



Social Tagging Networks: Structure, Dynamics & Applications

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Outline

- Structure and Dynamics of Social Tagging Networks
 - What is SNT?
 - Hypergraph Structures
 - Dynamics and emergent properties
- Applications in Personalized Recommendation (PR)
 - Why Recommendation?
 - How Tags benefit PR?
- Conclusions & Discussion

What is social tagging networks?

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users with similar interests

Personal Tags

What is social tagging networks?

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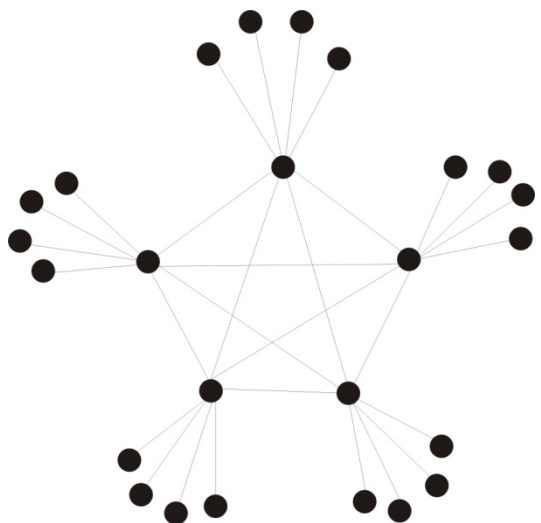
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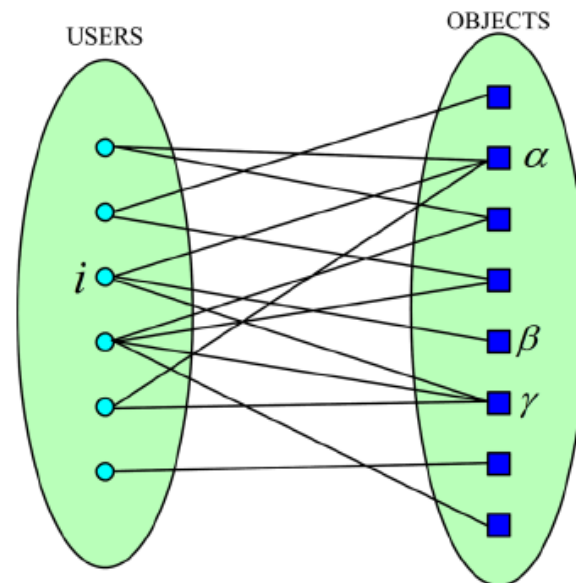
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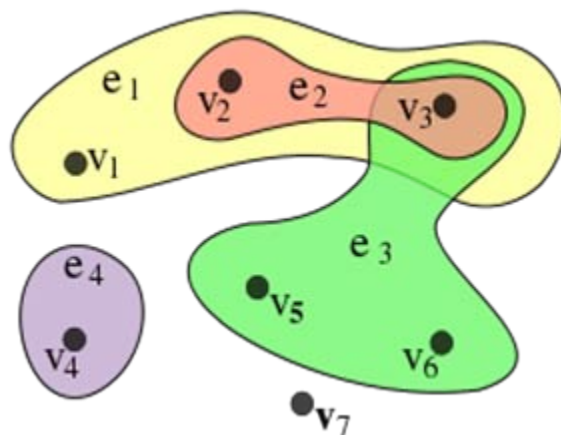
From Graph to Hypergraph



Unipartite Network



Bipartite Network
[EPL, 90 (2010) 48006]



Hyper Network [from wikipedia.org]

Hypergraph structures in STN

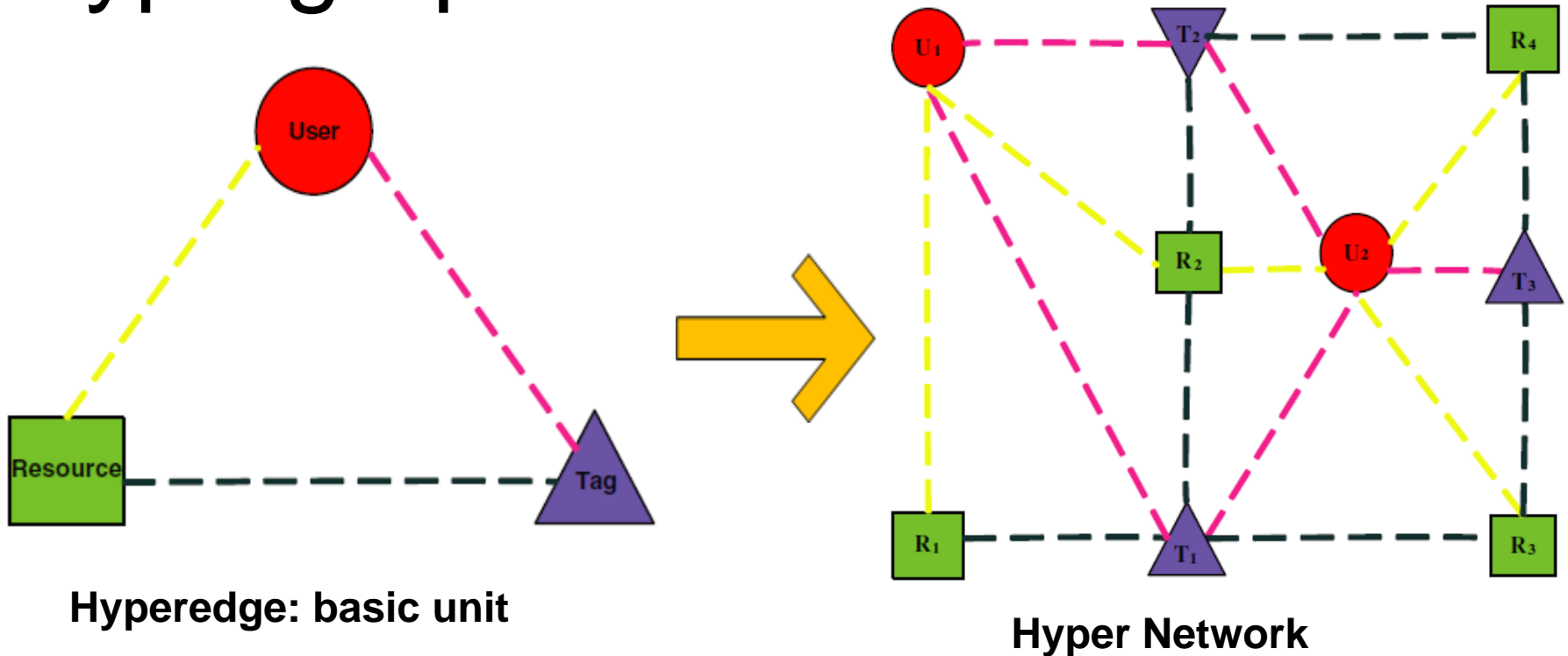
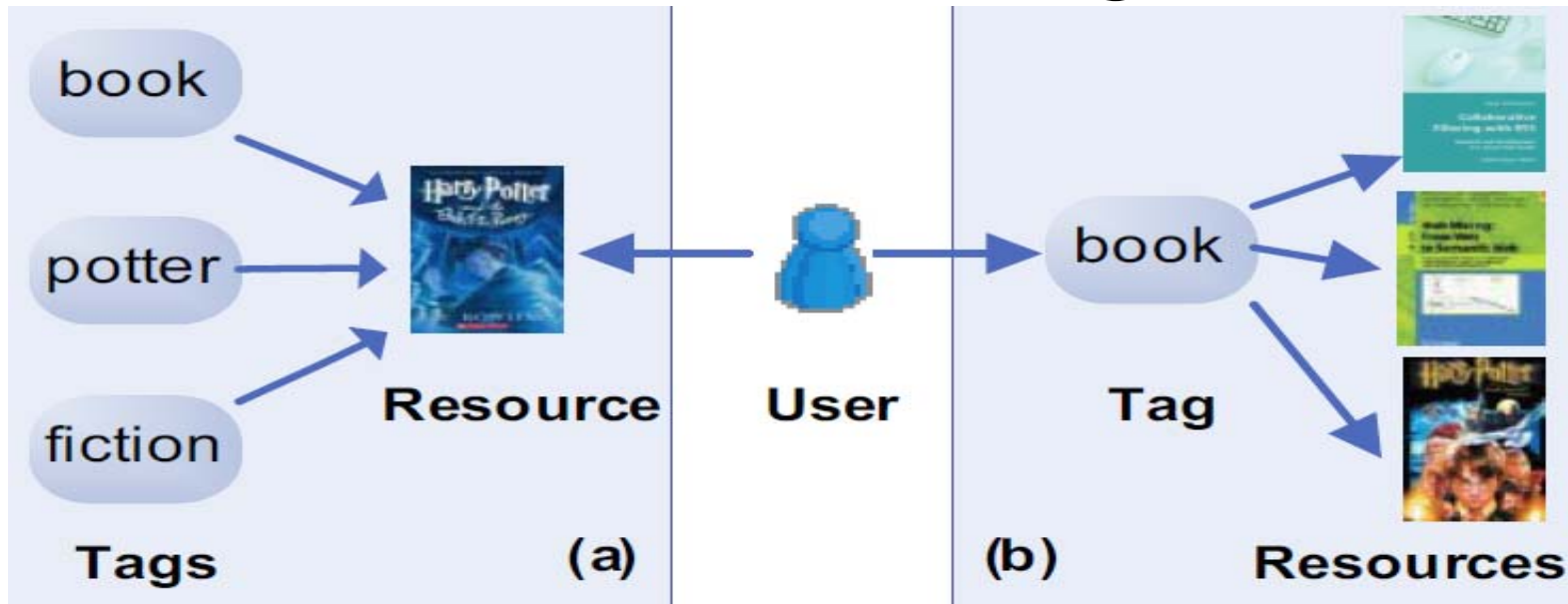


Figure 3. A descriptive hypergraph consists of two users, four resources and three tags. Take user U_2 and resource R_1 for example; the measurements are denoted as: (i) U_2 has participated in six hyperedges, which means its hyperdegree is 6; (ii) U_2 has directly connected to three resources and three tags, which suggests it possibly has $3 \times 3 = 9$ hyperedges maximally. Thus its clustering coefficient equals $6/9 \approx 0.667$, where its hyperdegree is 6; (iii) the shortest path from U_2 to R_1 is $U_2 - T_1 - R_1$, which indicates that the distance between U_2 and R_1 is 2.

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Two roles of social tags



■ Roles

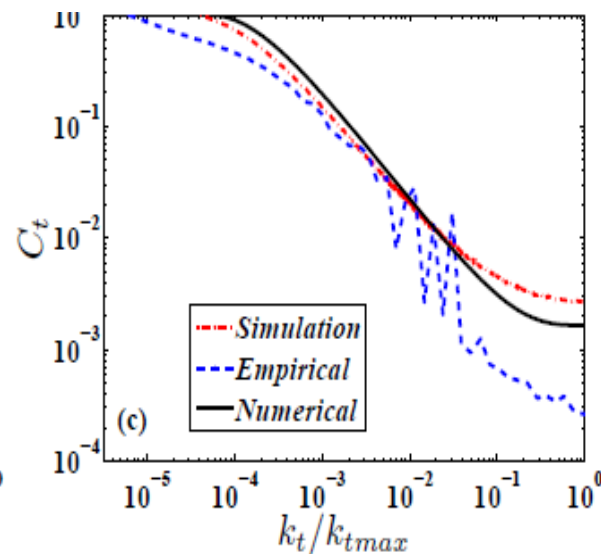
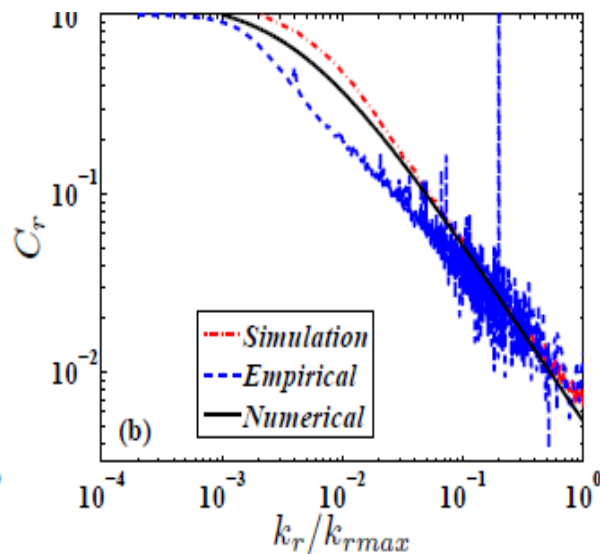
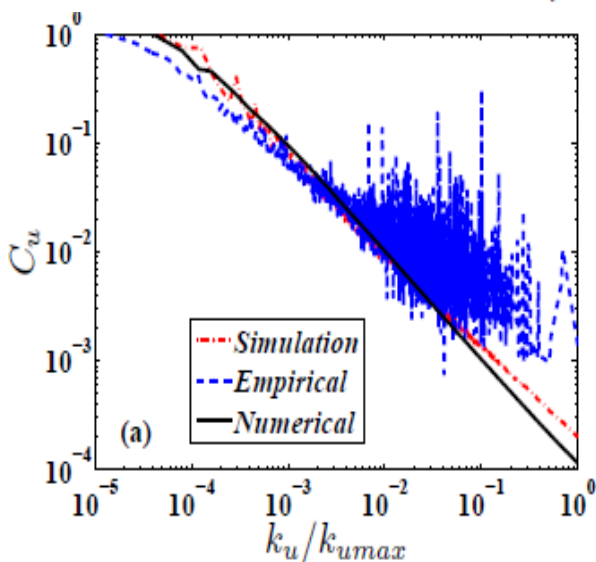
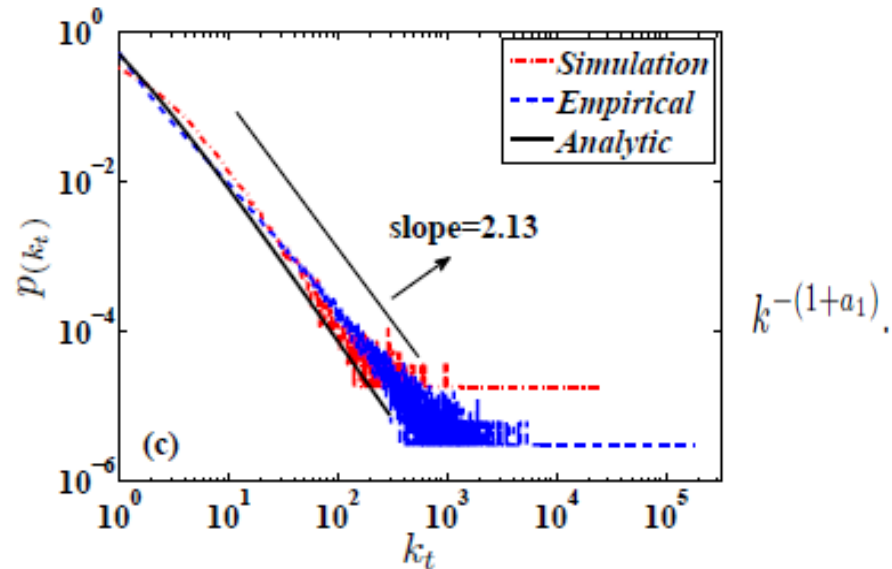
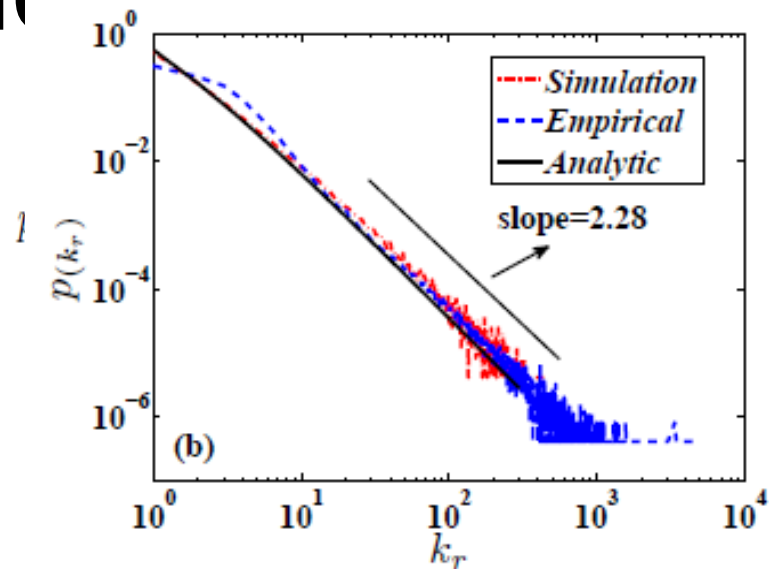
- **Role1:** an accessorial tool helping users organize resources: Fig. (a)
- **Role2:** a bridge that connects users and resources: Fig. (b)

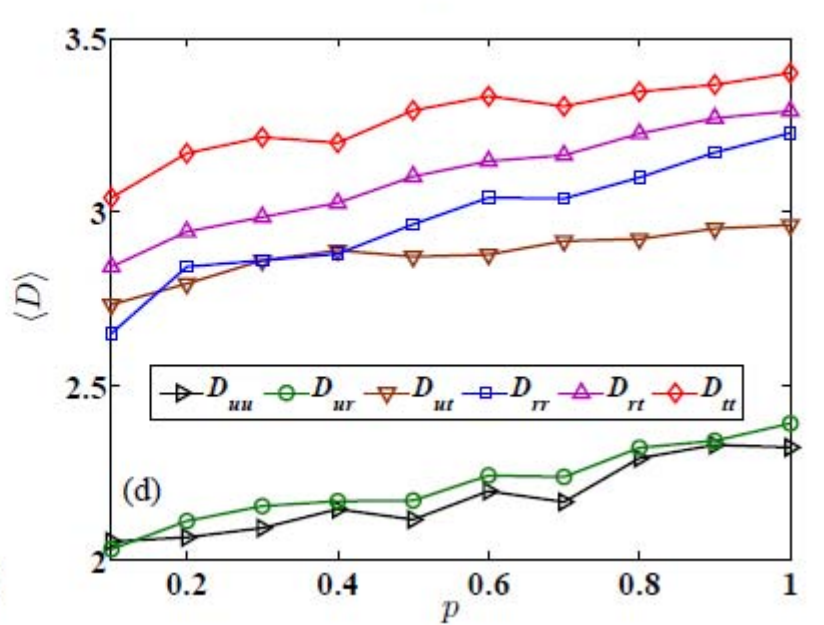
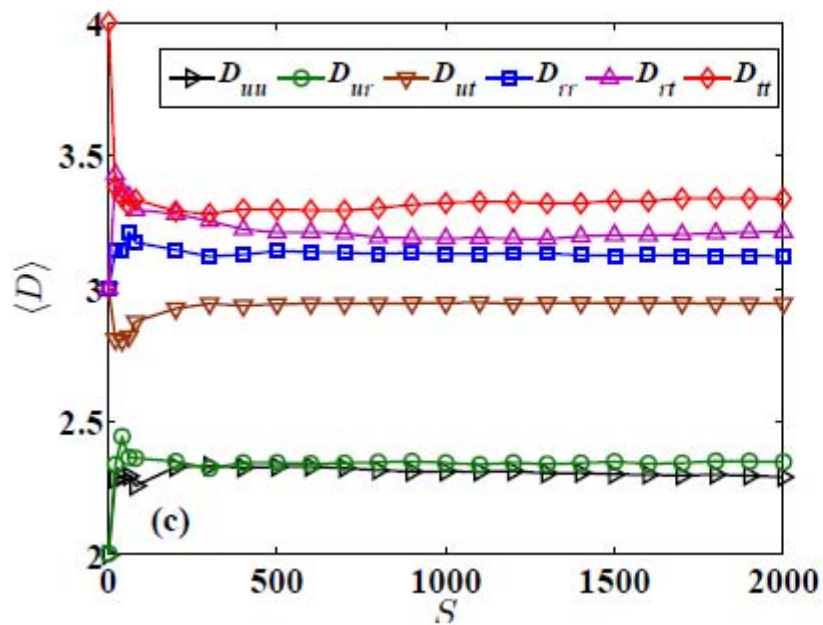
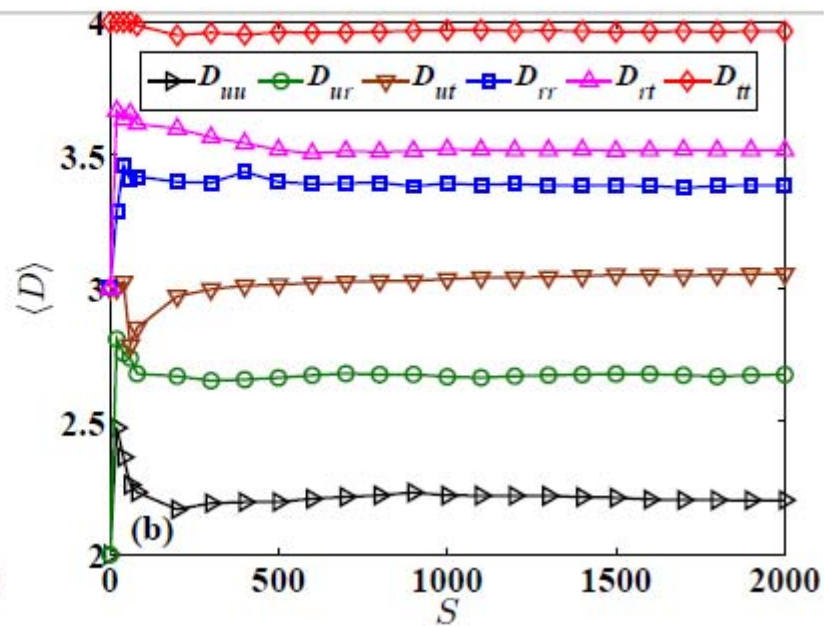
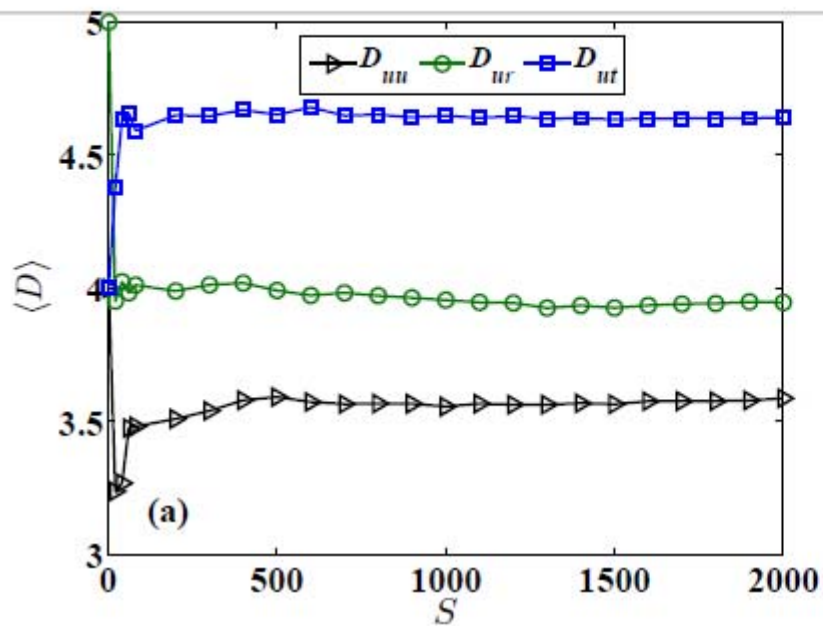
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Dynamics and evolution of social tagging networks (1/3)

- At each time step, a random user can either:
 - Choose an item(resource), and annotate it with a relevant or random tag with probability p (*Role 1*)
 - or choose a tag, and find a relevant or random item with probability $1-p$ (*Role 2*)

Dynamics of social tagging networks (2/2)





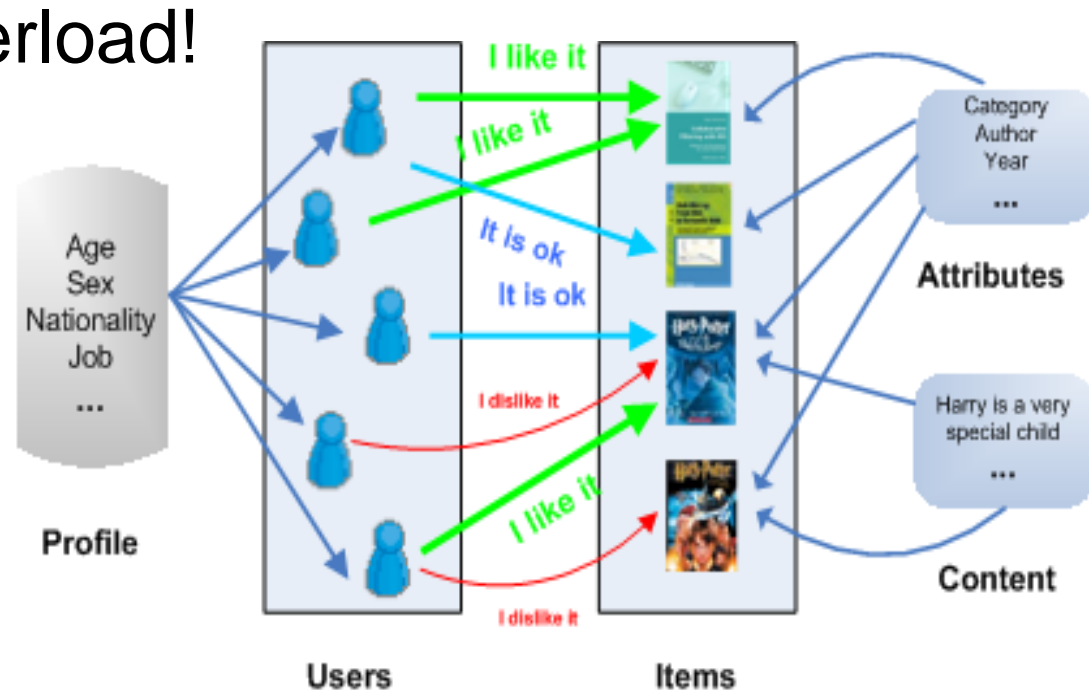
Applications in Personalized Recommendation (PR)

- Why Recommendation?

- Information overload!

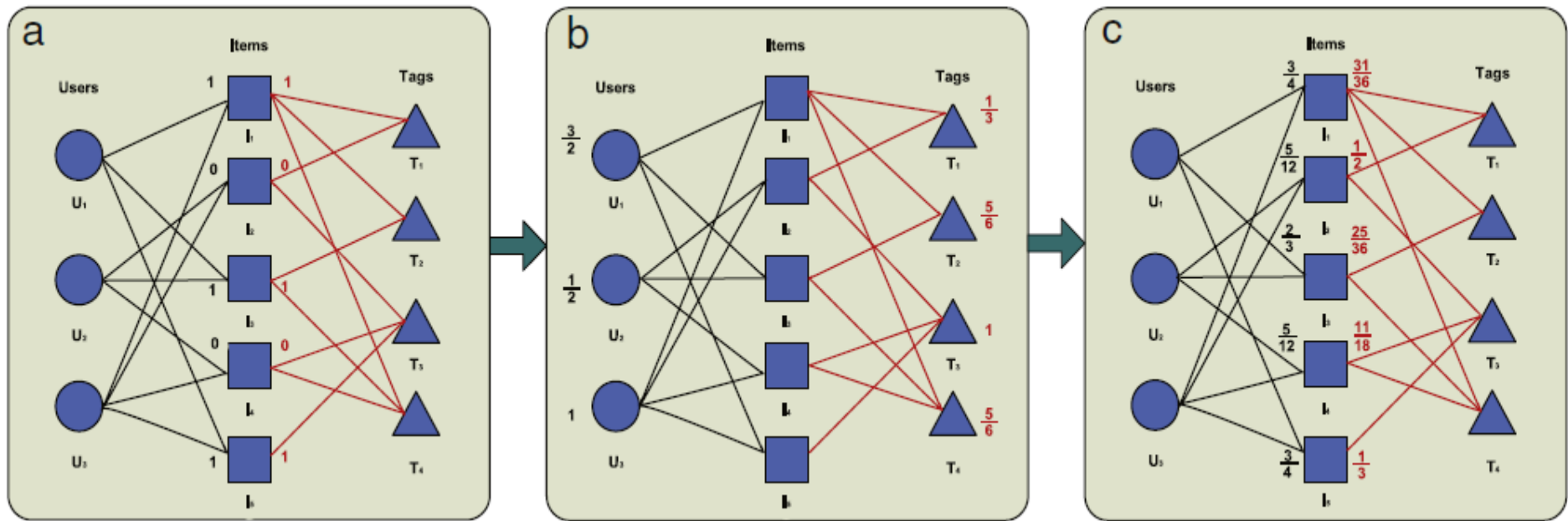
- How to be pers

- Social influence
- Content-based
- Network-base



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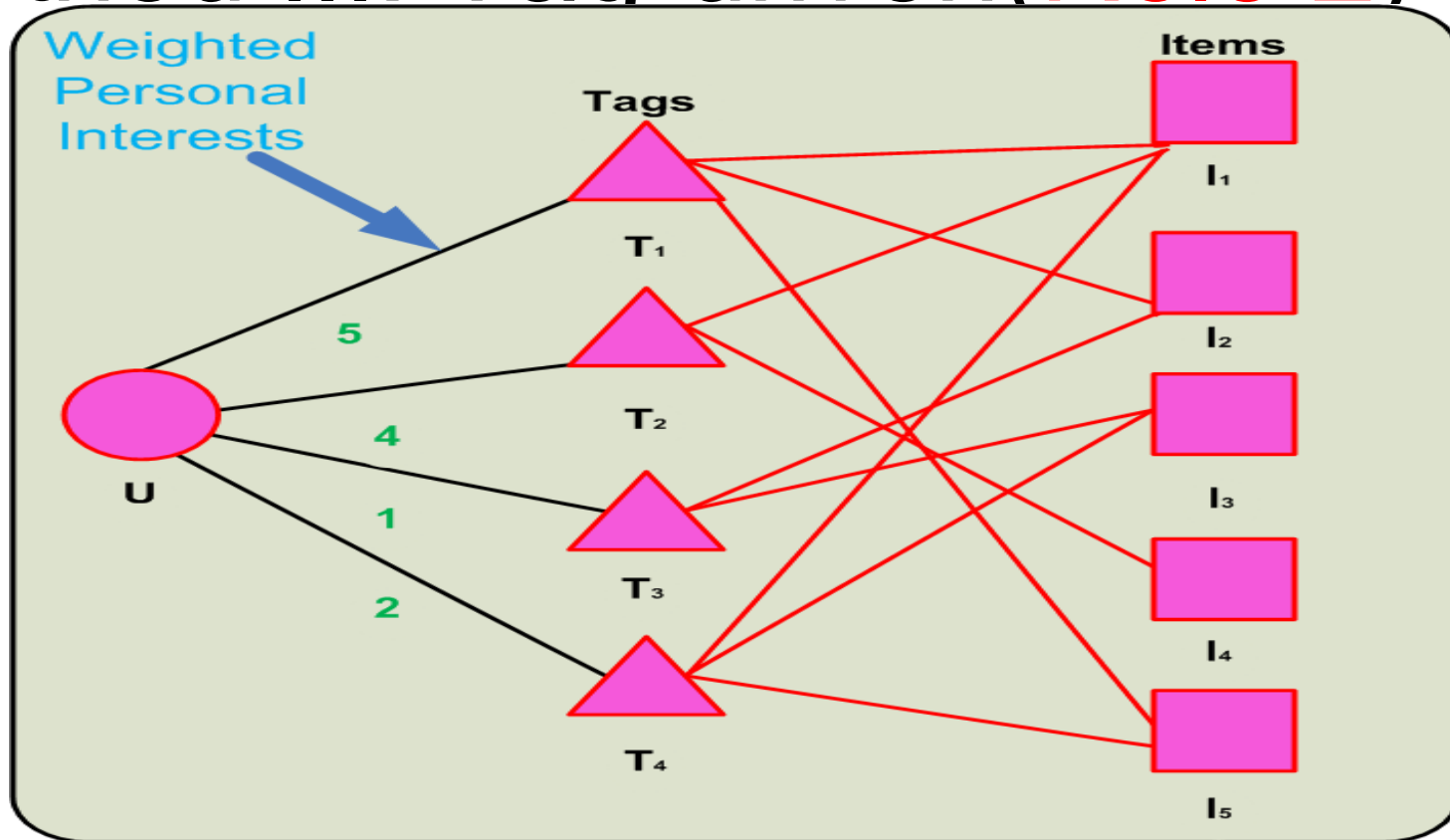
Method I&II: Tripartite Hybrid (Role 1)



- Item-user: $f'_j = \sum_{l=1}^n \frac{a_{lj}}{k(U_l)} \sum_{s=1}^m \frac{f_s}{k(I_s)}$, [Method I, PRE 76 (2007) 046115]
- Item-tag: $f''_j = \sum_{l=1}^r \frac{a'_{jl}}{k(T_l)} \sum_{s=1}^m \frac{f_s}{k'(I_s)}$, [Method II]
- Linear Hybrid: $\vec{f}^* = \lambda \vec{f}' + (1 - \lambda) \vec{f}''$

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Method III: Tag-driven (Role 2)



■ Method III:

$$\vec{f}^* = \sum_{l=1}^r \frac{a'_{jl} a''_{il}}{k(T_l)}, \quad j = 1, 2, \dots, m.$$

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Algorithm Performance (1/3)

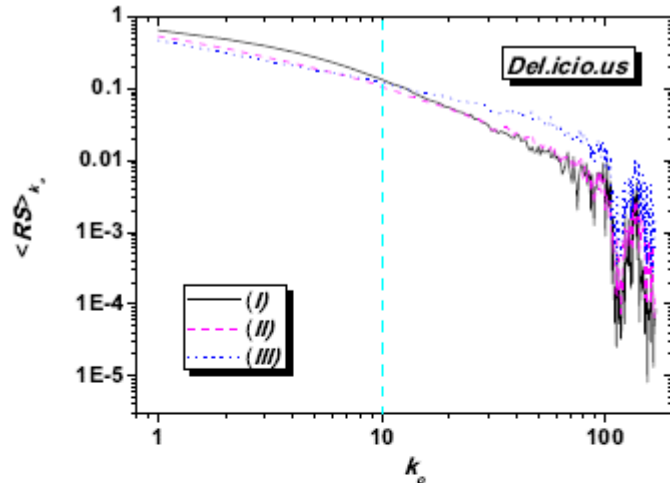


Table 2: Algorithmic accuracy for *Del.icio.us*. $\langle RS \rangle_{k_o \leq 10}$ is the average ranking score over objects with degree equal or less than 10, and $\langle RS \rangle_{k_o > 10}$ is the average ranking scores over objects with degree greater than 10. Each value is obtained by averaging over 50 realizations, each of which corresponds to an independent division of training set and testing set.

Algorithms	$\langle RS \rangle$	$\langle RS \rangle_{k_o \leq 10}$	$\langle RS \rangle_{k_o > 10}$
I	0.276	0.369	0.054
II	0.209	0.275	0.049
III	0.196	0.249	0.068

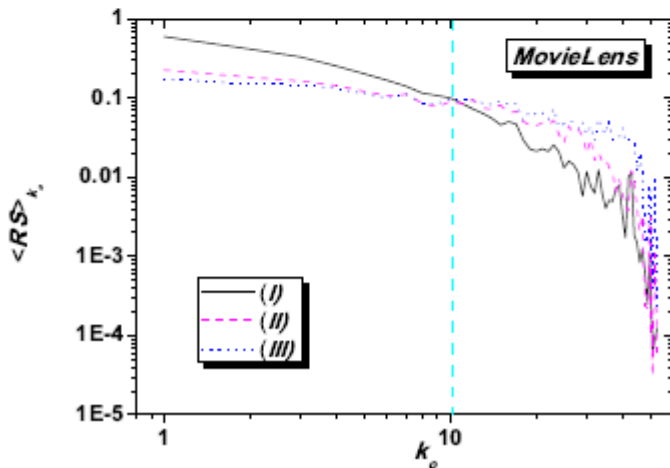
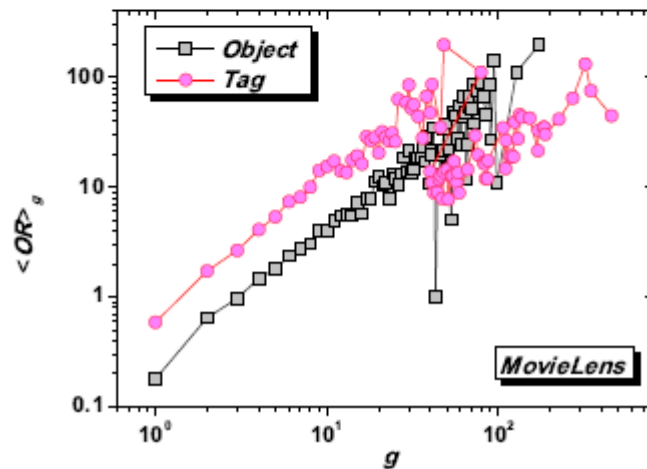
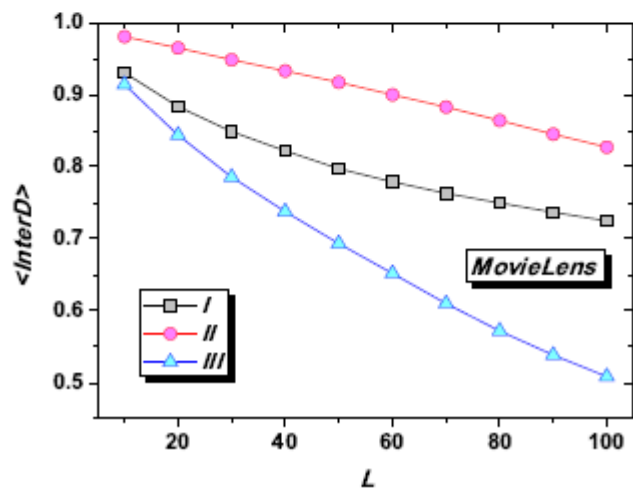
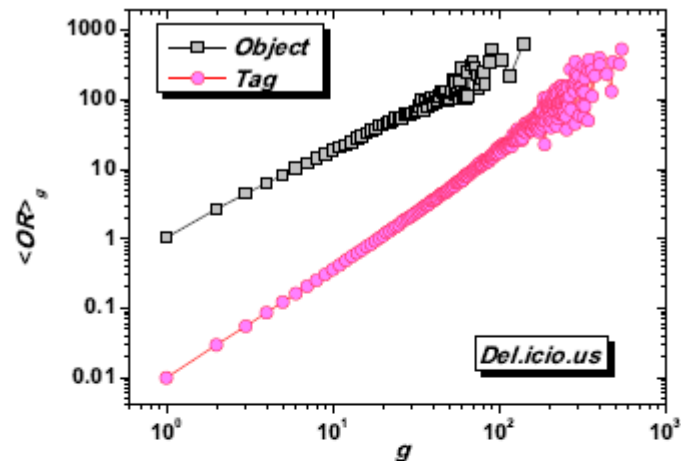
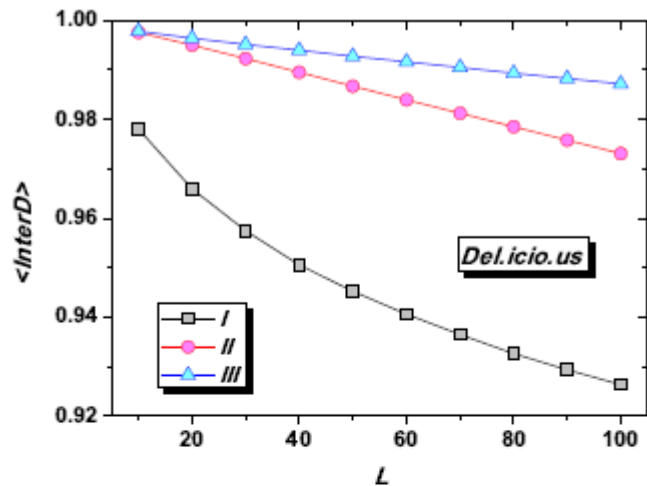


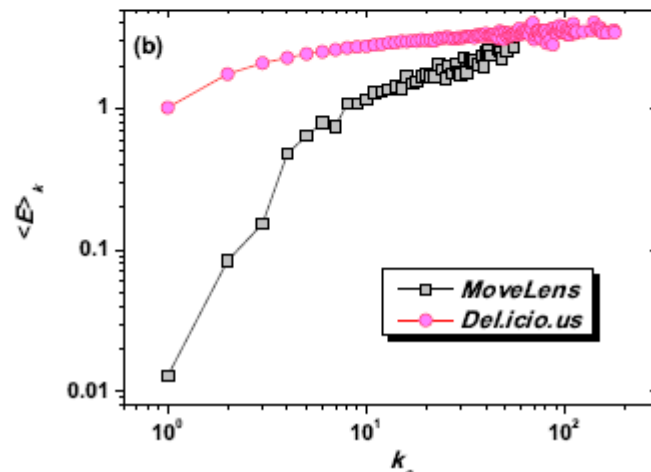
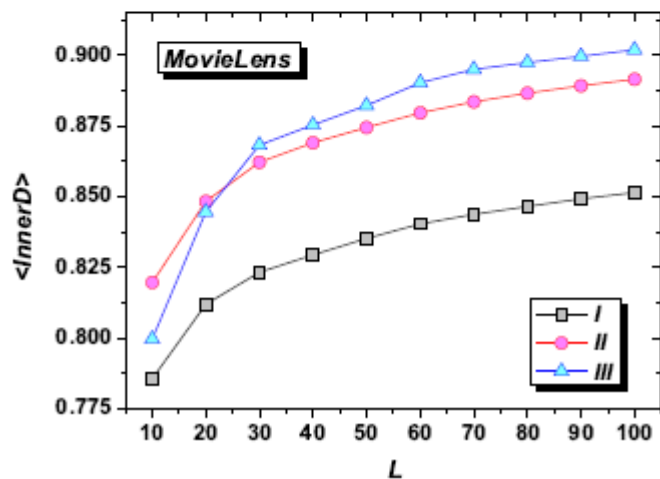
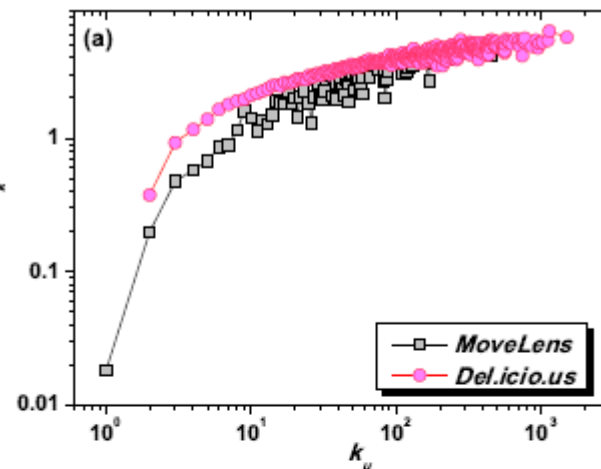
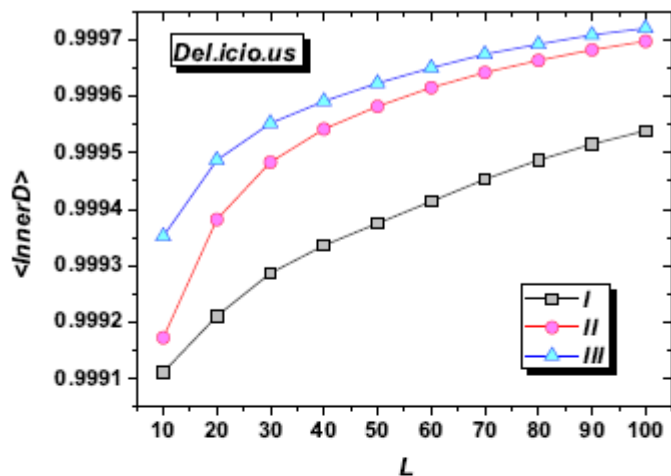
Table 3: Algorithmic accuracy for *MovieLens*.

Algorithms	$\langle RS \rangle$	$\langle RS \rangle_{k_o \leq 10}$	$\langle RS \rangle_{k_o > 10}$
I	0.207	0.307	0.039
II	0.130	0.168	0.055
III	0.123	0.146	0.070

Algorithm Performance (2/3)



Algorithm Performance (3/3)



Conclusions and Discussion

■ Conclusions

- Structure and Dynamics
- The roles of social tags
- Application in Personalized recommendation

■ Discussion

- Recommendation with full hypergraph structure
- Multi-scale recommendations (semantic-based)
- Recommendation with community structures



Thank You!

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