Dynamic of Local Community in Social Networks

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Plan

1. Introduction
2. Community detection in static networks
3. Community detection in dynamic networks
4. Communities prediction
5. Evaluation
6. Conclusions and perspectives
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Context

Twitter’s active users number is off – Twitter has more than half a billion registrations, but after half that many active users.
What is a dynamic network

Two kinds of dynamic

Interaction networks

Evolving network
Plan

1. Introduction

2. Community detection in static networks
   - What is a community?
   - Local community identification

3. Community detection in dynamic networks

4. Communities prediction

5. Evaluation

6. Conclusions and perspectives
Communities in networks

A definition based on the network topology:

- Group of densely connected nodes.
- Few links between groups.
Local community detection

- Local community: identified with local information only
- We start from a node
- At each step we have a local view of the network (see the fig.)
- The nodes outside the community (but connected to it) are evaluated one by one.
Local Community detection in action
Local Community detection in action
Local Community detection in action
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Communities in dynamic networks

No formal definition, but some trends

- Communities tracking
- Communities updating
- Long term communities detection
Communities tracking

General Framework (Image from Cazabet et al.)
## Examples
- Palla et al., 2007.
- Greene et al., 2010.
- Tantipathananandh et al., 2007.

## Remarks
- Instability of detection methods
- This can be reduced by community cores analysis
Communities updating

\[ G : \quad G_t \xrightarrow{\Delta G_t} G_{t+1} \]

\[ C : \quad C(G_t) \xrightarrow{A} C(G_{t+1}) \]
Examples

- Nguyen et al., 2011.
- Cazabet et al., 2010.

Remarks

- Dependence with previous partitioning
- Can start with an empty network
Long-term communities detection

(Image from Cazabet et al.)
Long-term communities detection cont’d

Examples
- Aynaud et al., 2010.
- Mitra et al., 2011.

Remarks
- No formal evaluation method.
- Some evaluations by applications.
Plan

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4. Communities prediction
   - Problem definition
   - The proposed approach
      - supervised method for interactions prediction
5. Evaluation
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Community prediction in interactions networks

\[ T \]

\[ \ldots \]

\[ T + n \]

\[ T + n + 1? \]

- **Observation**

- **Prévision**
The proposed approach

- Predict the interactions
- Compute the communities on the predicted network

Interaction prediction is more general than link prediction
Supervised learning approach

Attributes

For each time step extract the following attributes:
- the number of common neighbors
- the number of common community members
- number of interaction between the two nodes
- the attribute similarity between the two nodes (if available)

Target variable: An interaction is present or not in target time-step?

Model Construction

- Support Vector Machines
- RBF Kernel
- Normalization of the attributes
- Parameters estimated with grid search
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   - Datasets description
   - Evaluation protocol
   - Interaction prediction evaluation
   - Communities prediction evaluation
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# Datasets description

## DBLP
- Co-authorship dataset
- Nodes: authors
- Interactions: common publications
- 11 time-steps (years from 2000 to 2011)

## Facebook Walls
- A subset of Facebook New Orleans users
- Nodes: Facebook users
- Interactions: wall posts (undirected)
- 5 time-steps (years from 2004 to 2008)
Evaluation protocol

Dynamic network

PREDICT THE INTERACTIONS

Predicted target snapshot

Evaluation

Real target snapshot

COMPUTE THE COMMUNITIES

Predicted communities

COMPARE THE COMMUNITIES

COMPUTE THE COMMUNITIES

Real communities
Interaction prediction evaluation

Evaluation with Area Under the Curve (AUC)

<table>
<thead>
<tr>
<th>Model</th>
<th>DBLP</th>
<th>Facebook wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random model</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Similarity based model</td>
<td>0.69</td>
<td>0.84</td>
</tr>
<tr>
<td>Supervised model</td>
<td>0.87</td>
<td>0.92</td>
</tr>
</tbody>
</table>
Evaluation with Normalized Mutual Information (NMI)
Communities detected by local method from Ngonmang et al. 2012.
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Conclusions and perspectives

Some conclusions
- We have introduced the Community prediction problem
- We have proposed an approach using interaction prediction
- We have Tested on real networks

Some perspectives
- Deal with new nodes
- Test on other real networks
Thanks you for your attention

Questions?