

# Persistent Roles in Online Social Networks

ECML-PKDD 2016, M. Revelle, C. Domeniconi, and A. Johri

## Persistent Roles in Online Social Networks

2017-01-24

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# Introduction

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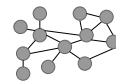
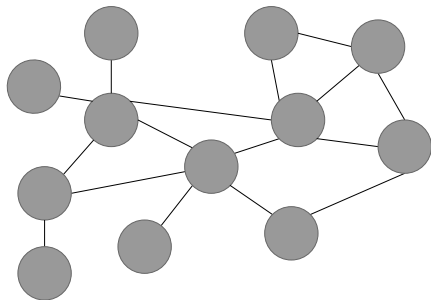
## Persistent Roles in Online Social Networks

- Introduction

Introduction

# Social Network Analysis

The study of relationship between actors.



Persistent roles should occur in any social network  
Based on the structure of the network

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## Persistent Roles in Online Social Networks

### └ Introduction

Persistent roles should occur in any social network  
Based on the structure of the network

# Applications

graph mining  
Targeted advertisement

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## Persistent Roles in Online Social Networks

└ Introduction

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Applications

graph mining  
Targeted advertisement

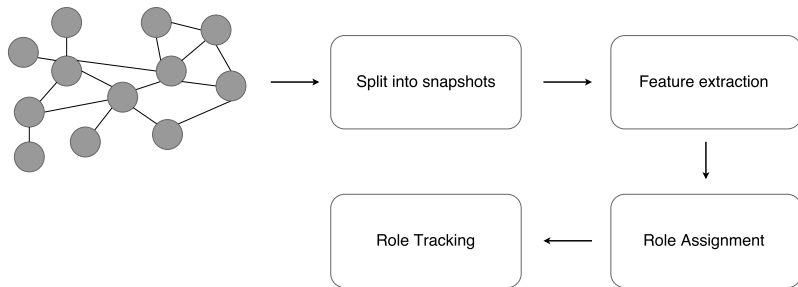
# Methodology

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Methodology

# The Approach



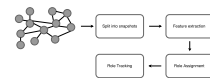
## Persistent Roles in Online Social Networks

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### Methodology

### The Approach

The Approach



### Feature-based approach

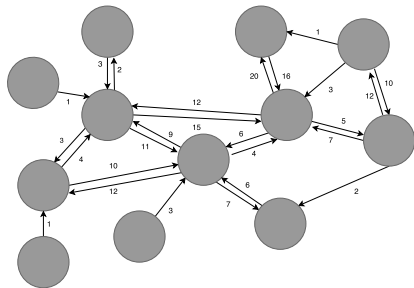


# The Data

## Datasets:

- Facebook - Wall posts from one user to another
- Scratch - Comments on uploaded programming projects

Directed, timestamps.



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### The Data

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### The Data

Datasets:  
 • Facebook - Wall posts from one user to another  
 • Scratch - Comments on uploaded programming projects  
 Directed, timestamps.



# Snapshot Split-up

The dataset is split into a total of 26 snapshots:

- 7 from facebook
- 19 from Scratch

Non-overlapping

Same length = observation window  $\Omega$ .

Something with node interaction being smaller than Omega. (90th percentile?)

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### Snapshot Split-up

The dataset is split into a total of 26 snapshots:

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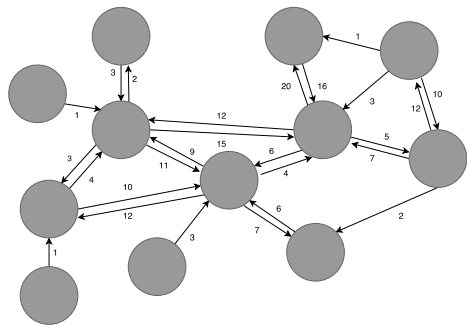
Non-overlapping

Same length = observation window  $\Omega$ .

Something with node interaction being smaller than Omega. (90th percentile?)

# Feature Selection

12 features based upon the graph.



|                        |
|------------------------|
| In-degree              |
| Out-degree             |
| Weighted in-degree     |
| Weighted out-degree    |
| Reciprocity            |
| New activity           |
| Social strategy        |
| Betweenness centrality |
| PageRank               |
| Weighted PageRank      |
| Transitivity           |
| Weighted transitivity  |

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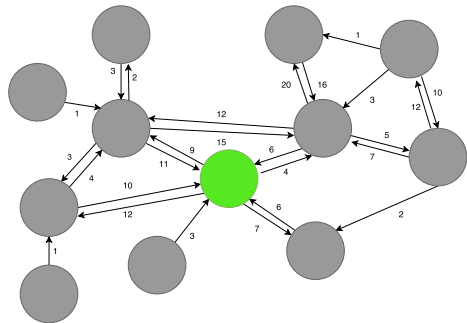
Feature Selection

Feature Selection

12 features based upon the graph.



# Feature Example



|                        |               |
|------------------------|---------------|
| In-degree              | 5             |
| Out-degree             | 4             |
| Weighted in-degree     | 36            |
| Weighted out-degree    | 32            |
| Reciprocity            | 4             |
| New activity           | 0             |
| Social strategy        | 0             |
| Betweenness centrality | 38.7          |
| PageRank               | 0.21          |
| Weighted PageRank      | -             |
| Transitivity           | $\frac{1}{3}$ |
| Weighted transitivity  | -             |

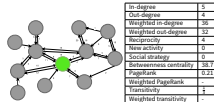
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Feature Example

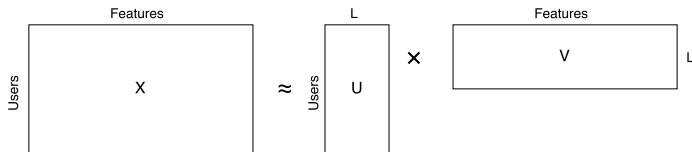
Feature Example



# Role Discovery and Membership

## Non-negative Matrix Factorization

$$X \approx UV$$



- Matrix U is role features
- Matrix V is membership weights for the roles for each user

## Persistent Roles in Online Social Networks

### Methodology

### Role Discovery and Membership

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### Role Discovery and Membership

#### Non-negative Matrix Factorization

$$X \approx UV$$



- Matrix U is role features
- Matrix V is membership weights for the roles for each user

- Frobenius NMF updated with euclidean distance
- U and V are initialized with left and right matrix from nndsvd (Modified svd)

# Selection of L

## Root Mean Squared Error

$$RMSE = \sqrt{\frac{1}{|X|} \sum_{(u,f) \in X} (X_{u,f} - X'_{u,f})^2}$$

Figure: Facebook

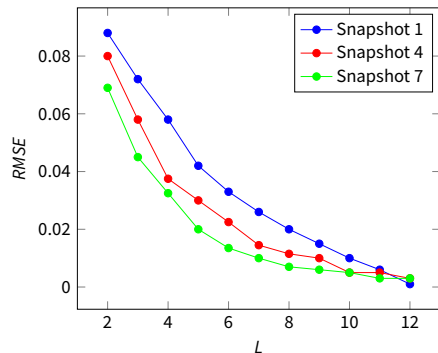
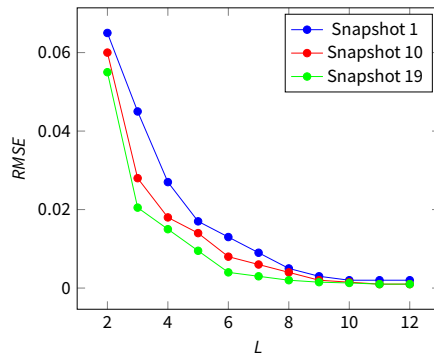


Figure: Scratch



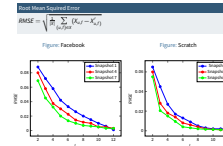
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### Methodology

### Selection of L

#### Selection of L



# Tracing Roles

The sim between snapshots.

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Tracing Roles

The sim between snapshots.

# Results

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## Persistent Roles in Online Social Networks

### Results

Results



# Data Processing

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└─ Results

└─ Data Processing

Data Processing

# The Roles

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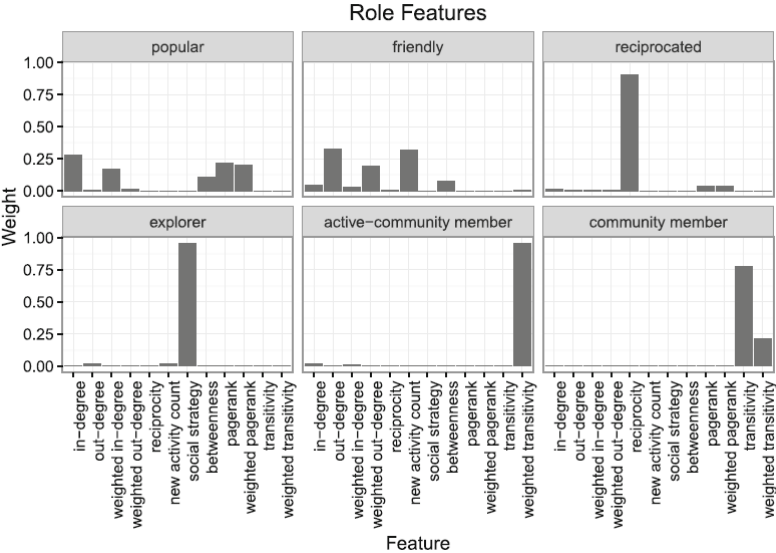
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The Roles

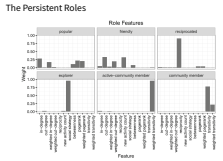
# The Persistent Roles



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# Evidence of Roles

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## Persistent Roles in Online Social Networks

### Results

### Evidence of Roles

# Affinity Analysis?

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## Persistent Roles in Online Social Networks

### └ Results

### └ Affinity Analysis?

Affinity Analysis?

# Role Transition

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## Persistent Roles in Online Social Networks

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└─ Role Transition

# Conclusion

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Conclusion



# Future Work?

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Future Work?

# Shortcomings

They does not argue for their selection of features or give a reference to an article that does.  
Number of snapshots.

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└ Shortcomings

Shortcomings

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