Awareness of Social Influence on Global Social Service Network

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Outline

1. Introduction
2. Our Previous Work
   - Background
   - Linked data: give birth of Linked Socal Service
   - Constructing global social service network
3. Motivating Example
4. Awareness of Social Influence
   - Social factors observation
   - Mathematical model
5. Conclusion and Future Work.

Introduction

- ✓ Social influence is a complex and subtle force to govern user behaviors and relationship formation in social networks.
  - ➢ A company can market a new product by first convincing a small number of influential users to adopt the product and then triggering further adoptions through the effect of influence maximization.
  - ➢ In academic networks, thanks to the influence between research collaborators, novel ideas or innovations quickly spread and lead the blooming of new academic directions.
  - ➢ On social websites, e.g., Facebook and Twitter, users are very likely to follow influential friends in their social circle to retweet a microblog or to "like" a picture.
- ✓ Therefore, there is a clear need for methods and techniques to analyze and quantify the social influences for many mining applications such as representative service identification and service recommendation.

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Background #1

Web Service has been considered to have a tremendous impact on the web, as a potential silver bullet for supporting distributed service-based economy at a global scale. But:

– Most services published on the web are never used, only few of services has ever been discovered, composed, or invoked.

Background #2

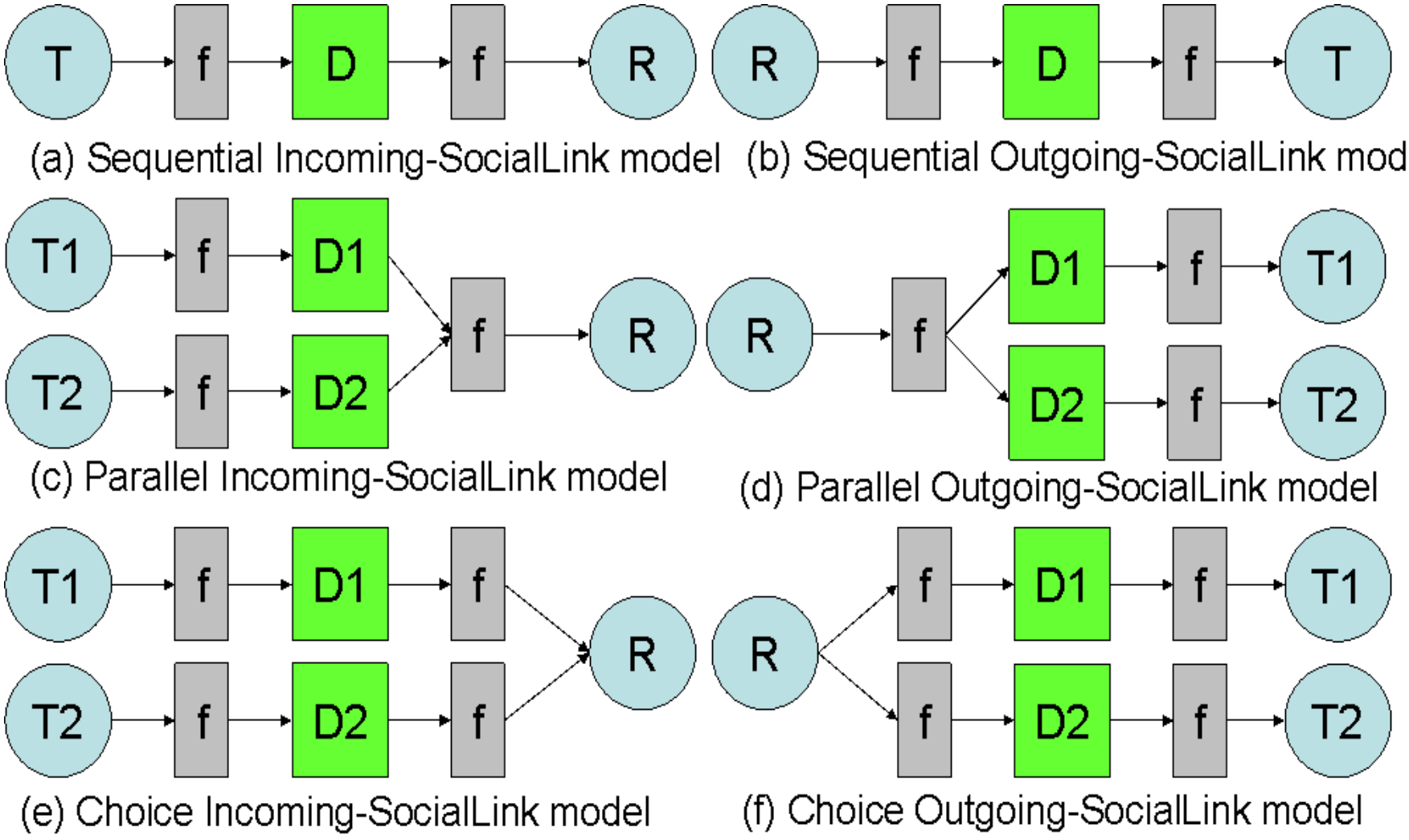
- Isolated service islands have hampered service discovery and service composition.
  - Nowadays, services published in UDDI are service islands without any links to related services.
  - Lack of global service space, due to Isolated service islands.
  - Most approaches to service discovery lack consideration of interactions with the service consumers, so the usability threshold for service consumers is still high.
  - Service consumers are not limited to using a single service, but want to locate multiple services that can work together. However, guiding service consumers to discover services, starting from a service at hand and extending to peer services, is still a challenging issue because current services are isolated.

Motivation

We propose an methodology to connect isolated service islands into a single global service space to enable exploring service to service:

- improve the usage threshold.
- enhance interaction with service consumer.
- enable exploring service to service.

Social Link


T
f
D
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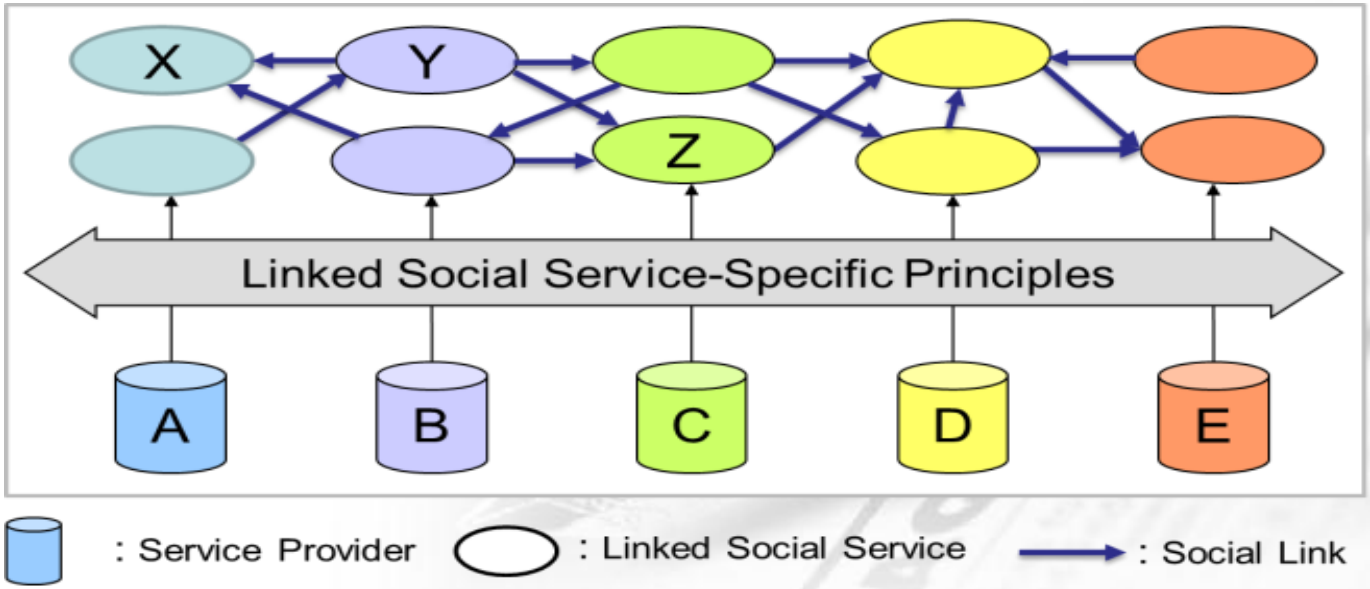
R
(a) Sequential Incoming-SocialLink model
R
f
D
f
T
(b) Sequential Outgoing-SocialLink model
T1
T2
f
D1
D2
f
R
(c) Parallel Incoming-SocialLink model
R
f
D1
D2
f
T1
T2
(d) Parallel Outgoing-SocialLink model
T1
T2
f
D1
D2
f
R
(e) Choice Incoming-SocialLink model
R
f
D1
D2
f
T1
T2
(f) Choice Outgoing-SocialLink model

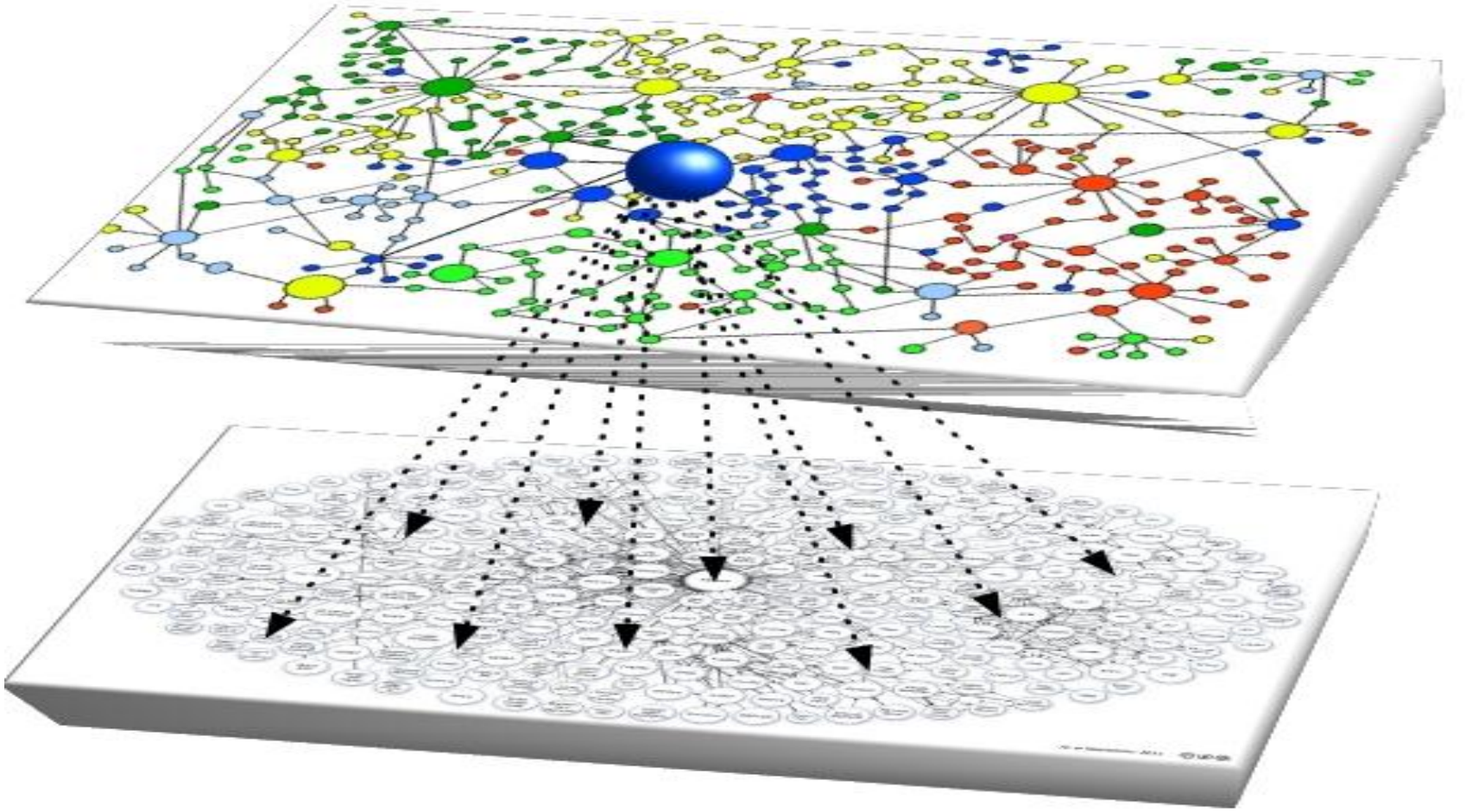
Linked data: give birth of Linked Socal Service

Linked social service-specific Principles:

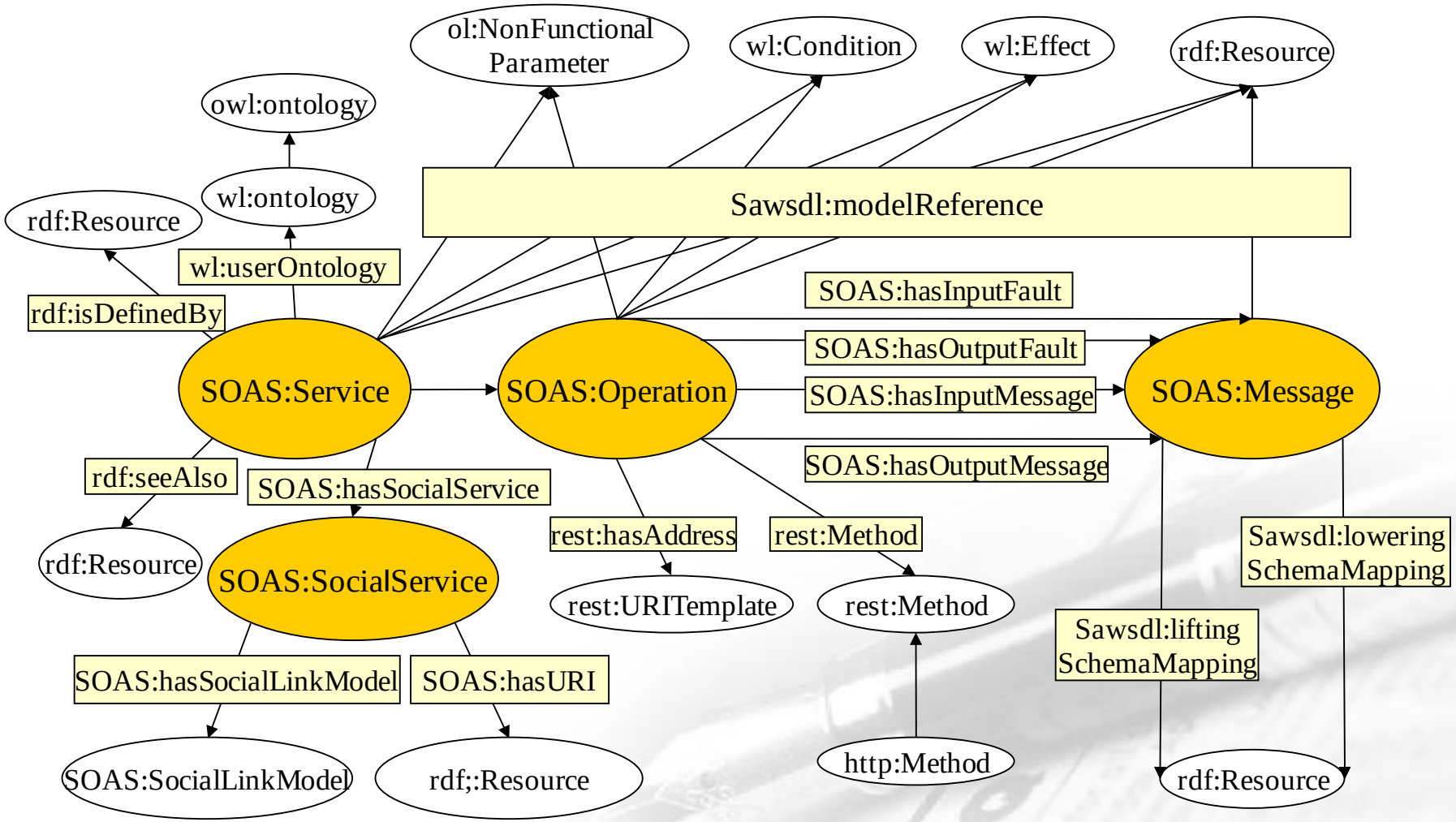
1. Services are published on the open web following Linked Data principles.
2. Services are built upon the web of data.
3. Services shall link to related services or be linked from related services functionally, using Social link.
4. Interlink services to reflect service social reality.



Linked Socal Service



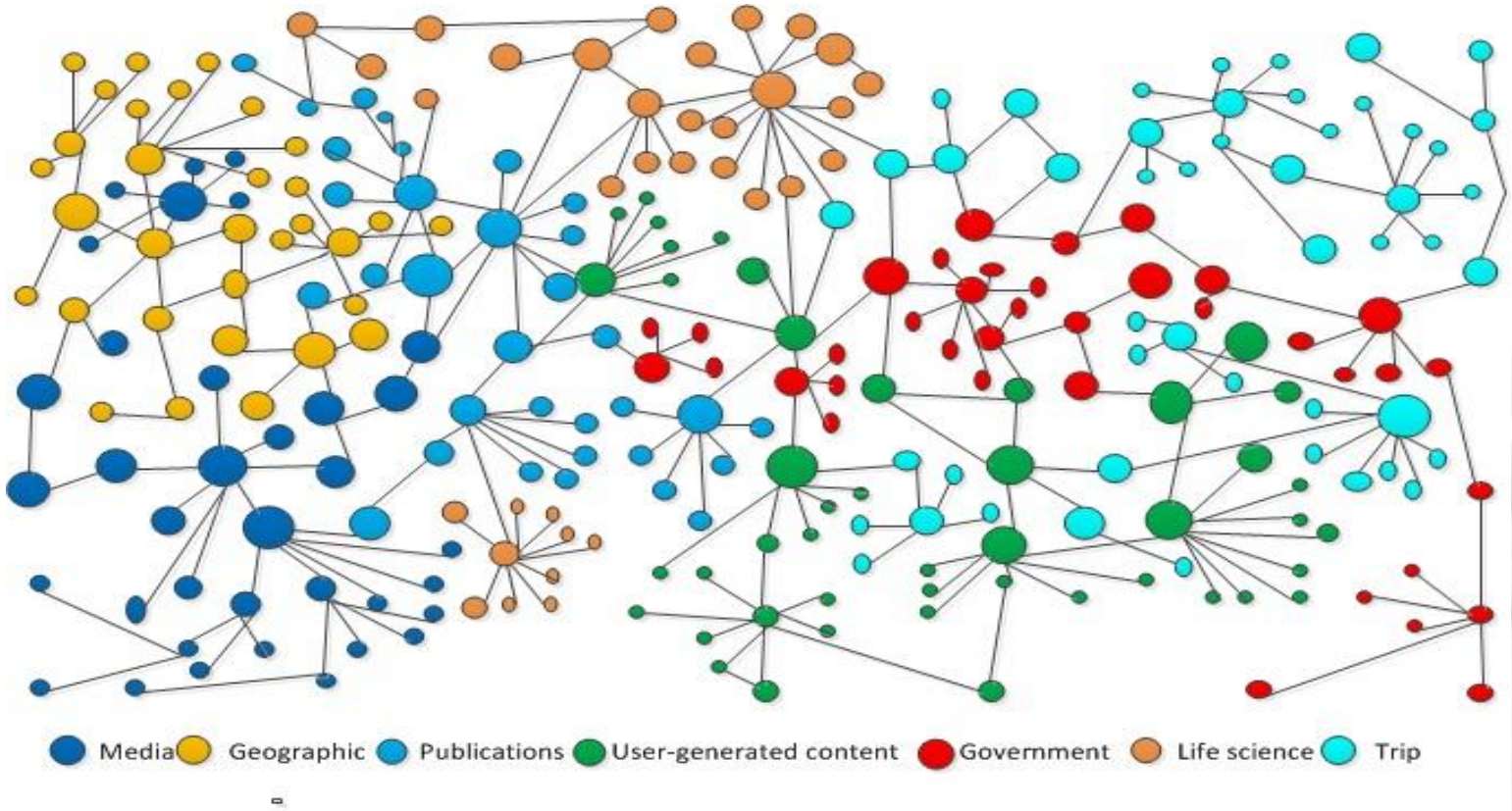
Service-Of-A-Service Model



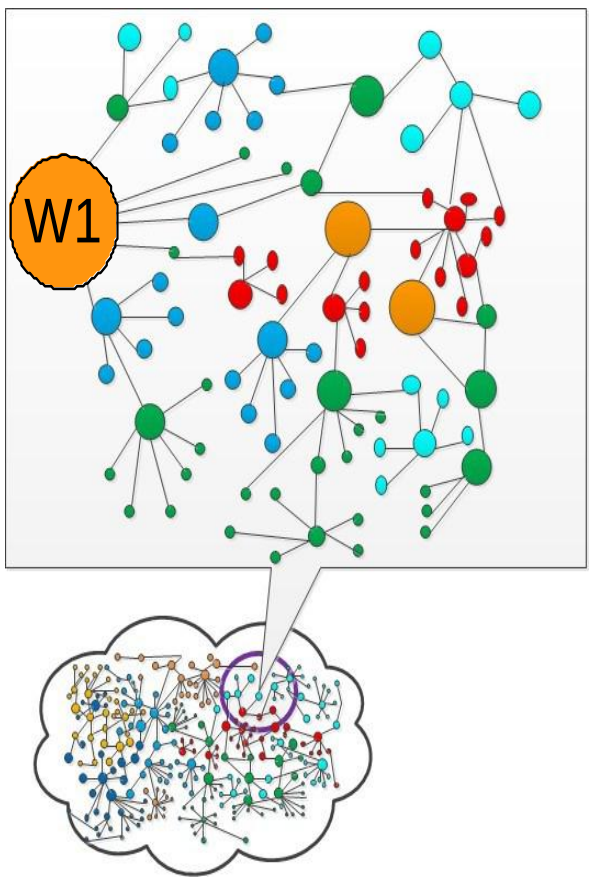
Global social service network

Definition 1: Global social service network is a directed graph G(V,E), where

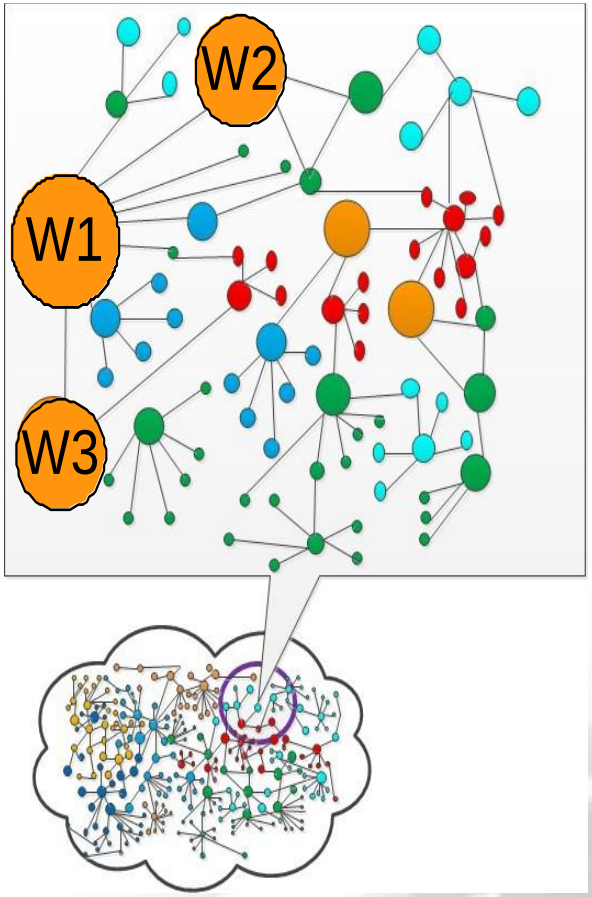
- V represents a set of nodes, each node is a linked social service.
- E represents a set of directed edges, each edge responding to a social link.



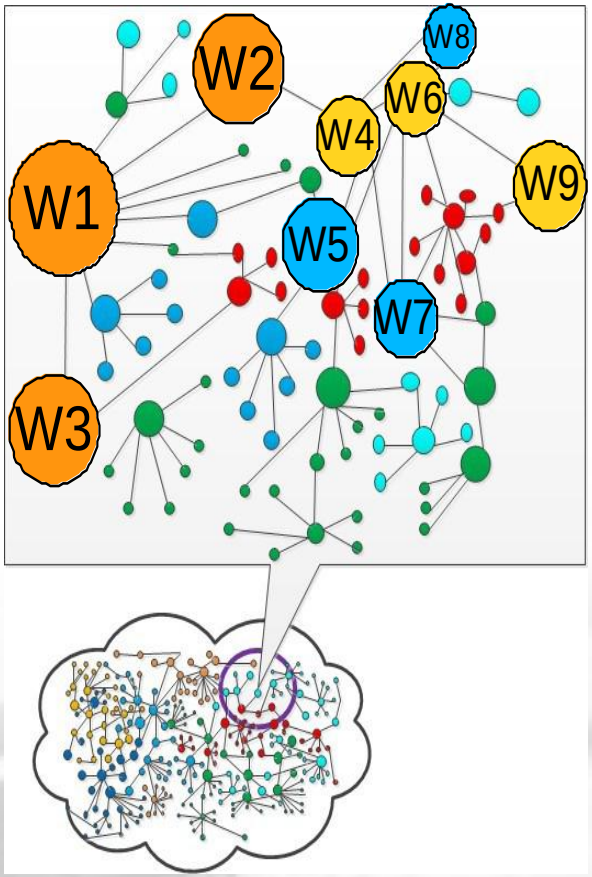
Constructing Global social service network



(a): Publish W1



(b): Publish W1,W2,W3



(c): Publish the Scenario

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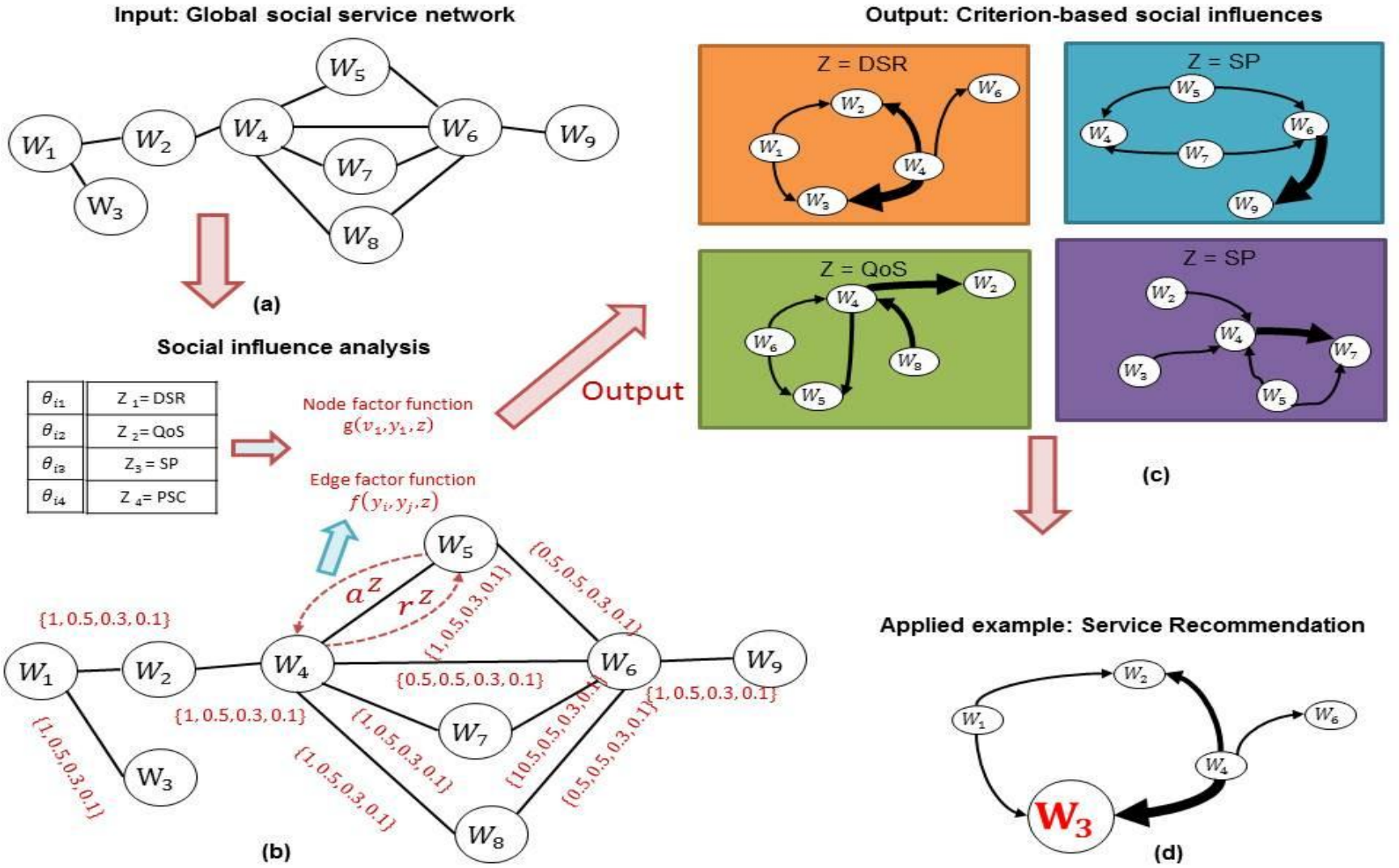
Motivating Example



Technical Challenge

- ✓ Underlying social factors observation
  - ➢ What are the fundamental factors that essentially influence the formation of link relationships?
  - ➢ How to observe fundamental social factors which impact the social influence strength between Linked social services in global social service network?
- ✓ Mathematical model
  - ➢ What are the fundamental (micro-level) mechanisms of social influence in social networks?
  - ➢ How we can leverage both network structure and social factors? In particular, when the influence is affected on different social factors (e.g., functionality, QoS, and service activity).

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Social Factors Observation

- ✓ In order to be fully aware of the effect of social influence, We focus on four aspects:
  - Social influence vs. functionality homophily: how influence between social services correlates with their functionality?
  - Social influence vs. QoS preference: how service's influence on its neighbors correlates with its QoS?
  - Social influence vs. sociability preference: how service's usage history impacts its influence strength?
  - Social influence vs. active connectivity: how one's activity impacts his/her influence strength?

Influence vs. Functionality homophily

- Homophily is the tendency of individuals to choose friends with similar characteristics and its principle suggests that users with similar characteristics (e.g., social status, age) tend to associate with each other.
- Here we consider the functionality homophily between the resource service R and target services T according to service data correlations, which are data mappings between the input/output (I/O) attributes of services.

Influence vs. QoS

- QoS is a set of nonfunctional properties that encompass performance characteristics, such as execution cost, time, reliability, and security.
- When several target services have similar values of Functionality homophily for a given resource service, their QoS properties such as price, availability, reliability and reputation become important to ensure the quality of the social link.

Influence vs. Sociability Preference

- Users whose actions frequently correlate have a stronger influence on each other.
- The co-occurrence frequency is often used to indicate the correlation strength between two nodes, which is denoted by the weights of edges in networks.
- Thus the influence strength between two nodes would be enlarged by their frequent co-occurrence.
- For example, if author a cites a number of papers of author b, then a should be strongly influenced by b.

Influence vs. Active Connectivity

- Most real networks exhibit preferential connectivity, meaning a new node links with higher probability to nodes that already have a large number of links.
- For example, a newly created Web page will more likely include links to well-known, popular documents with high connectivity than will an older Web page,
- Here we try to examine whether services with a higher degree centrality have a stronger influence in the social network.

Mathematical Model

- ✓ Problem Model
- ✓ Joint Distribution

Problem Model

- Feature Functions. There are three kinds of feature functions:
  - Node feature function $g(v_i, y_i, z)$ is a feature function defined on node v_i specific to criterion z.
  - Edge feature function $f(y_i, y_i, z)$ is a feature function defined on the edge of the input network specific to criterion z.
  - Global feature function $h(y_1, \ldots, y_N, k, z)$ is a feature function defined on all nodes of the input network w.r.t. criterion z.

$$g(v_i, y_i, z) = \begin{cases} \dfrac{w^z_{i y^z_i}}{\sum_{j \in NB(i)} \left(w^z_{ij} + w^z_{ji}\right)} & y^z_i \neq i \\ \dfrac{\sum_{j \in NB(i)} w^z_{ji}}{\sum_{j \in NB(i)} \left(w^z_{ij} + w^z_{ji}\right)} & y^z_i = i \end{cases} \quad (1)$$

$$\alpha_{ij} = \begin{cases} Q_{FH}(V_i, V_j) & if\ z = DSR \\ Q_{QoS}(V_i, V_j) & if\ z = QoS \\ Q_{SP}(V_i, V_j) & if\ z = SP \\ k_i & if\ z = PSC \end{cases} \quad (3)$$

$$w^z_{ij} = \theta^z_j \alpha_{ij} \quad (2)$$

$$h(y_i, \ldots, y_N, k, z) = \begin{cases} 0 & \text{if } y^z_k = k \text{ and } y^z_i \neq k \text{ for all } i \neq k \\ 1 & \text{otherwise.} \end{cases} \quad (4)$$

$$f\left(y_i, y_j, z\right) = \begin{cases} 1 & \text{if } y_i \text{ and } y_i \text{ has edge} \\ 0 & \text{otherwise.} \end{cases} \quad (5)$$

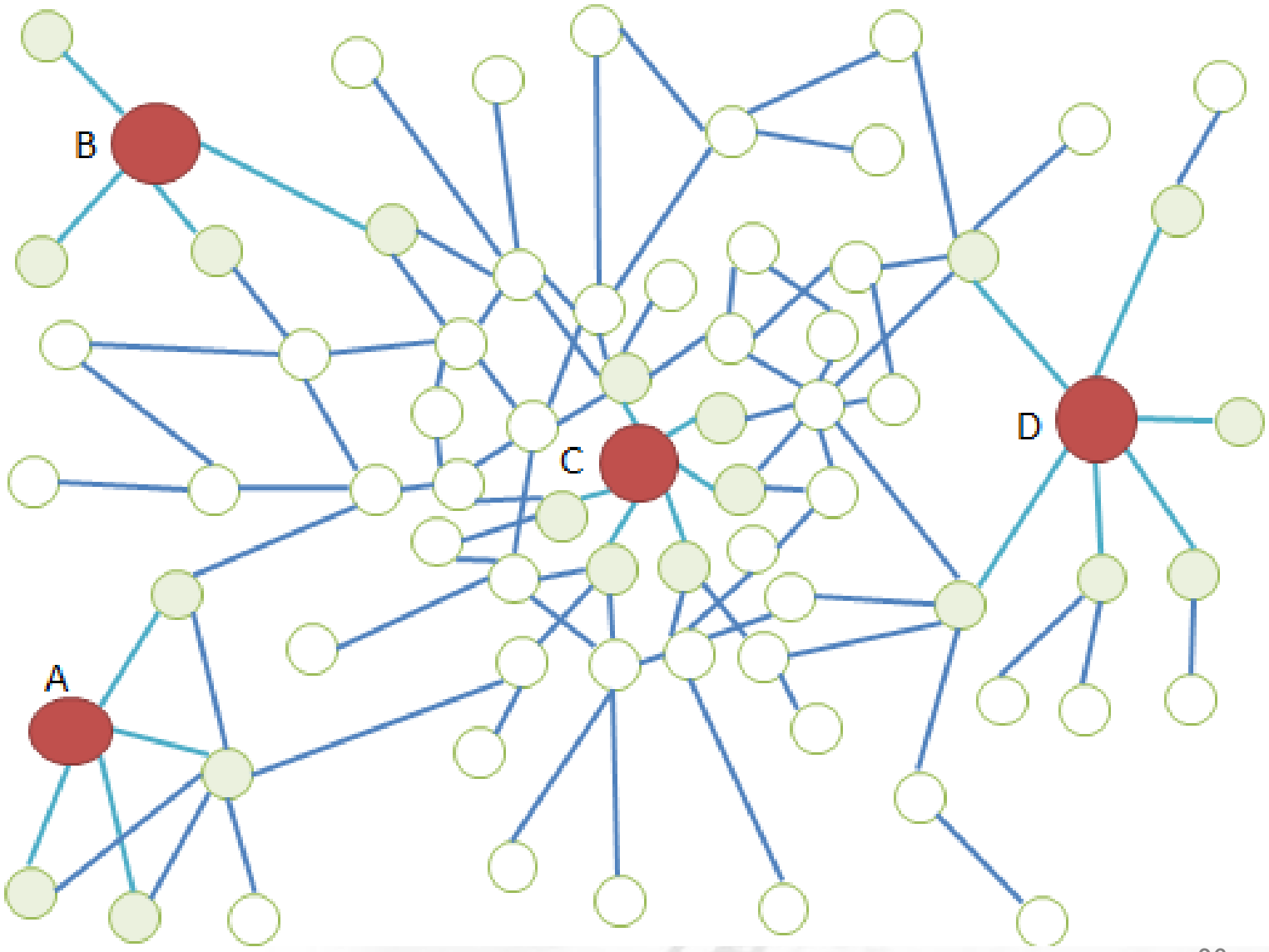
Joint Distrbuition

The objective likelihood function can be defined as:

$$P(v,Y) = \frac{1}{Z}\prod_{k=1}^{N}\prod_{z=1}^{T} h(y_1,\dots,y_N,k,z) \prod_{i=1}^{N}\prod_{z=1}^{T} g(v_i,y_i,z) \prod_{e_{kl}\in E}\prod_{z=1}^{T} f(y_k,y_l,z) \quad (5)$$

- ✓ where $v = [v_1,\dots,v_N]$ and $Y = [y_i,\dots,y_N]$ corresponds to all observed and hidden variables, respectively;
- ✓ g and f are the node and edge feature functions; h is the global feature function; Z is a normalizing factor.
- ✓ Based on this formulation, the task of social influence is cast as identifying which node has the highest probability to influence another node on a specific criterion along with the edge.

Representative Node



Conclusion

- ✓ We have proposed a flexible model for effective awareness of social influence to provide a quantitative measure of the influential strength.
- ✓ An application example, representative service identification was provided.

In future work, we will focus:

- Learning algorithm shall be developed.
- More evaluation of our approach qualitatively and quantitatively.
- Apply to our approach for service recommendation.

Thank you for your kind attention!