



Ego-net mining & Implicit social graphs

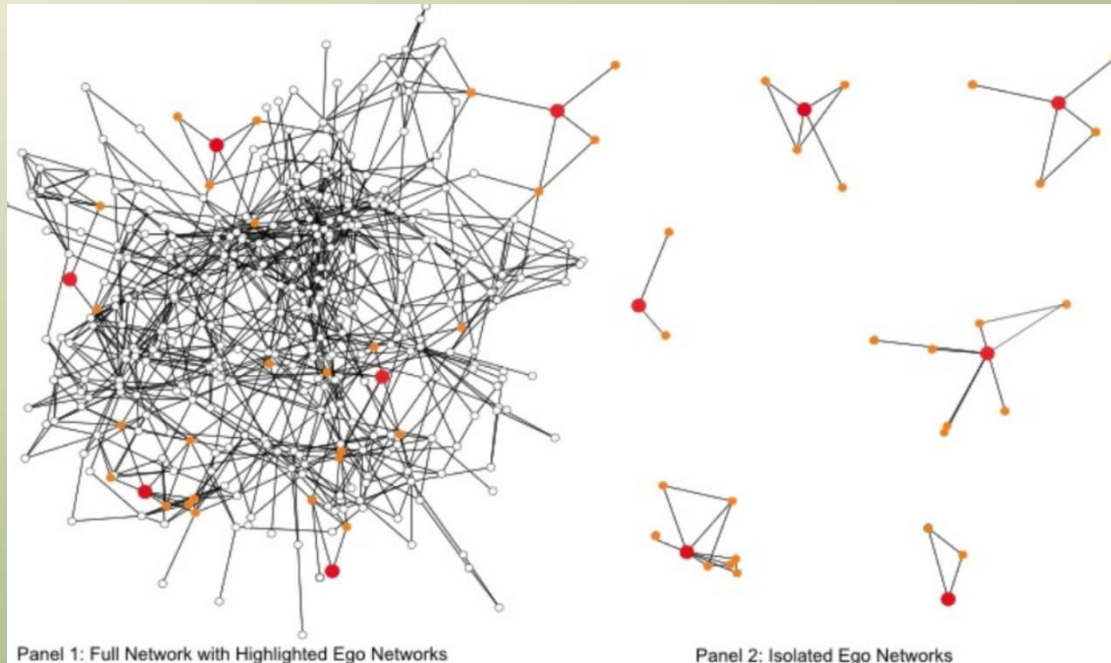
**Applied to friend suggestions
in social networking**

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Introduction:

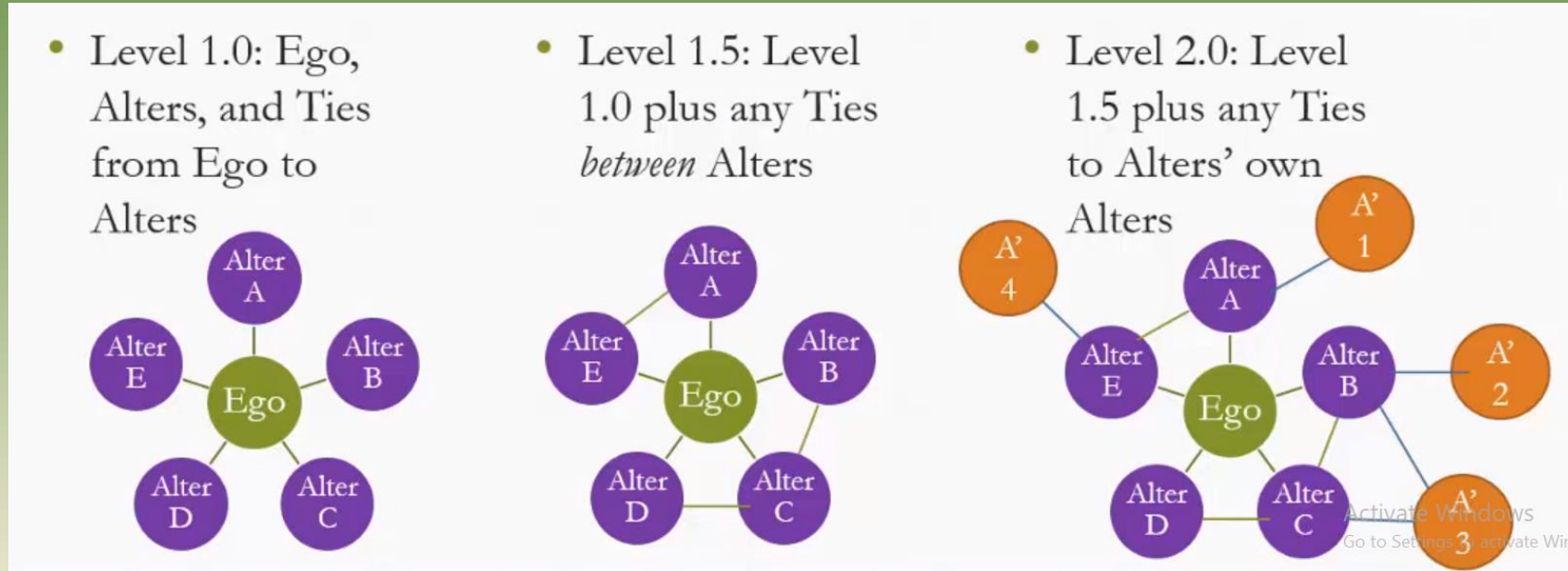
- Various results have been confirmed by recent studies that observed that real life communities hardly follow the assumptions of the most commonly used algorithms [3]. They strongly overlap with each other and often have more connections outside than inside themselves. This makes it hard to even define communities at the global graph level.

In contrast with these findings, it has been observed that while communities might be difficult to find at a global level, their structure seems to be much more clear at a microscopic level [4]. This is particularly true at the level of node-centric structures called **ego-networks** (or ego-nets) which are the sub-graphs representing the connections among the neighbors of a given node.



Ego networks:

set of *ties* connecting *ego* and *alters*, out to a set distance.



But why stop at level 2?

"Horizons of Observability"[5]

beyond a network distance of 2 from them, people are only very rarely aware of important details in their networks.

[For investigation purposes, ego network of criminals is increased to a distance of 3]

Feels like 'friends of friends' in facebook?

No! there will be a difference after we introduce implicit social graphs into the picture.

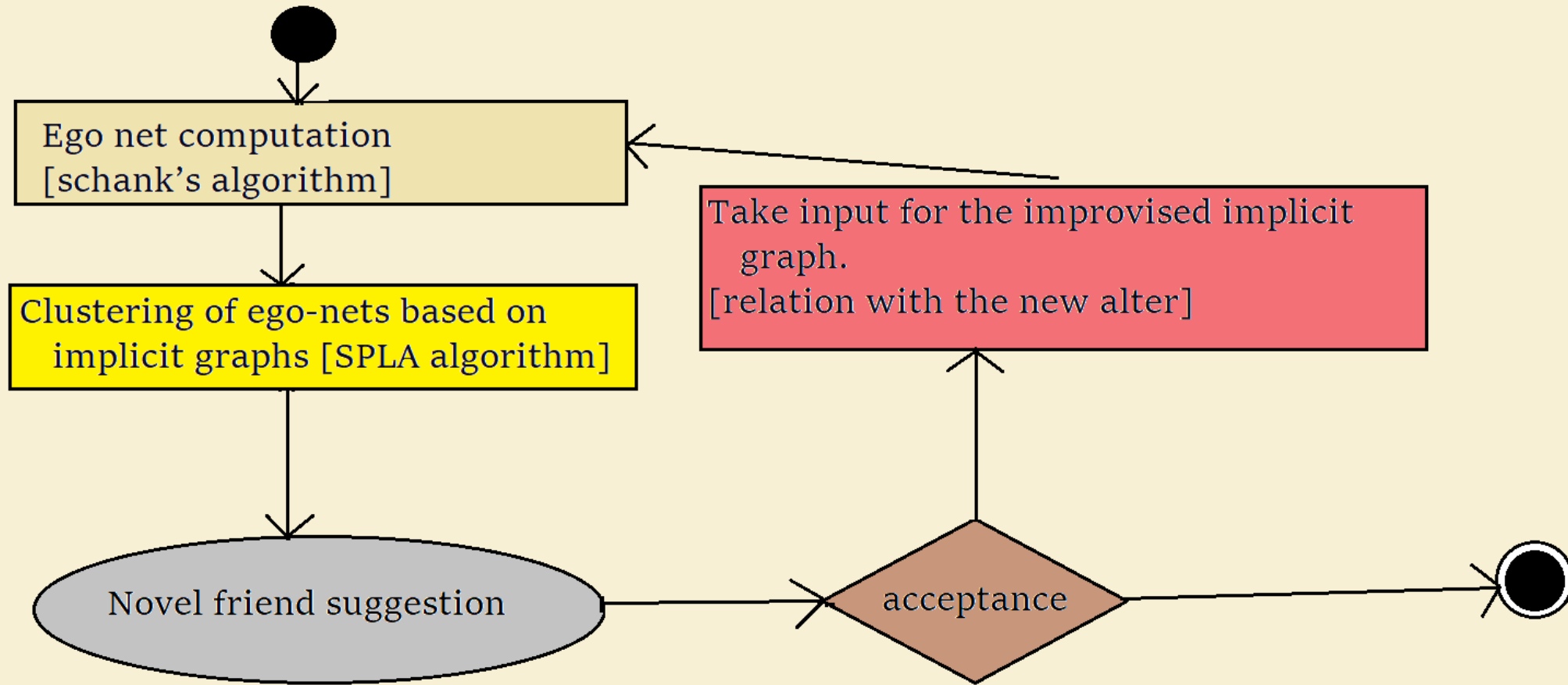
For instance, if you are an employer and you get a suggestion of your employees' relative! That is totally irrelevant for you.

So, the actual problem is to get suggestions of friends of friends who have similar relations with your alters as you!

Implicit social graph::

The implicit social graph which is formed by users' interactions with contacts and groups of contacts, and which is distinct from explicit social graphs in which users explicitly add other individuals as their "friends". We introduce an interaction-based metric for estimating a user's affinity to his contacts and groups.

Research methodology:



Ego net computation:

- This procedure can be implemented in time $O(n \cdot t(\Delta^2) + n^3)$, where t is the maximum degree in the graph and n is the number of nodes. Clearly this technique does not scale in large graphs as nodes might have very high degrees.
- For efficient ego net computing, we can use schank's algorithm[6] for enumerating triangles with a slight change. Which then changes the complexity to $O(m^{1+1/2})$!

Algorithm 2 Fast ego-network construction

Input: $G(V,E)$

Output: All ego-nets of nodes of G .

while $V \neq \emptyset$ **do**

$u \rightarrow$ node of minimal degree.

for $\forall v, z \in N(u)$ **do**

if $(v, z) \in E$ **then**

 Add (u, v) to S_z

 Add (v, z) to S_u

 Add (u, z) to S_v

end if

end for

 Delete node u and its adjacent edges.

end while

Clustering of ego-nets based on implicit graphs:

- The SPLA algorithm[7] is used for ego-net clustering as it has the best performance than other clustering algorithms like LPA, k-core clustering.

Friend suggestion based on clusters.

Learning from the acceptance/rejection of the suggestion.

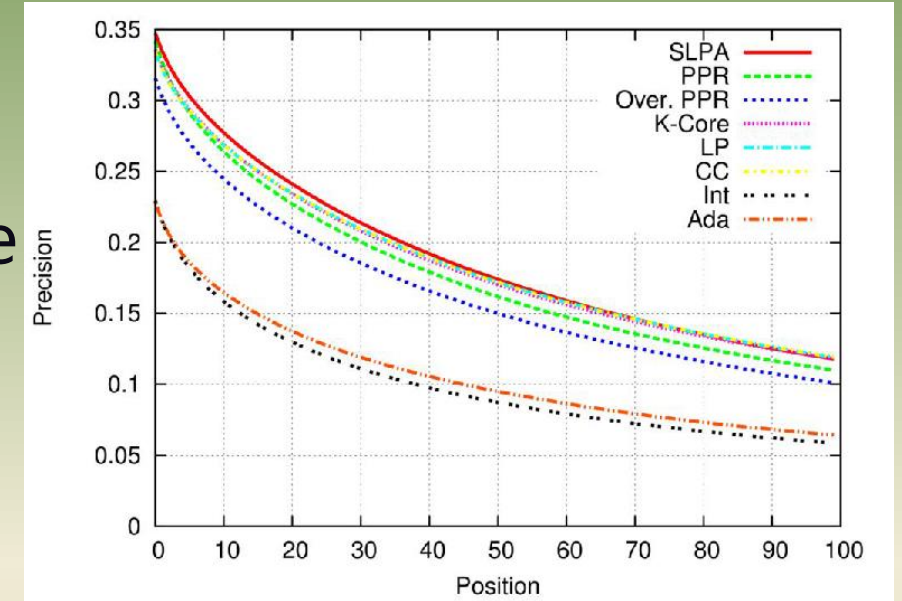
Take input for the improvised implicit graph.

Related works:

- In a classic paper in social network analysis [8] Adamic and Adar defined a first measure of similarity between not adjacent nodes in a social network.
- Gleich and Seshadhri [9] noted the ego networks are good seed for the Personalize PageRank clustering.
- Akoglu et al [10] showed that simple statistics on ego-nets help find suspicious and spam nodes.
- Sharma et al [11] showed that suggestions based solely on information on the neighbors of node give performance in line (and sometimes superior) to using the entire graph.

Results & Conclusion :

- It was observed that the simple *ego-net friendship score* defined before performs better than the number of common friends and the Adamic Adar score.
- An increase in acceptance rate by more than 1.5% and a decrease in rejection rate by more than 3.3% was noted.
- Ego-net mining could be potentially used to detect spam requests to join circles.
- Can try to extend our framework for ego-net mining to the context of *dynamic graph streams*.



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Thank you!