Learning to Discover Social Circles in Ego Networks

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Abstract

Our personal social networks are big and cluttered, and currently there is no good way to organize them. Social networking sites allow users to manually categorize their friends into **social circles** (e.g. 'circles' on Google+, and 'lists' on Facebook and Twitter), however they are laborious to construct and must be updated whenever a user's network grows. We define a novel machine learning task of identifying users' social circles. We pose the problem as a node clustering problem on a user's ego-network, a network of connections between her friends.

"Knows your circles better than you do!"

– Wired

Properties of circles

Our goal is to automatically detect **circles** using **profile** and **network** information. We develop a model of circles with the following properties:

- Circles form around nodes with common properties.
- Different circles are formed by different properties, e.g. one circle might be formed by family members, and another by students who attended the same university.
- Circles can overlap, and 'stronger' circles form within 'weaker' ones, e.g. a circle of friends from the same degree program may form within a circle from the same university.
- We leverage both profile information and network structure in order to identify circles.

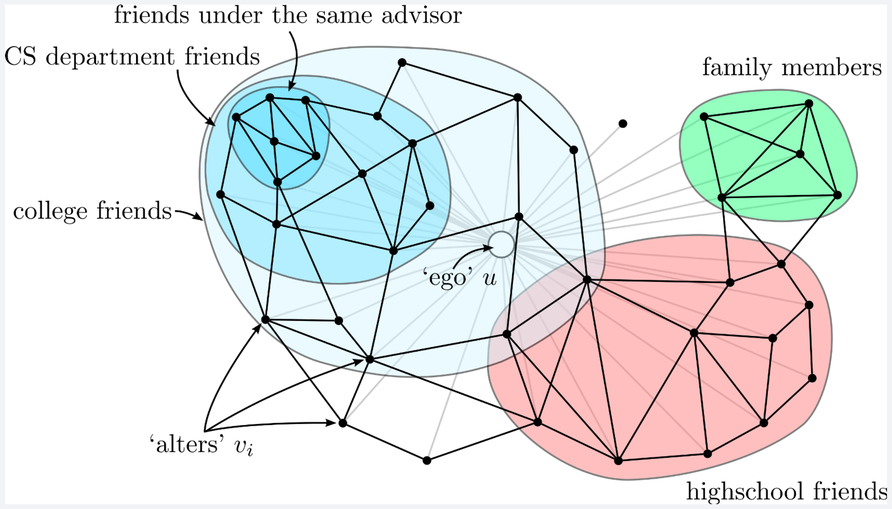
Model

Our model predicts **hard** memberships to multiple, **overlapping circles**, using both **profile** and **network** information.

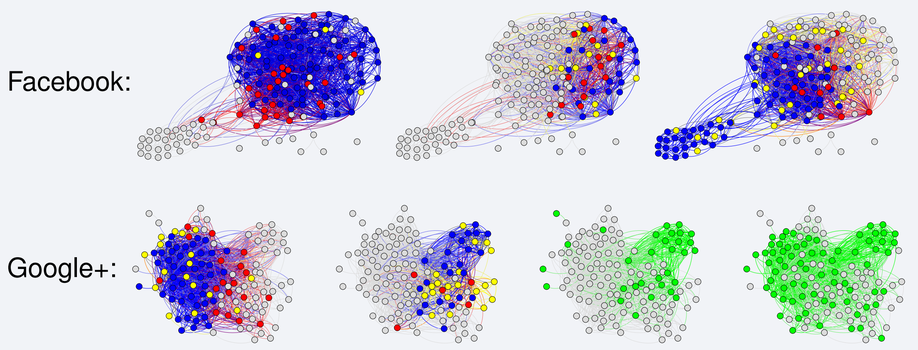
$$p((x,y) \in E) \propto \exp\left\{ \underbrace{\sum_{C_k \supseteq \{x,y\}} \langle \phi(x,y), \theta_k \rangle}_{\text{circles containing both nodes}} - \underbrace{\sum_{C_k \not\supseteq \{x,y\}} \alpha_k \langle \phi(x,y), \theta_k \rangle}_{\text{all other circles}} \right\}$$

Training is done by maximum likelihood, using QPBO and L-BFGS.

An ego-network

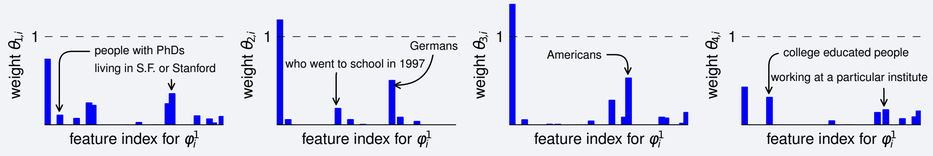


Some detected circles



Blue = true positive; gray = true negative; red = false positive; yellow = false negative; green = detected circles for which we have no groundtruth.

Examples of model parameters for four circles



Data

We collect data from **Facebook, Google+, and Twitter**

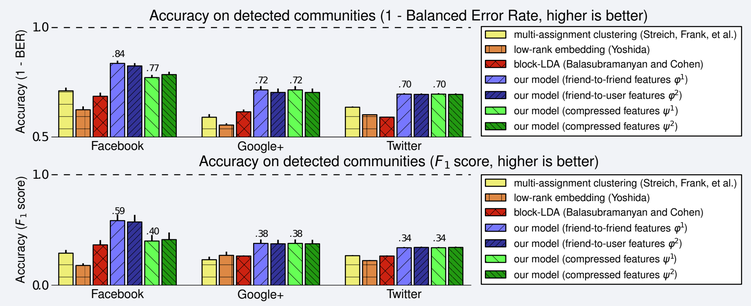
	ego-networks	circles	nodes	edges
Facebook	10	193	4,039	88,234
Google+	133	479	107,614	13,673,453
Twitter	1,000	4,869	81,306	1,768,149

All data are **available** on `snap.stanford.edu/data/`

"Results are decent"

– MIT Technology Review

Some results



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