Toward Relational Learning with Misinformation

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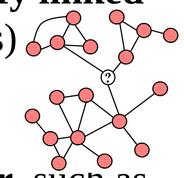
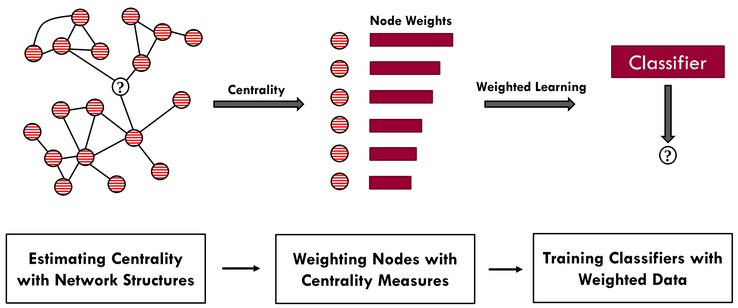
Background

- Relational learning aims to **classify linked nodes** in a graph (social networks)



- Node attributes can be very noisy
  - Attacks of **content polluter**, such as spammers, bots, crowdturfers
  - **Colloquial language** of regular users

- A common framework for denoising social media data with network structures

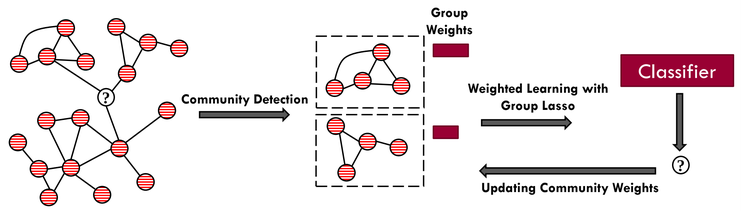


Challenges

- Social networks are also noisy. Regular users may make friends with content polluters due to carelessness or reflexive reciprocity
- Availability of network data is limited. Twitter API restricts 200 users per request

Intuition

- Social community structures are more robust to noisy data and adversarial attacks
  - Linking with an individual regular user: *Easy*
  - Systematically linking with a community: *Hard*



Proposed Framework

$$\min_{\boldsymbol{c},\boldsymbol{w}} \underbrace{\sum_{i=1}^{m} \boldsymbol{c}_i(\boldsymbol{V}_{i,*}\boldsymbol{w} - \boldsymbol{y}_i)^2}_{\text{Learning Classifiers}} + \underbrace{\lambda_1 ||\boldsymbol{w}||_2^2}_{\text{Avoiding Overfitting}} + \underbrace{\lambda_2 \sum_{i=1}^{d}\sum_{j=1}^{n_i} ||\boldsymbol{c}_{G_j^i}||_2}_{\text{Updating Weights}}$$

$\mathbf{c} \in \mathrm{R}^{\mathrm{m}}$: data instance weights
$\mathbf{w} \in \mathrm{R}^{k}$: model coefficients
i : index of data instance
$\mathbf{S} \in \mathrm{R}^{\mathrm{n}\times\mathrm{n}}$: adjacency matrix
$\boldsymbol{c}_{G_j^i}$: membership of group j on layer i

m: *number of data instances*
k: *number of features*
d: *number of cluster layers*
n_i: *number of clusters on layer* i
λ_1: *extent of model complexity*
λ_2: *extent of sparseness of groups*

Optimization

Update $\boldsymbol{c}$ (instance weighting): $\min_{\boldsymbol{c}} \sum_{i=1}^{m} \boldsymbol{c}_i \boldsymbol{p}_i + \lambda_2 \sum_{i=1}^{d}\sum_{j=1}^{n_i} ||\boldsymbol{c}_{G_j^i}||_2$
subject to $\sum_{i=1}^{m} \boldsymbol{c}_i = 1$

Update $\boldsymbol{w}$ (classifier training): $\min_{\boldsymbol{w}} \boldsymbol{c}_i(\boldsymbol{V}_{i,*}\boldsymbol{w} - \boldsymbol{y}_i)^2 + \lambda_1 ||\boldsymbol{w}||_2^2$

Datasets

Dataset	#Instances	#Labels	#Features
Blog Catalog	5,198	6	8,189
Flickr	7,575	9	12,047

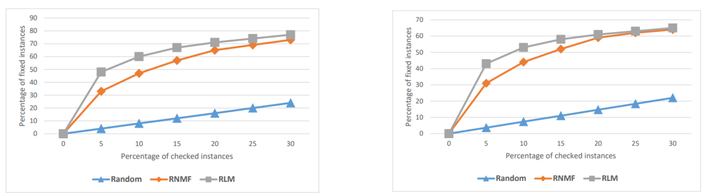
Experimental Results

Macro- and Micro-average of F_1-measures of different methods with increasing ratio of misinformation

BlogCatalog

Flickr

Effectiveness of different methods on identifying mislabeled instances by checking more data



BlogCatalog Flickr

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