Ego-net Patterns

Oddball: Spotting anomalies in weighted graphs
Leman Akoglu, Mary McGlohon, Christos Faloutsos
PAKDD 2010
Ego-net Patterns

- $N_i$: number of neighbors (degree) of ego $i$
- $E_i$: number of edges in egonet $i$
- $W_i$: total weight of egonet $i$
- $\lambda_{w,i}$: principal eigenvalue of the weighted adjacency matrix of egonet $i$
Pattern: Ego-net Power Law Density

\[ \text{Oddball: Spotting anomalies in weighted graphs} \]

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Pattern: Ego-net Power Law Weight

\[ W_i \propto E_i^\alpha \]

\( 1 \leq \alpha \)

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Pattern: Ego-net Power Law Eigenvalue

$\lambda_i \propto W_i^\alpha$
$0.5 \leq \alpha \leq 1$
Using graph patterns to find roles

Useful node features:
- Degree
- Nodes in ego-net
- Edges in ego-net
- Edges leaving ego-net
- Mean of neighbor degree
- Sum of neighbor degree
- Expand recursively…
Using graph patterns to find roles

Learn classifier to predict node labels

It’s who you know: Graph mining using recursive structural features
Keith Henderson, Brian Gallagher, Lei Li, Leman Akoglu, Tina Eliassi-Rad, Hanghang Tong, Christos Faloutsos
KDD 2011
## Using graph patterns to find roles

<table>
<thead>
<tr>
<th></th>
<th>“Web”</th>
<th>“DNS”</th>
<th>“Peer-to-Peer”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Training Instances</strong></td>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Test Instances</strong></td>
<td><img src="image4.png" alt="Graph" /></td>
<td><img src="image5.png" alt="Graph" /></td>
<td><img src="image6.png" alt="Graph" /></td>
</tr>
</tbody>
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![Graph Patterns Diagram]

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Using graph patterns to find roles

Use graph features to find similar types of behavior:

- Christos Faloutsos & Andrei Broder: tightly knit communities
- Albert-Laszlo Barabasi & Mark Newman: bridge communities
- John Hopcroft and Jon Kleinberg: mainstream
- Lada Adamic and Bernardo Huberman: elongated clusters