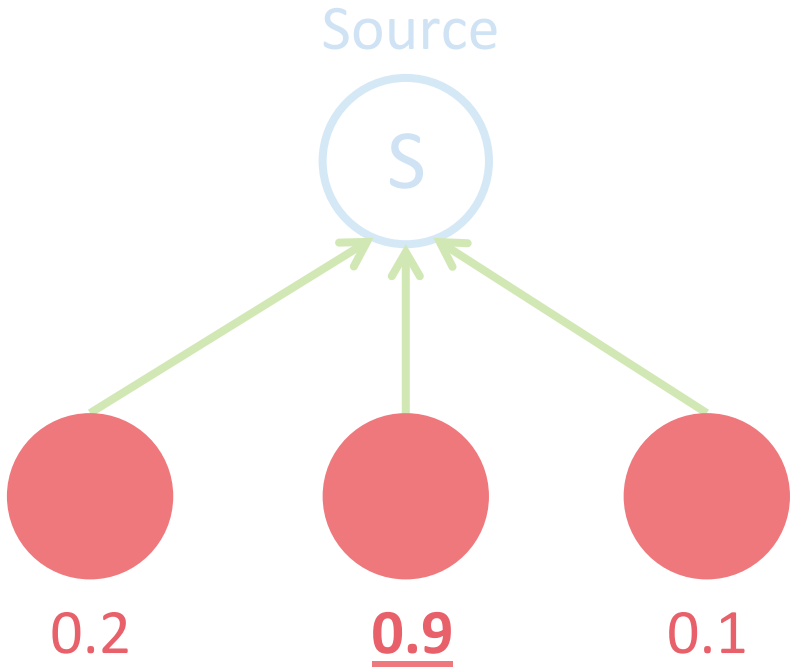

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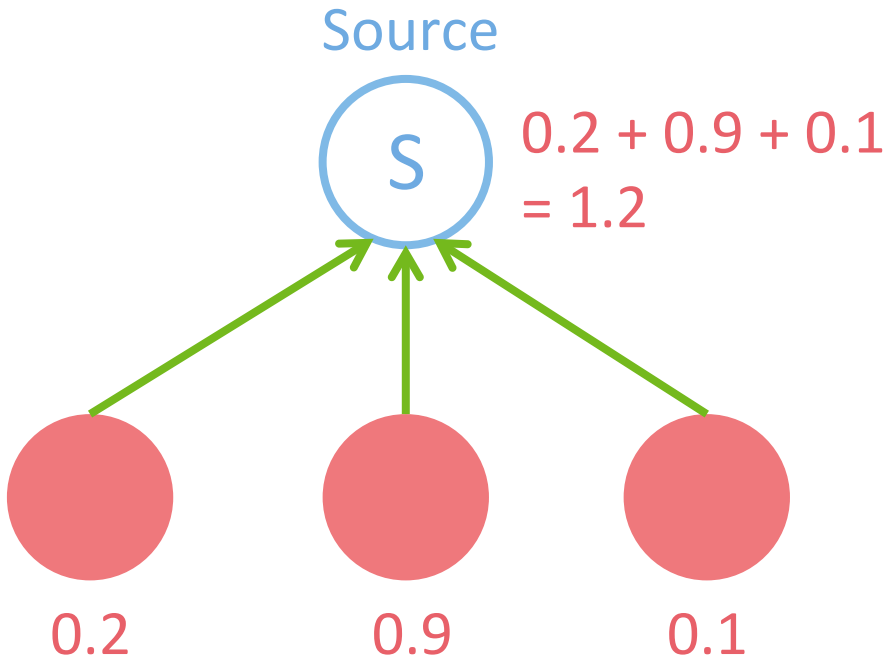

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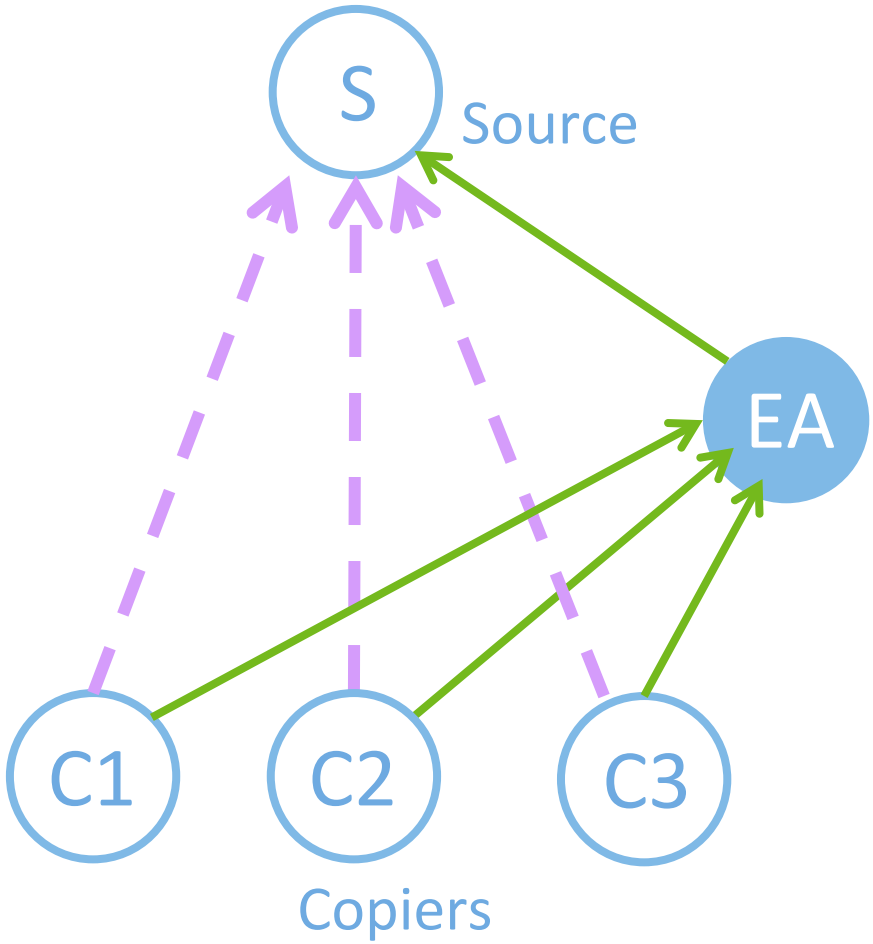

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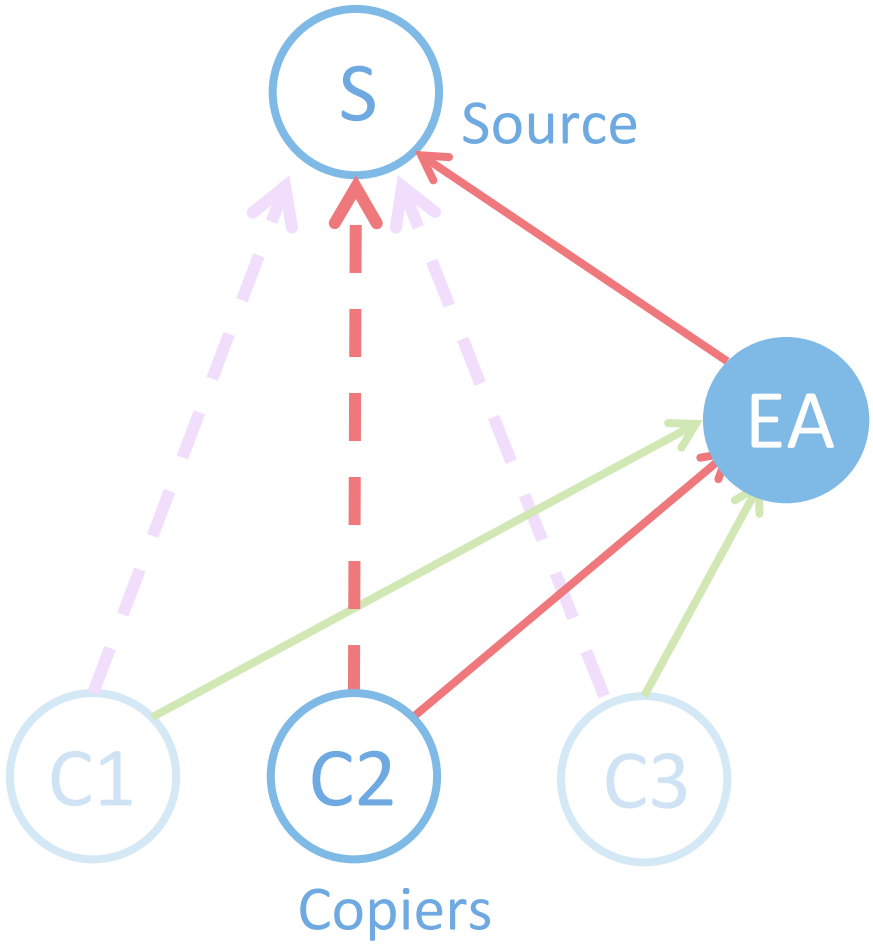

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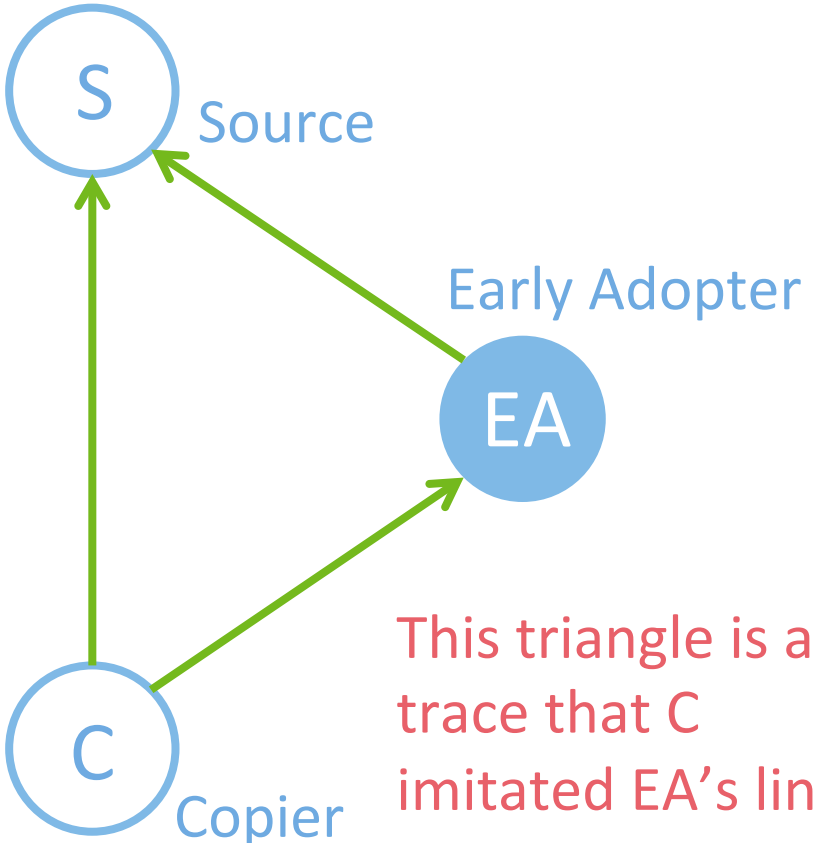

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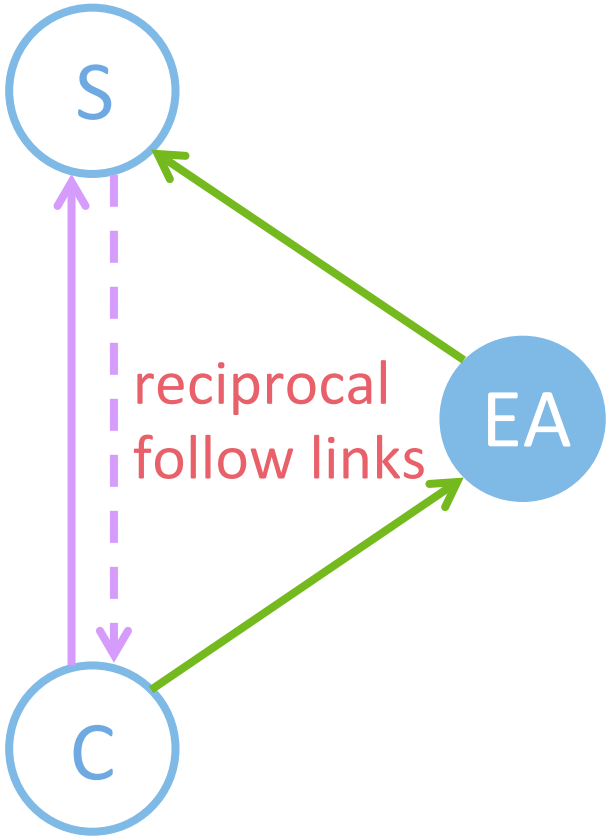

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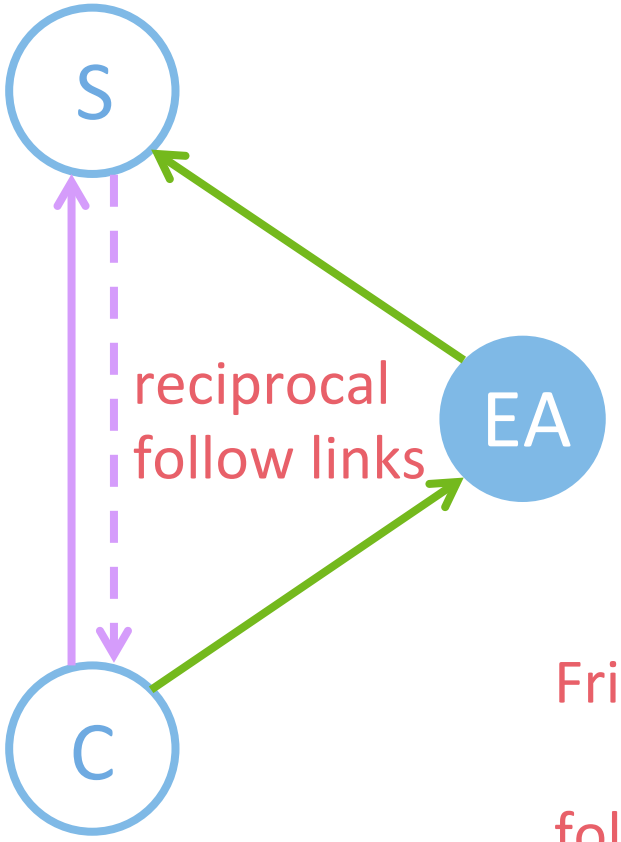
It is important whether this link of triangle is reciprocal or non-reciprocal.



Friendship
or
followback

DETECTION OF LINK IMITATION

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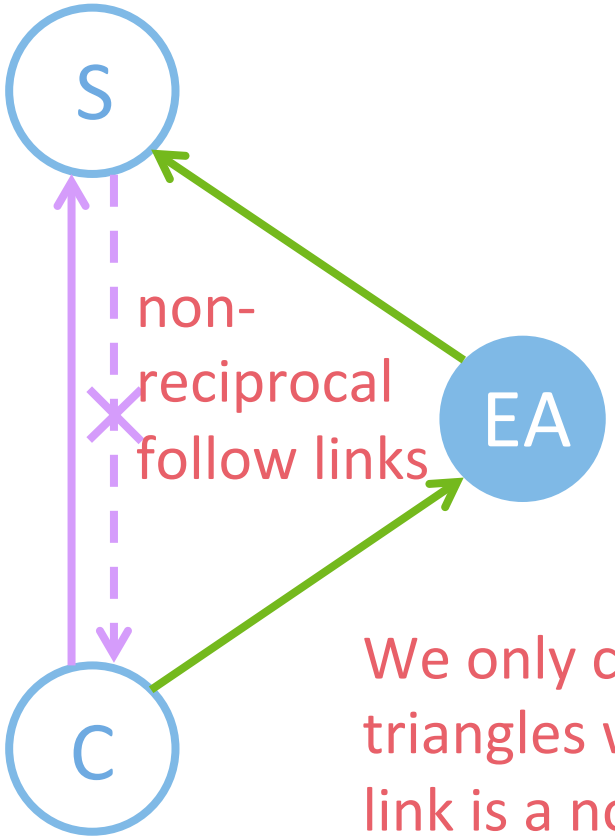

We only count triangles where the link is a non-reciprocal.

DETECTION OF LINK IMITATION

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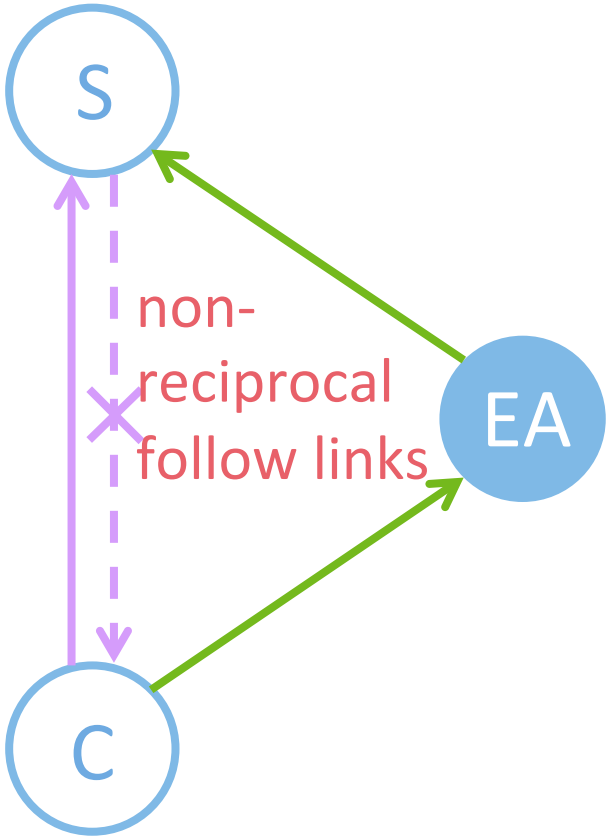
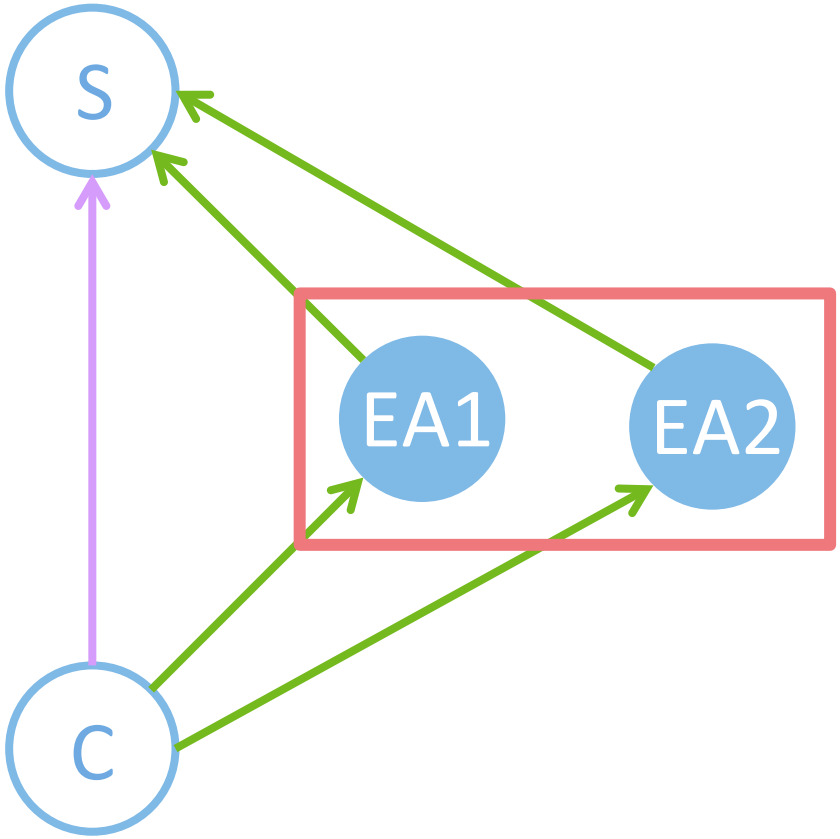
We can detect links created through imitation



WHEN THERE ARE MULTIPLE CANDIDATES

However, in the right figure, it is difficult to determine which was imitated by C, EA1 or EA2



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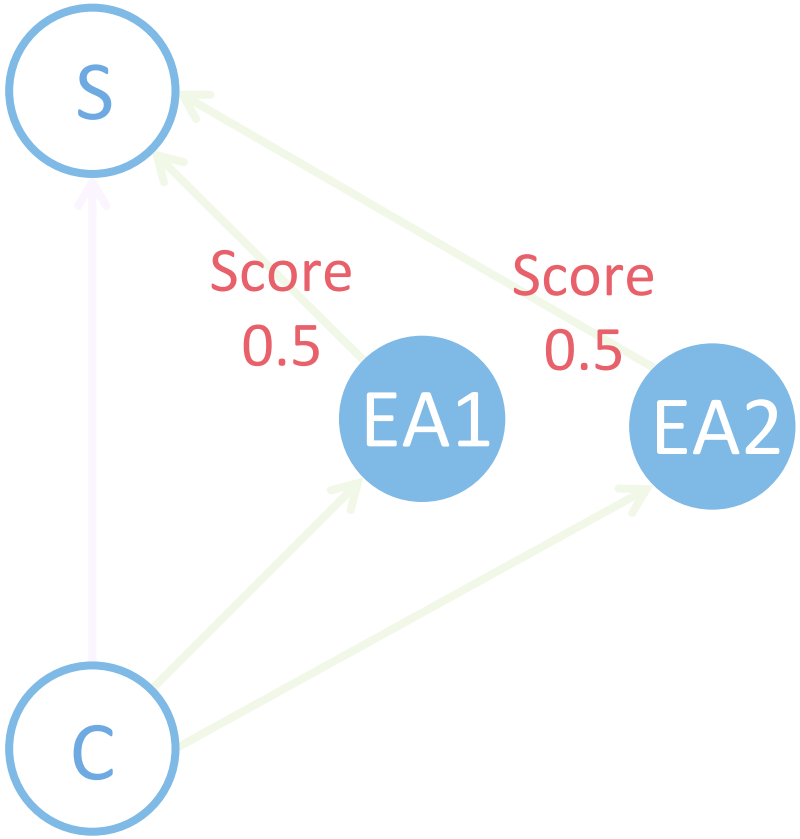
Each candidates are given a score equally.



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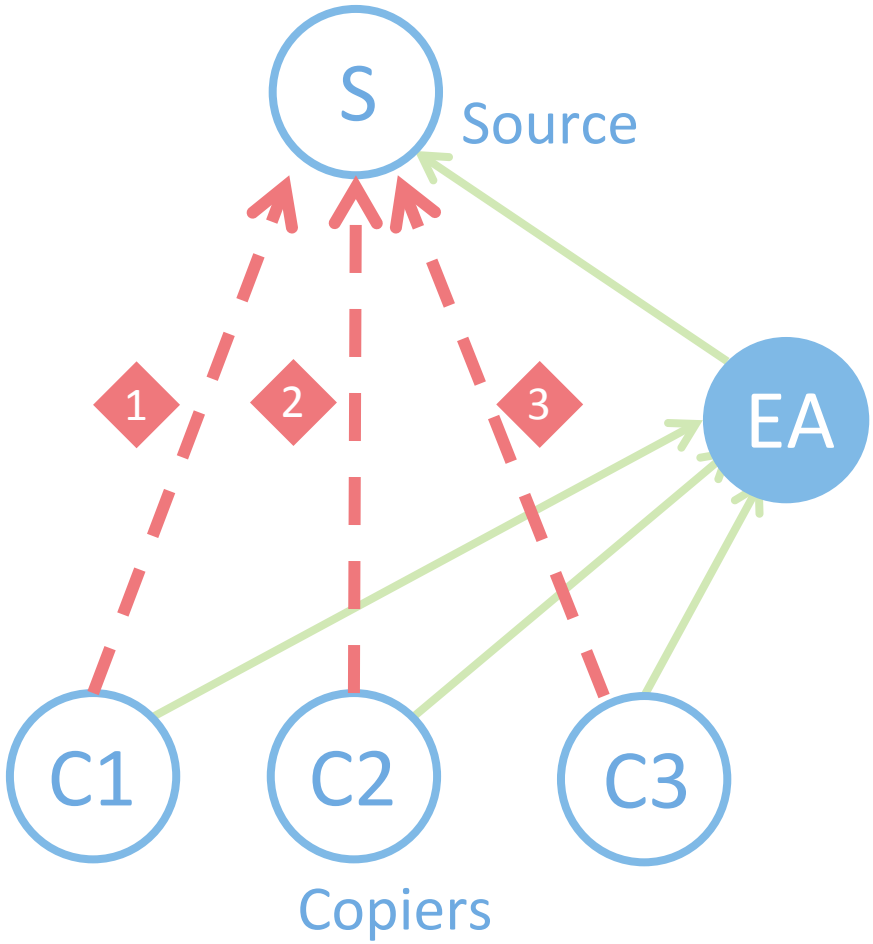
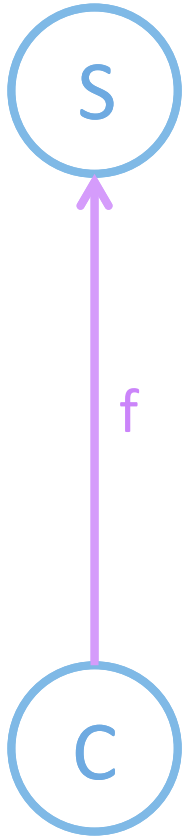


HOW TO COUNT NUMBER OF IMITATION

Our method process all edges in the graph one by one.

Each follow link f in a graph



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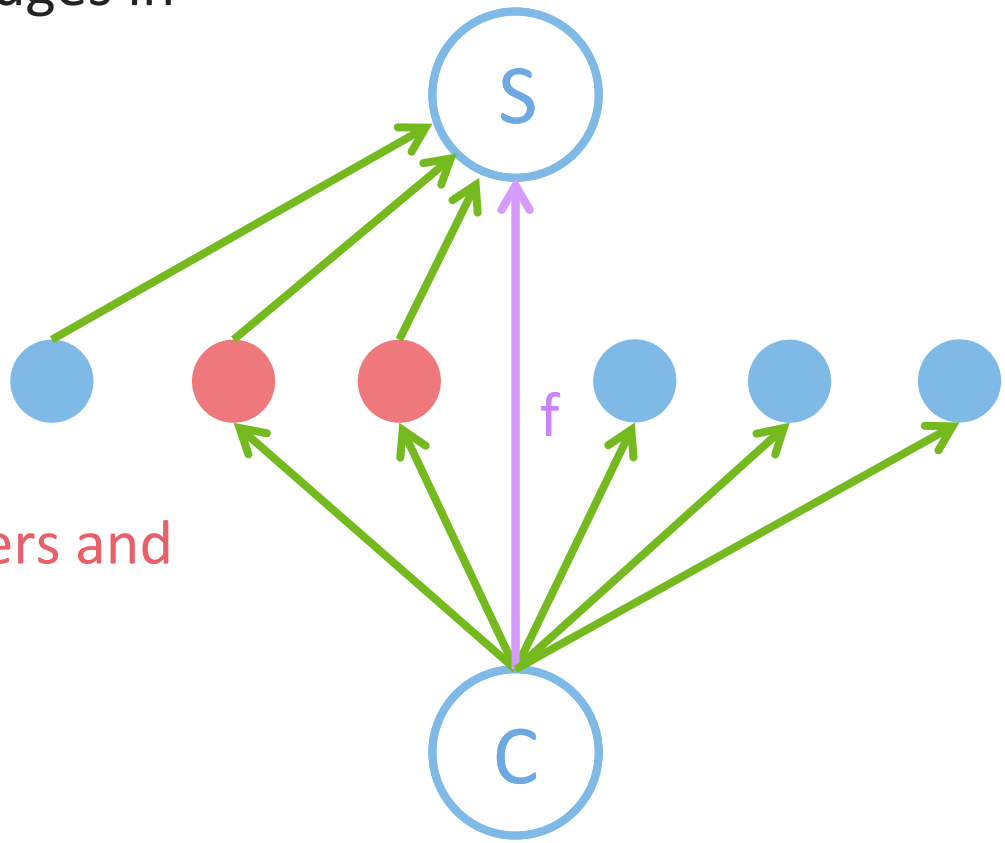

Intersection of S's followers and C's followees

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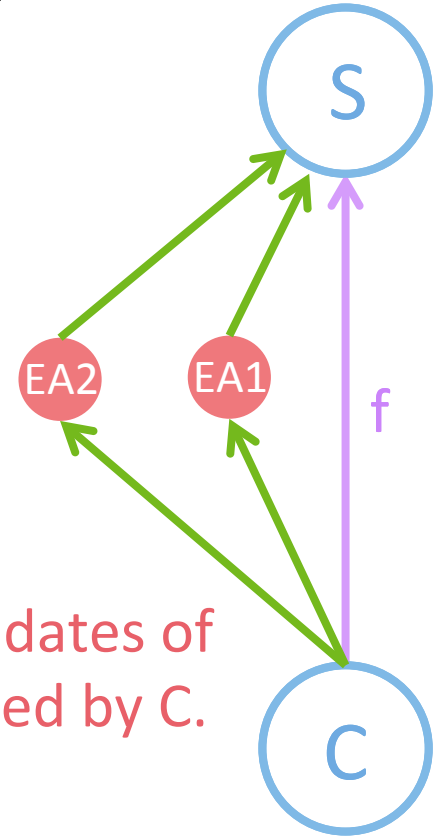

These intersection users are candidates of users whose links to S were imitated by C.

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Accumulating the score for each candidate

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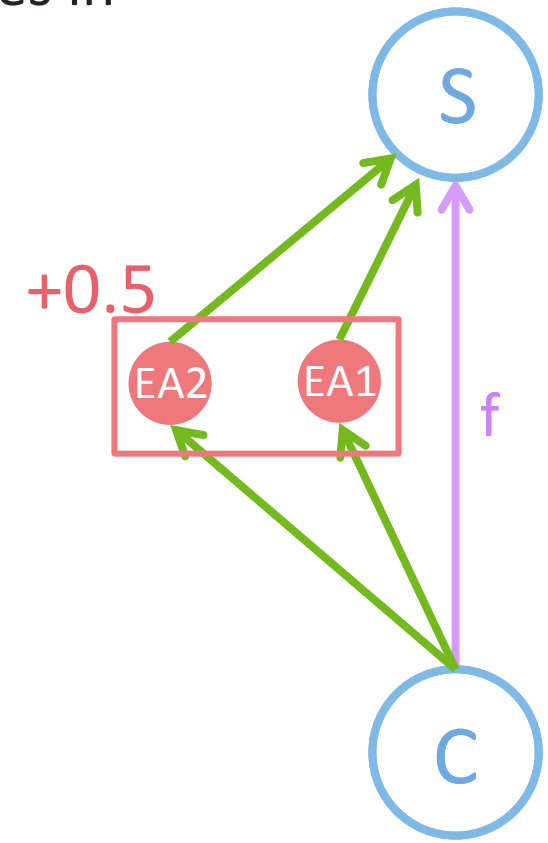

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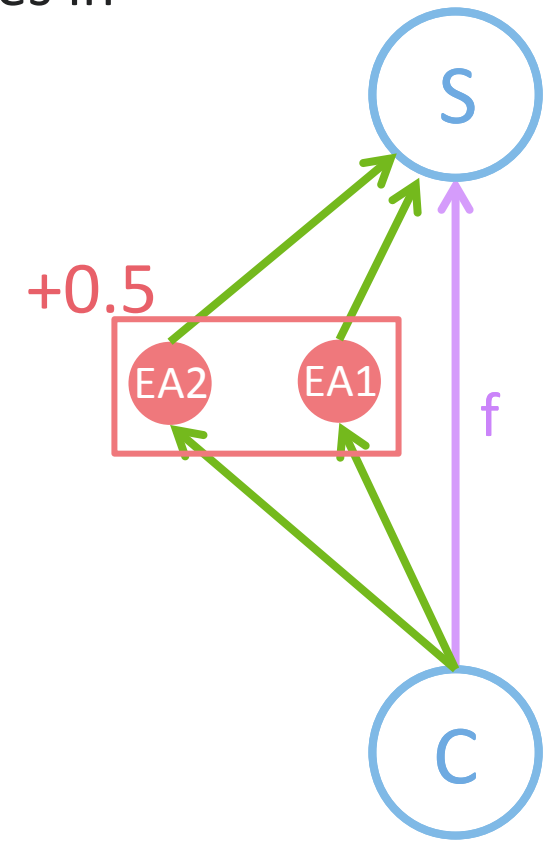

Accumulating the score for each candidate

EA1's accumulated score = 0.5

HOW TO COUNT NUMBER OF IMITATION

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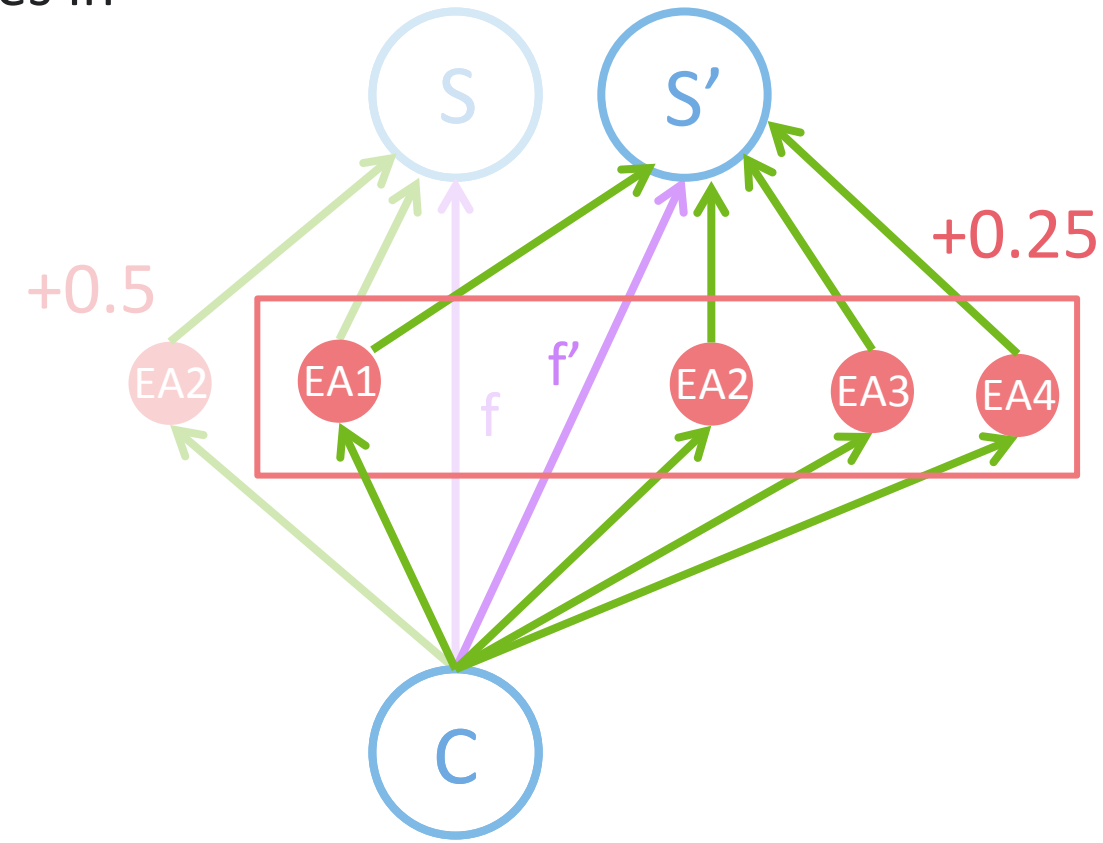
Accumulating the score for each candidate

EA1's accumulated score
= 0.5 + 0.25
= 0.75

Each follow link f in a graph



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After processing all links in the graph, the scores accumulated to each user is the expected number of times that user has been imitated.

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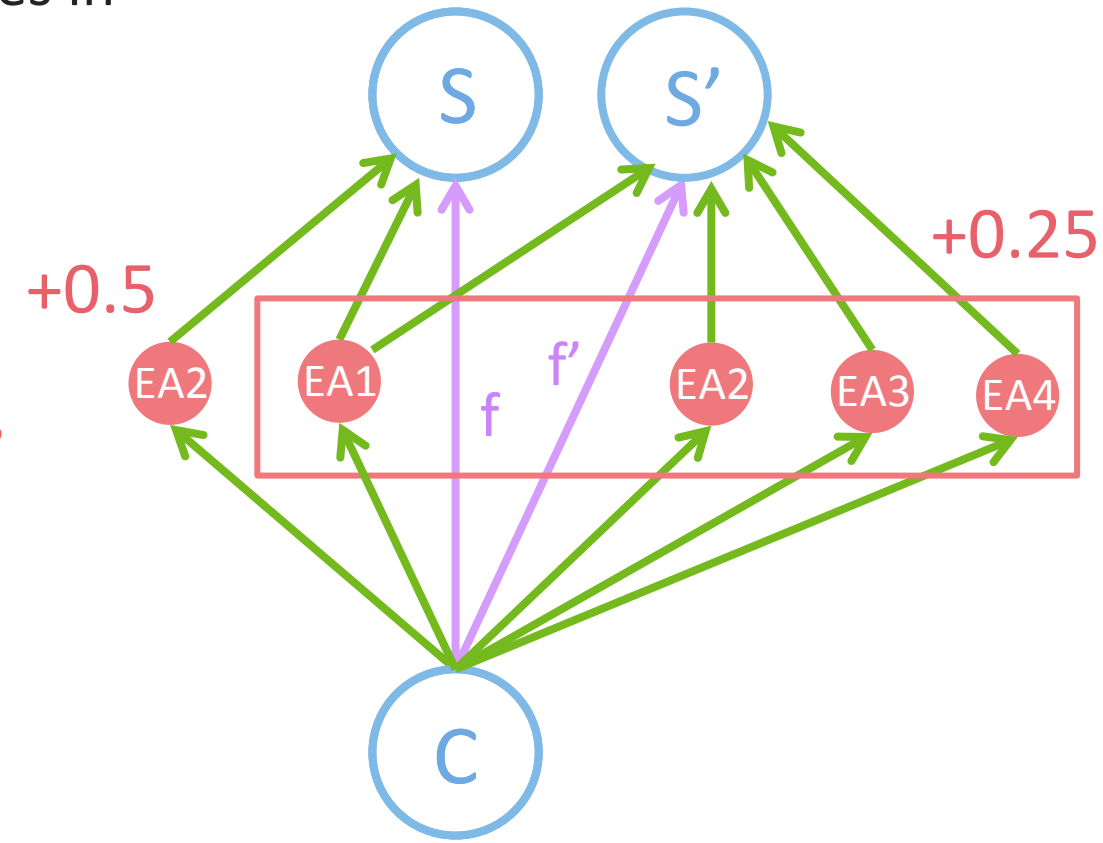

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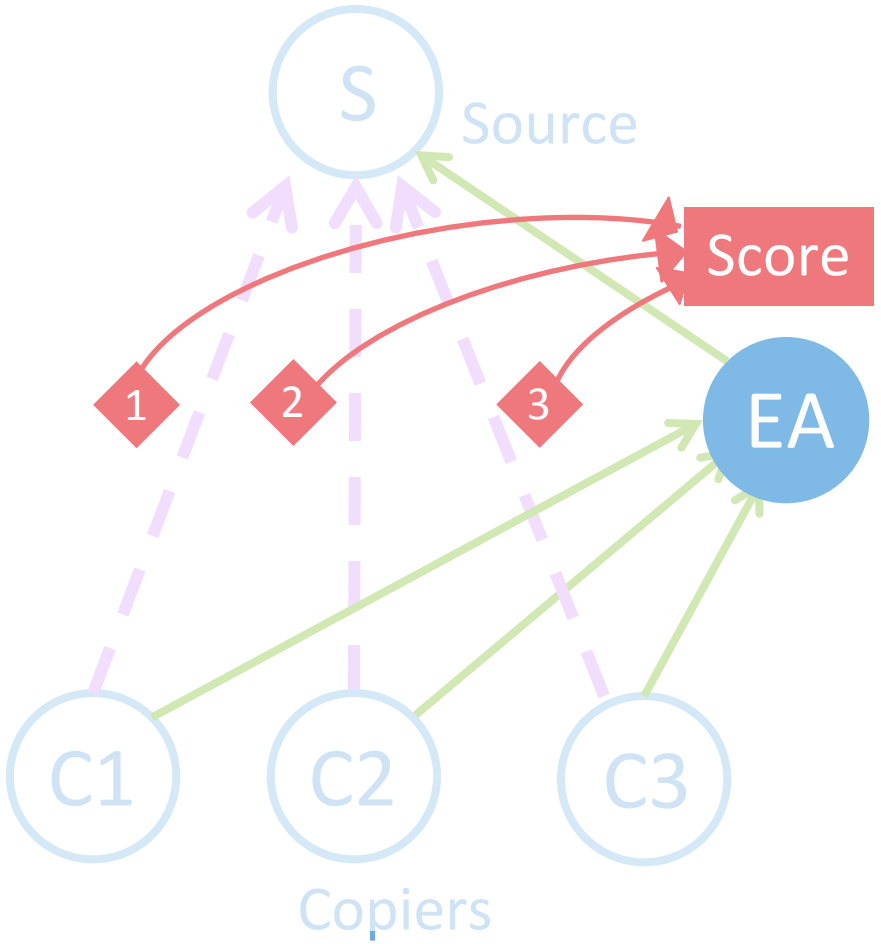

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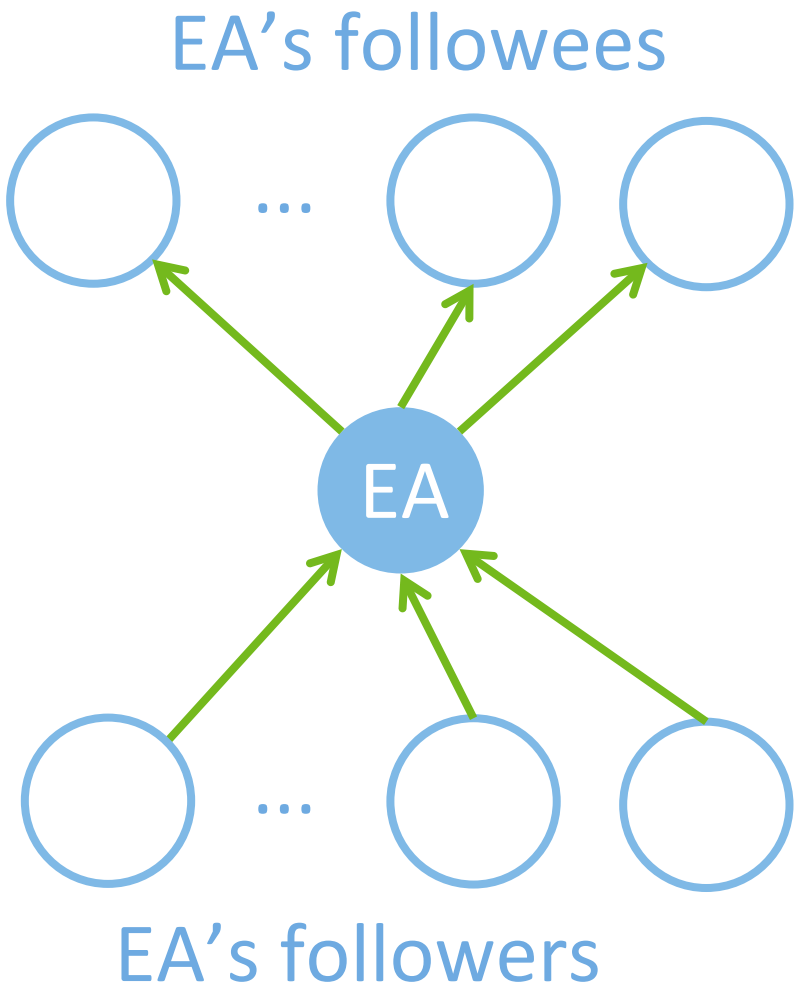
Early adopter score

$$= \frac{\text{Number of link imitation}}{|\text{followees}| \times |\text{followers}|}$$



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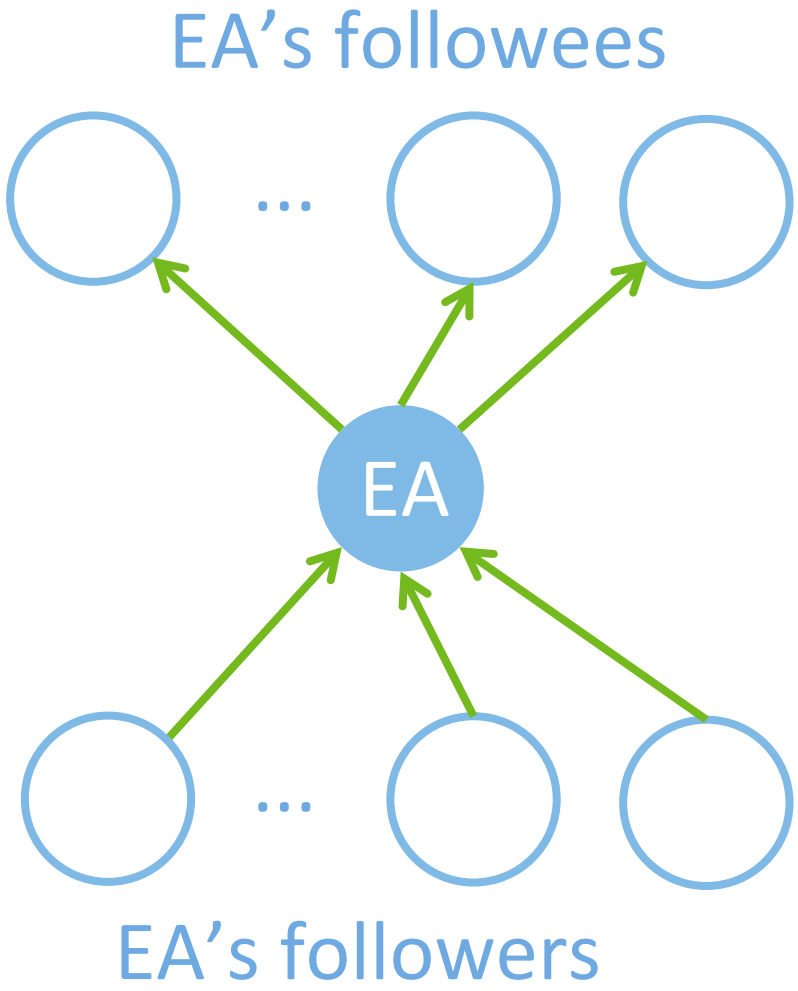
This denominator corresponds to the maximum number of times this user could be imitated.



EARLY ADOPTER SCORE

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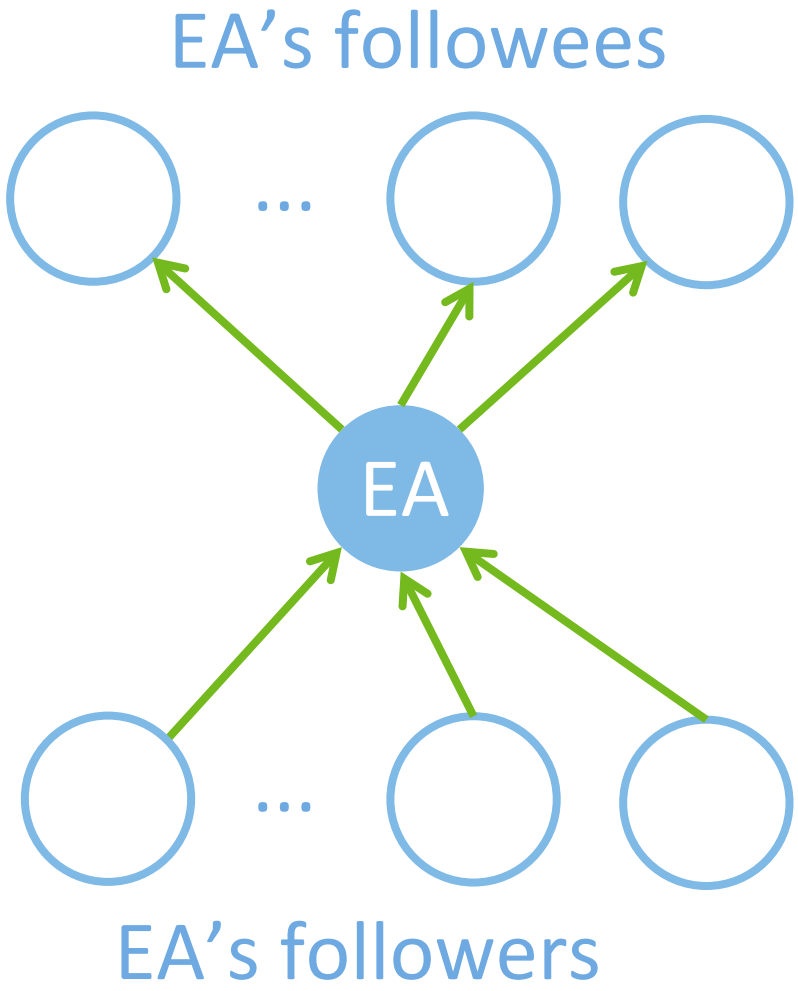
This fraction corresponds to the imitation ratio of this user.



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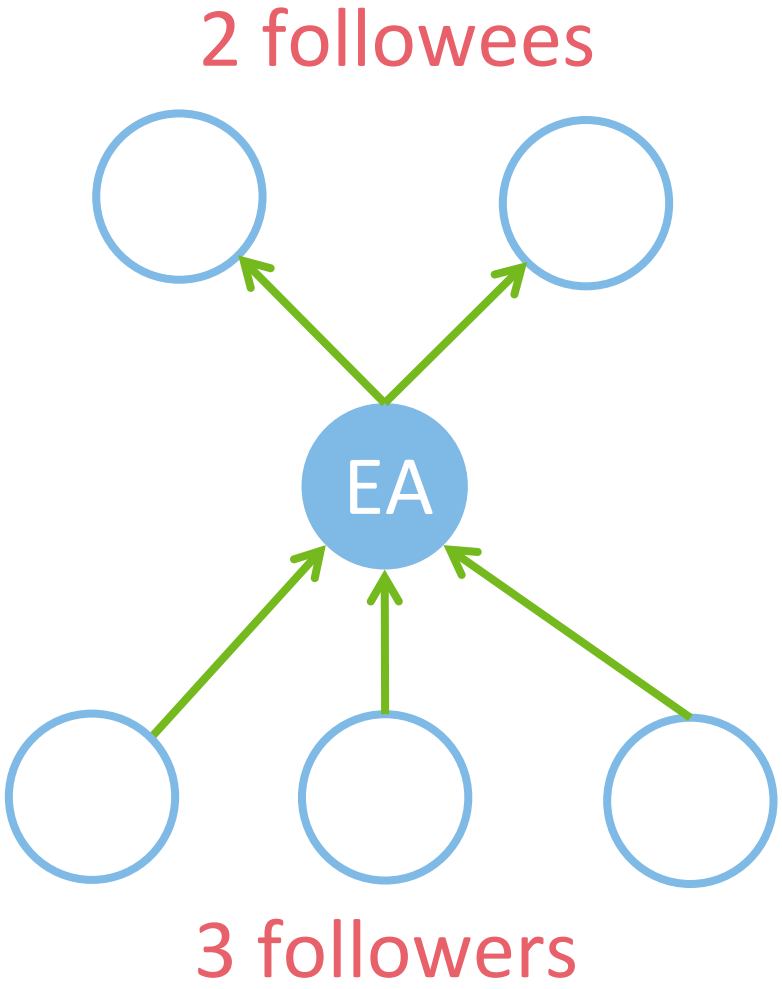

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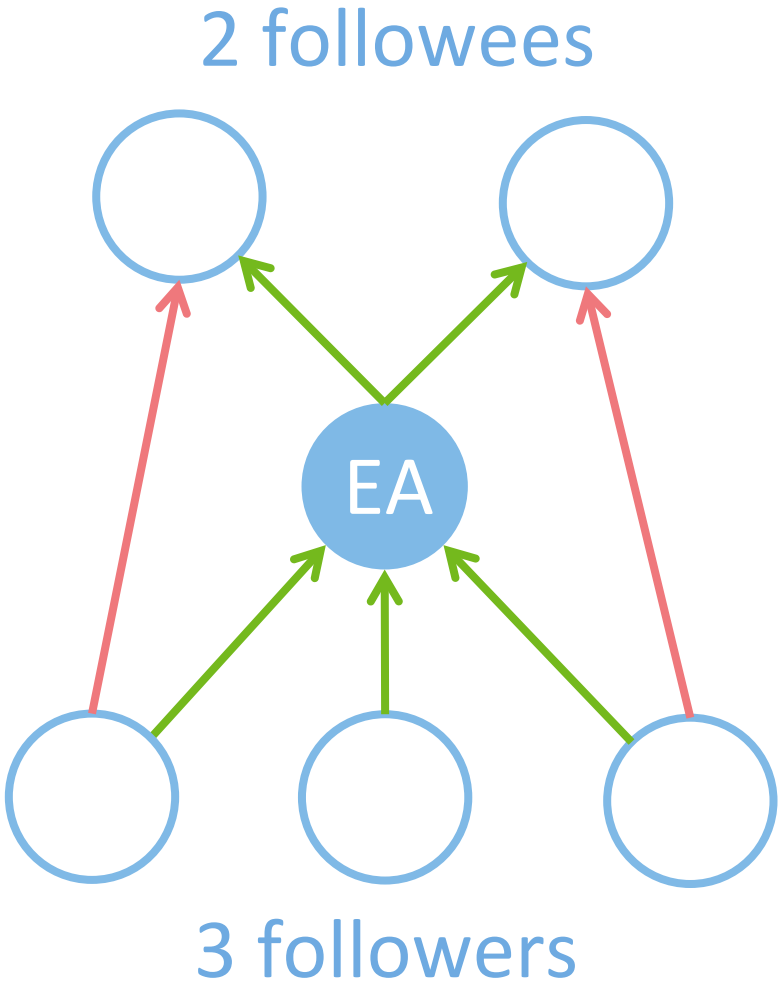

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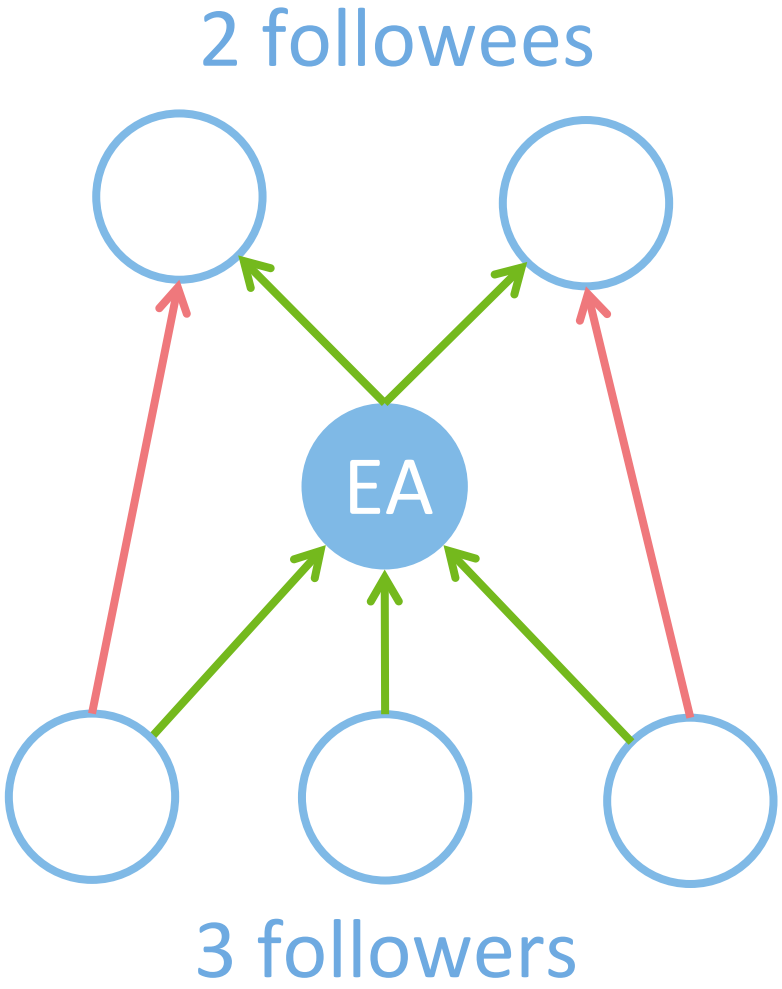

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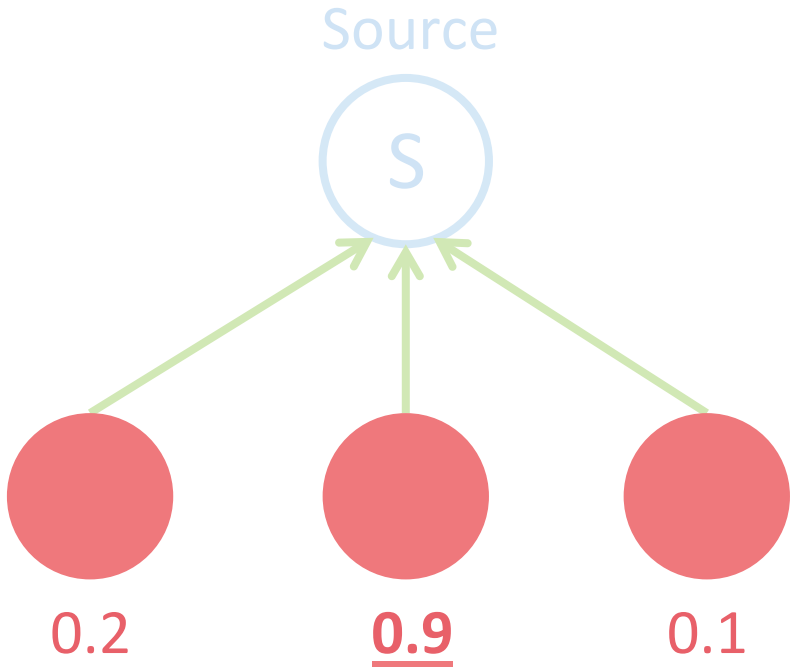

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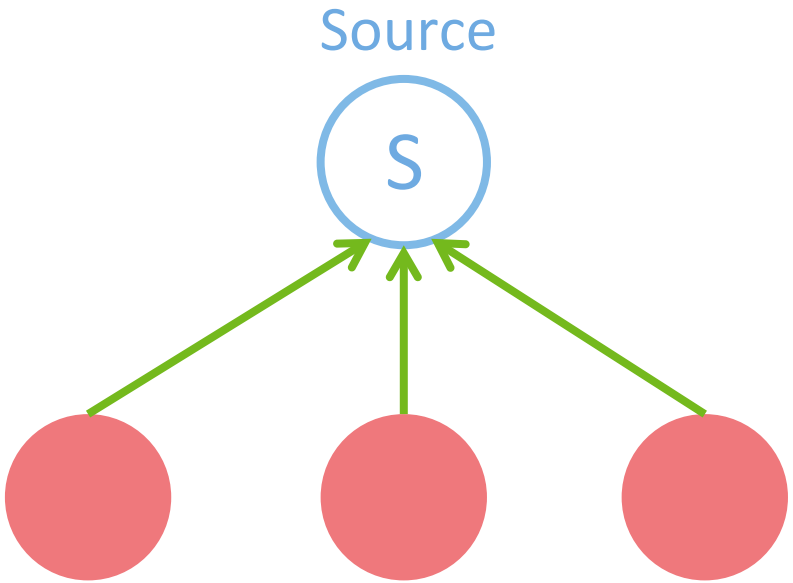

FUTURE POPULARITY SCORE

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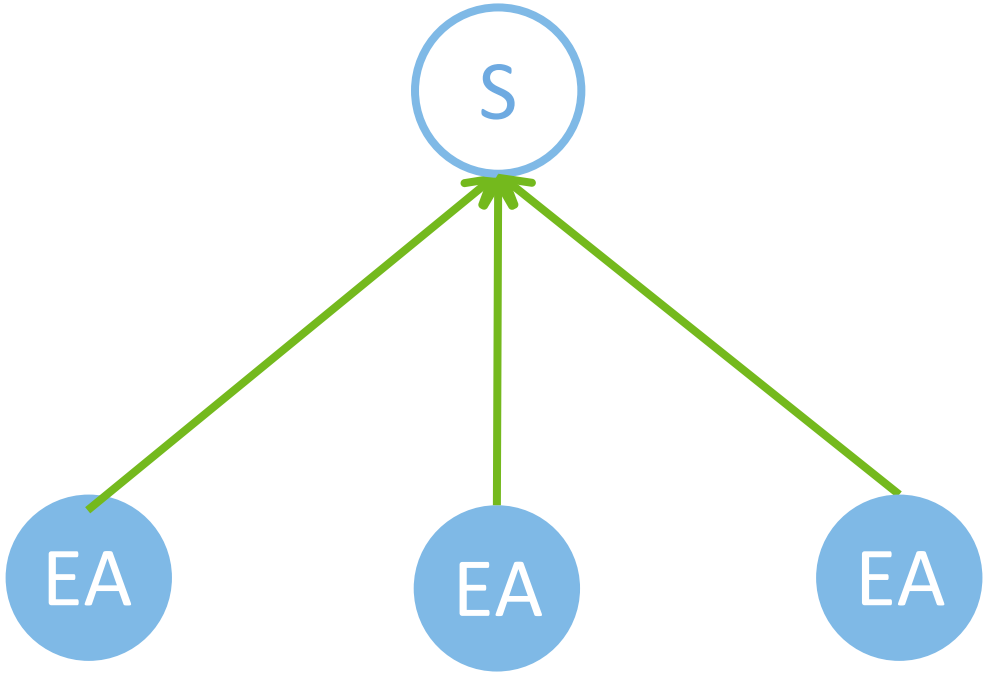

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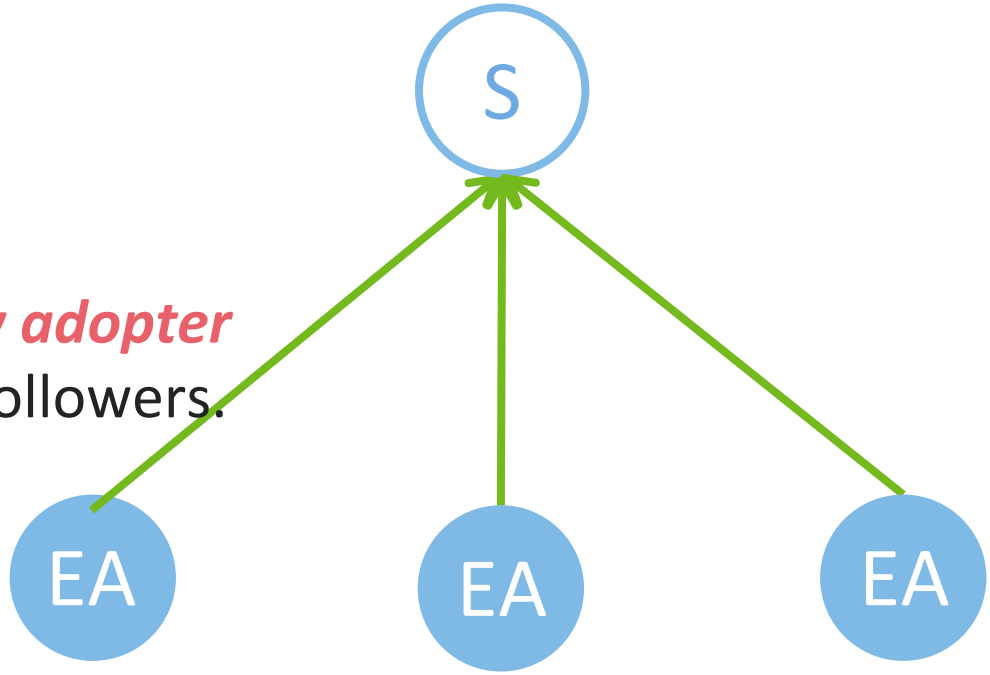

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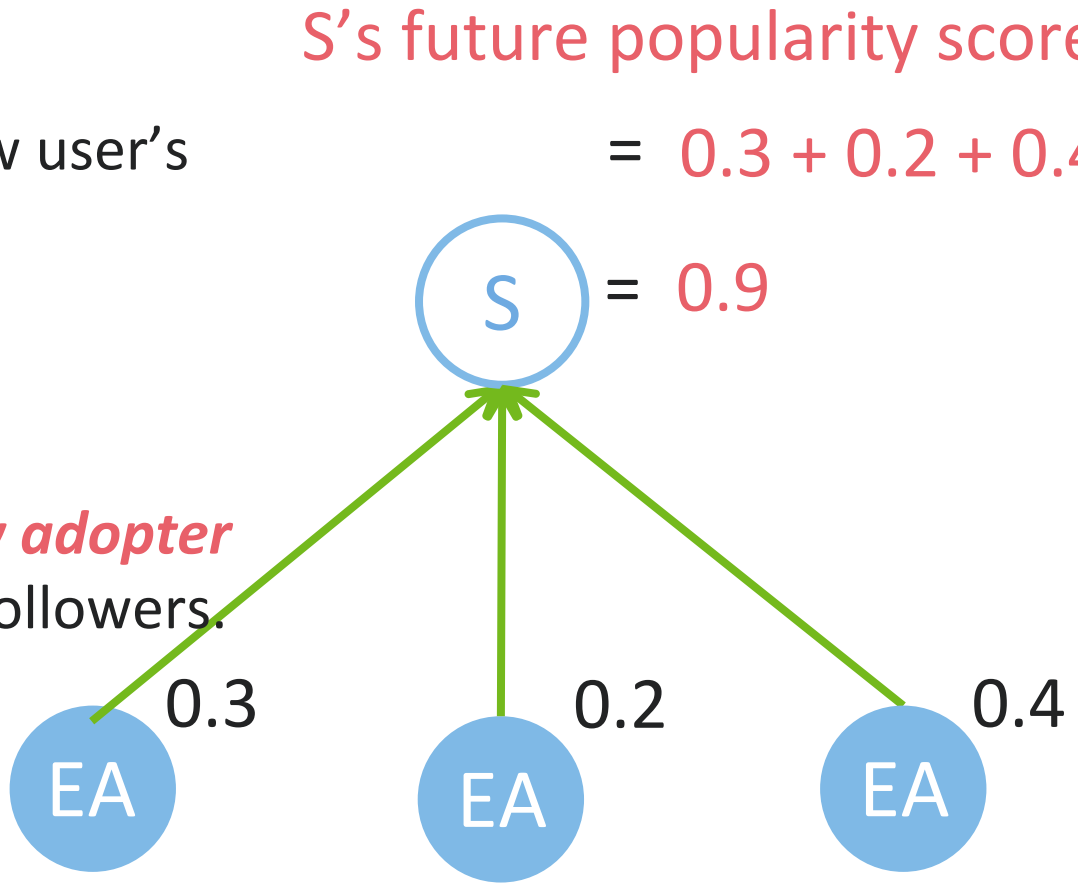

OUR EXPERIMENT

- Dataset [Li et al., KDD 2012]
  - A sub-graph of Twitter crawled in 2011
  - About 20,000,000 users
  - About 300,000,000 follow links
- Target users
  - T_n^w: we select then-new users that are
    - within *w* weeks after the creation, and
    - have more than *n* followers

OUR EXPERIMENT

- Evaluation
  - We rank users in T_n^w by our methods and baselines.
  - Ground truth: we rank users by their number of non-reciprocal followers as of 2015.
  - Compute Spearman's ρ

OUR EXPERIMENT

- Baseline methods
  - FW: Number of followers in May 2011
  - PR_{nr}: PageRank scores on the graph consisting only of non-reciprocal links
  - $HITS_{nr}$: HITS scores on the graph consisting only of non-reciprocal links
  - AD: Adamic-Adar index
- Our methods
  - FPS: Feature popularity score
  - LR: The linear regression of FPS and some baselines

OUR EXPERIMENT

Method	T^4_{10}	T^2_{10}	T^4_{20}	T^2_{20}	T^4_{30}	T^2_{30}
data size	6921	1515	2259	431	979	165
FW	0.18	0.23	0.15	0.07	0.19	0.00
$HITS_{nr}$	0.26	0.31	0.30	0.35	0.38	0.46
PR_{nr}	0.16	0.09	0.21	0.20	0.30	0.32
AD	-0.21	-0.13	-0.30	-0.46	-0.27	-0.50
FPS	0.39	0.41	0.39	0.45	0.40	0.47
LR	0.43	0.46	0.43	0.50	0.45	0.58

OUR EXPERIMENT

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green: best within baselines

- HITS works best in most cases.
- AD is the best in some cases.

OUR EXPERIMENT

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FPS	0.39	0.41	0.39	0.45	0.40	0.47
LR	0.43	0.46	0.43	0.50	0.45	0.58

- FPS is the best in most cases among all the methods excluding LR
- LR is the best for all cases. It means that FPS captures some aspects that are not captured by other methods.

red: best
blue: best excluding LR

CONCLUSION

- We proposed a method of estimating prospective popularity of new users.
- Our method estimate it through the discovery of early adopters.
- Experiment by using sub-graph of Twitter.
- Our method outperforms baselines.