

DynFluid: Predicting Time-Evolving Rating in Recommendation Systems via Fluid Dynamics

The slide features several decorative light purple circles. One circle is positioned behind the word 'Fluid' in the title. Another circle is behind the name 'Jie Wu'. There are also several other circles scattered in the background, some overlapping the text.

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1. Personalized Recommendation

Too many choices in daily life:
which restaurant for dinner,
which movie to watch,
which product to purchase....


Restaurant near Philadelphia, PA Pric

 4.5 ★★★★★ 565 reviews	 3.9 ★★★★★ 267 reviews	 4.2 ★★★★★ 213 reviews	 4.6 ★★★★★ 239 reviews	 4.2 ★★★★★ 1,118 reviews	 4.3 ★★★★★ 484 reviews	 4.5 ★★★★★ 379 reviews
Zahav z • \$\$\$ • Israeli	Five Guys Burgers and Fries \$ • Hamburger	Raw Sushi & Sake Lounge z • \$\$ • Sushi	Bibou z • \$\$\$ • French	El Vez z • \$\$ • Mexican	Ruth's Chris Steak House z • \$\$\$ • Steak	Butcher and Singer z • \$\$\$ • Steak

1. Personalized Recommendation

Two types of trust-based recommendations
friend advices and public channel

[Apple iPhone 5S 16GB](#) from [£428.89](#) to [£1,373.00](#) (25 offers) · [Product Information](#)



★★★★★ User reviews (49)
#3 Top 10 The Best Smartphones & Mobile Phones

[eBay](#) Offers for Apple iPhone 5S 16GB

Ask a question Write your own review Receive review alert for this product

Product Description

Compare Prices Product Information **Reviews**

Rating Summary

★★★★★	(25)
★★★★☆	(19)
★★★☆☆	(3)
★★☆☆☆	(2)
★☆☆☆☆	(0)

Detailed rating



Look & Feel	★★★★☆
Durability & Robustness	★★★★☆
Battery standby time	★★★★☆
Value for money	★★★★☆
Range of features	★★★★☆


Show only

- Reviews with images (8)
- Diamond reviews (1)

Public Broadcast Channel

1-15 of 49 reviews

[ChemicalRo...](#) ★★★★★ [My Second iPhone Certainly Won't Be My Last!](#)  



Shiny, New, Looks Fab, Does Exactly What You Want...
It's Expensive!

"...that I changed my mind! == Apple == Apple are a technology giant all across the world, most people have heard copying each others products. Or because they bring out new phones every few months, or at least it feels that way ship them out personalised if you pay for it. ..." [Read review](#)
23.10.2013

Ciao members have rated this review on average: ■■■■■ exceptional

Friends' Ratings

2. Motivation



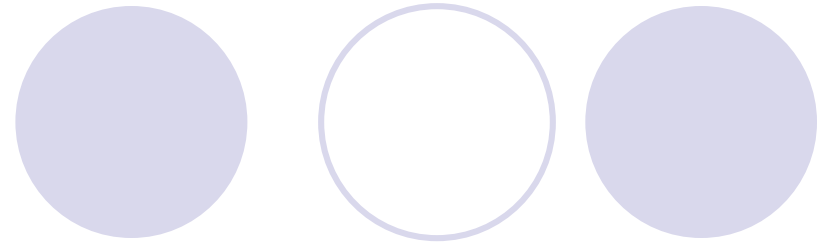
Existing trust-based recommendation methods

- Calculate at the current time
- Take direct friends, and friends of friends, equally
- Assume adoption of all influences

In real life

- Time-evolving system
- Closer friends have more impact
- Users have different features

3. System Setting

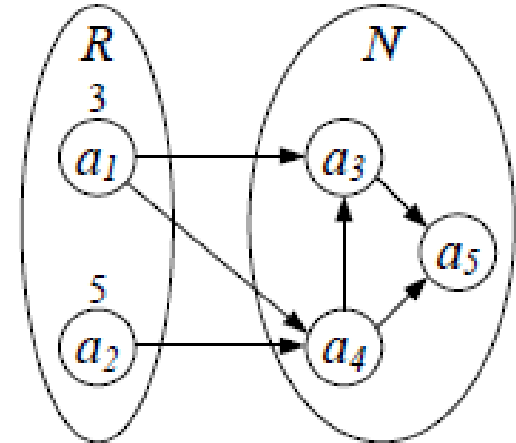


Nodes

- Raters, R
- Non-raters, N

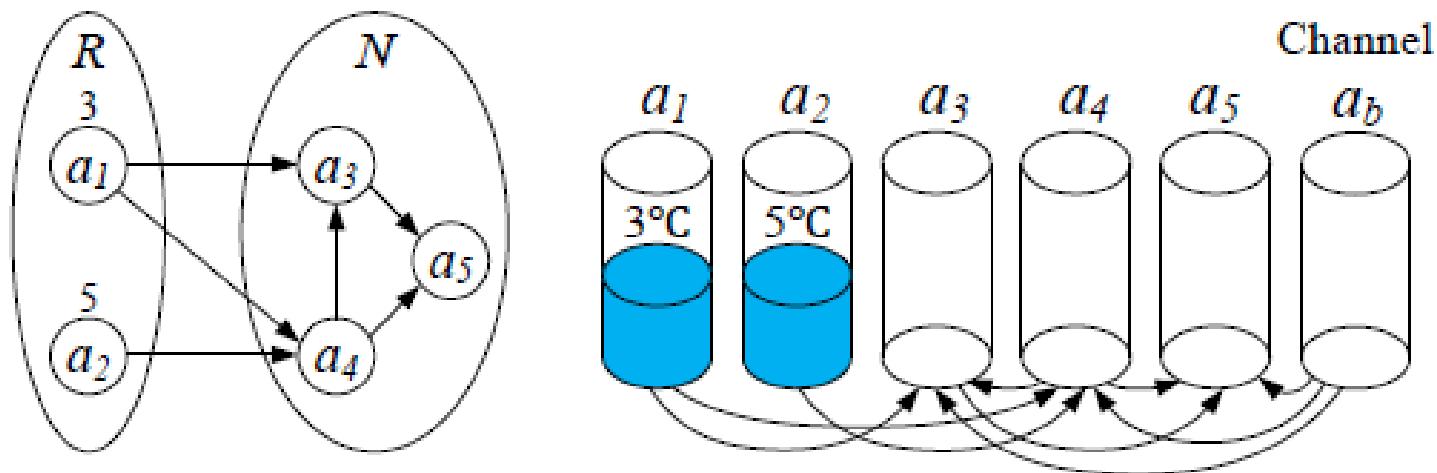
Influence Relationships

- Converted from trust relations
- Among raters and non-raters
- Each relationship is weighted



4. Model

Fluid Model to capture recommendations



Containers -> Users

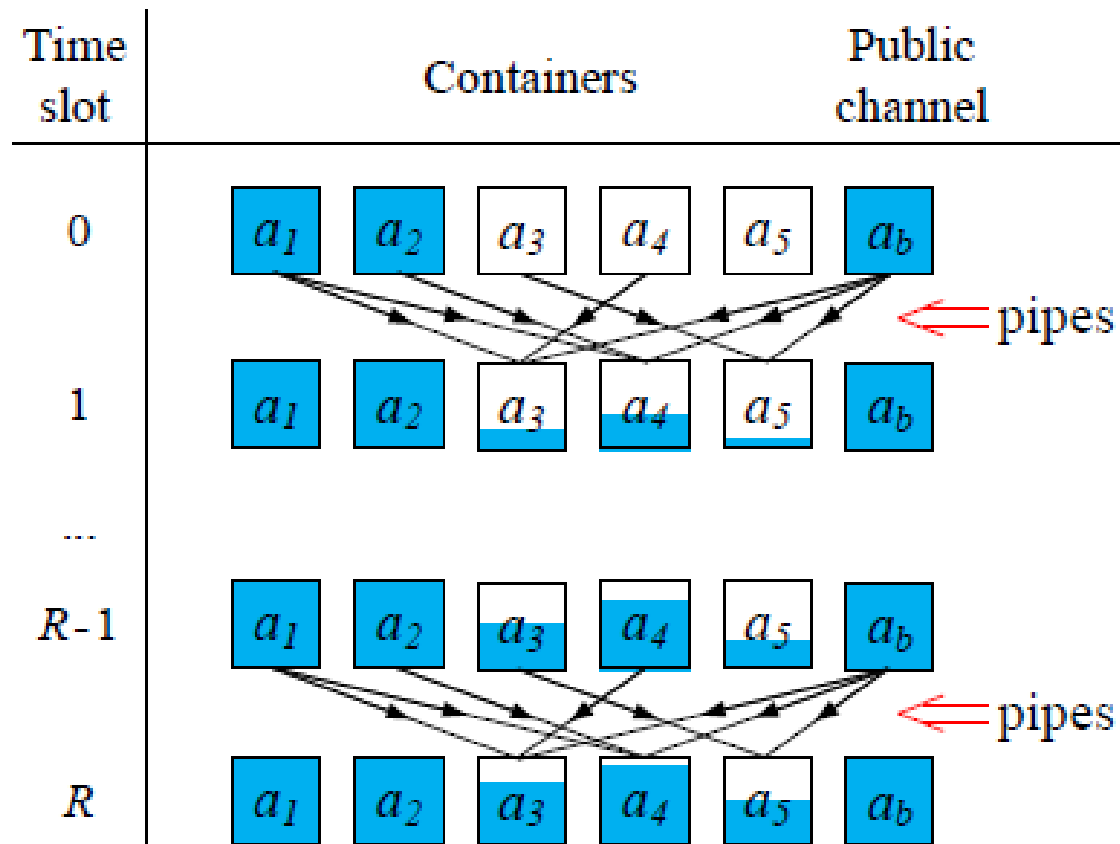
Container fluid height -> User persistency

Fluid temperature -> User Rating Score

Public channel -> A special public container

4. Model

Discrete approach to compute fluid update



4. Model

Container fluid volume update rule:

$$s_a(i+1) = s_a(i) - \sum_{a' \in N_a^+} s_{aa'}(i) + \sum_{a' \in N_a^-} s_{a'a}(i)$$

Container fluid temperature update rule:

$$t_a(i+1) = \frac{[s_a(i) - \sum_{a' \in N_a^+} s_{aa'}(i)] \cdot t_a(i) + \sum_{a' \in N_a^-} [s_{a'a}(i) \cdot t_{a'a}(i)]}{s_a(i+1)}$$

5. Theorem and Property

The title is centered at the top of the slide. It is flanked by five circles: a solid light purple circle on the far left, followed by an outlined light purple circle, a solid light purple circle, another outlined light purple circle, and a solid light purple circle on the far right.

Theorem 1: If we use a constant value (denoted by h) to initialize the fluid heights of all the raters and the public channel, then the fluid heights of all the non-raters will always be no larger than h , during the fluid updating process.

Theorem 2: If we use a constant value (denoted by h) to initialize the fluid heights of all the raters and the public channel, then, after a time period that is sufficiently long, the fluid heights of all the non-raters will be h .

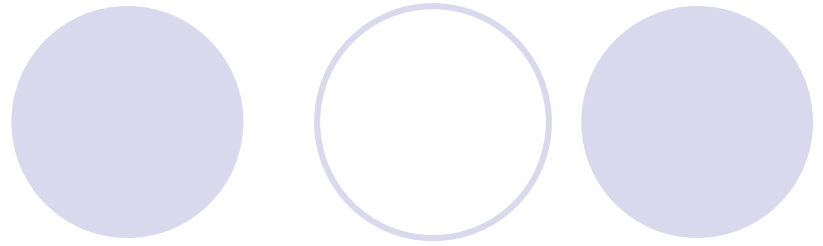
5. Theorem and Property



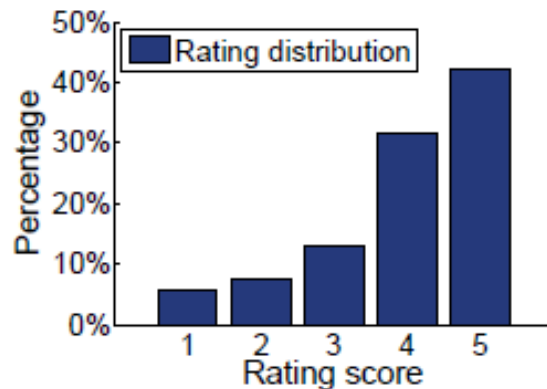
Property 1: In DynFluid, the opinion influence from a user, a , to another user, a' , decays monotonously with respect to the hop-count distance from a to a' .

Property 2: In DynFluid, the certainty of the rating prediction for a non-rater can be measured by the fluid height (or persistency) of that non-rater.

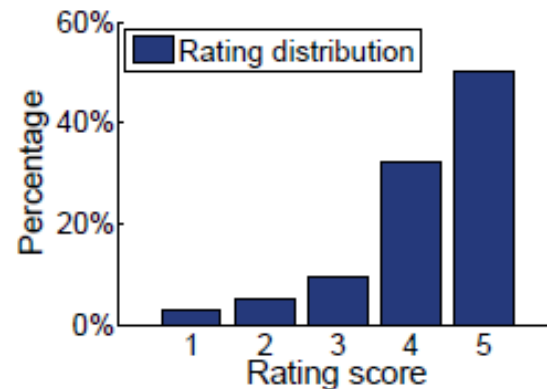
6. Experiments



- Epinions dataset consists of 49,290 users who rated a total of 139,738 different products. The total number of issued trust relationships is 487,181.
- The Ciao dataset consists of 2,248 users who rated a total of 16,861 different products. The total number of issued trust relationships is 57,544



(a) Rating scores in Epinions.



(b) Rating scores in Ciao.

6. Experiments



Performance metric

- Root mean squared error (RMSE)
- F-score (harmonic mean of precision and recall)

Default parameters

- Time slot length is 0.1
- Rounds of update is 10
- Cross-sectional areas of all the containers are 1
- Initial temperature of the public channel is the average score of all the raters.

Comparison algorithms: TidalTrust, MoleTrust, Random Walk, PageRank, and FluidRating

6. Experiments

Epinions and Ciao result (RMSE and F-score):

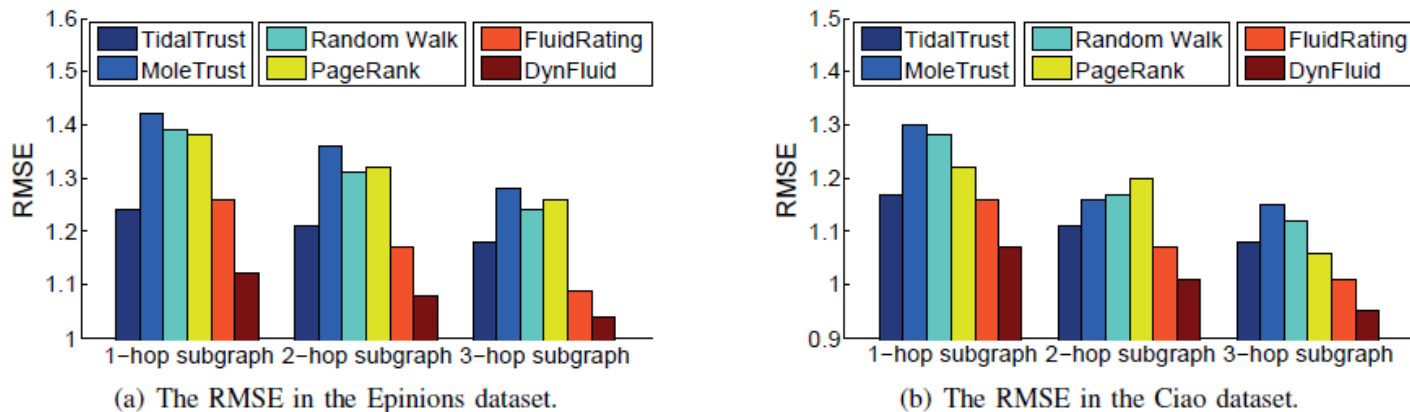


Fig. 6. Compare DynFluid with the other methods, in terms of the RMSE metric.

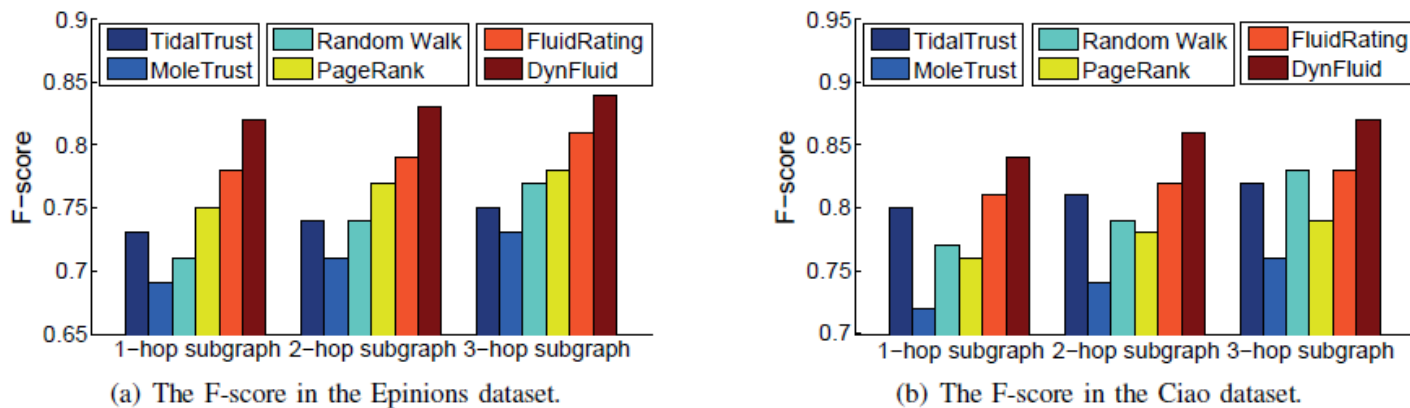
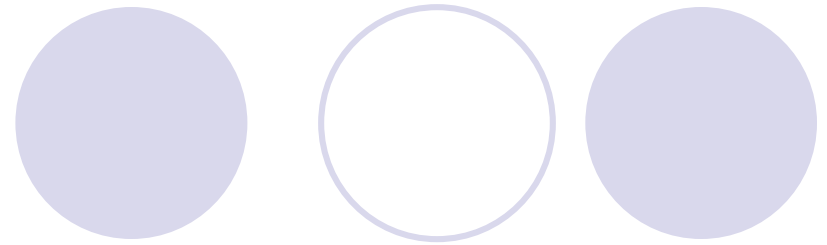
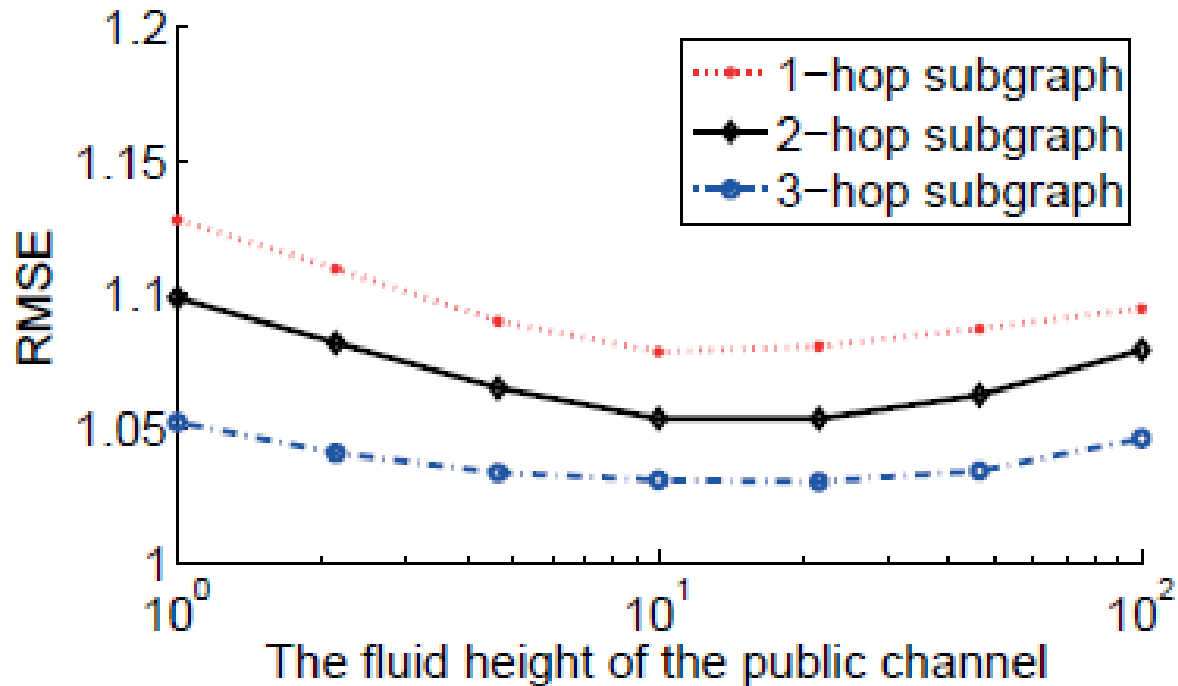


Fig. 7. Compare DynFluid with the other methods, in terms of the F-score metric.

6. Experiments

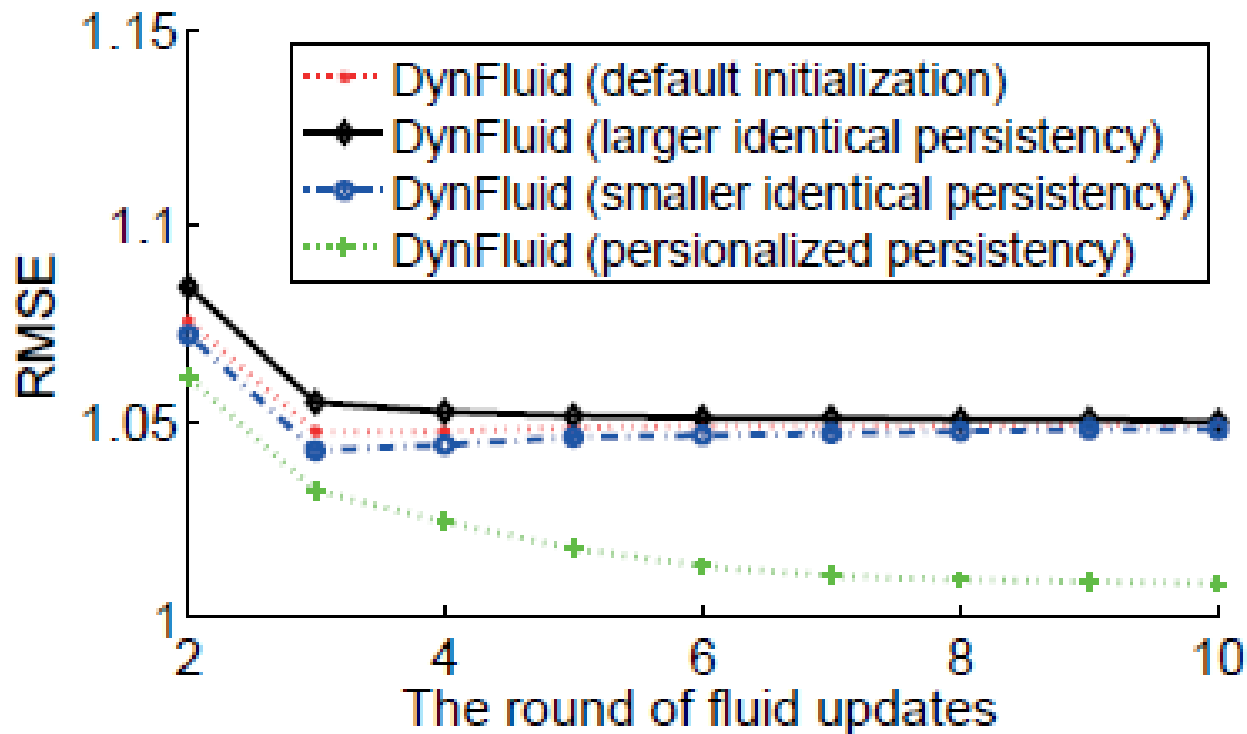


Impact of the public channel (Epinions):



6. Experiments

Impact of the user persistency (Epinions):



7. Conclusion



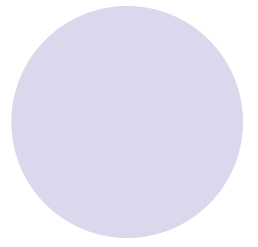
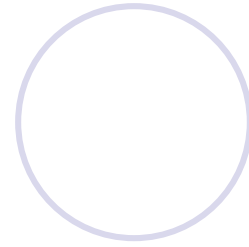
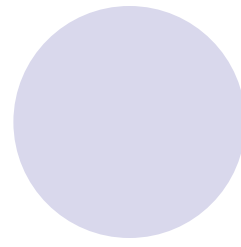
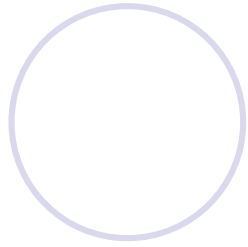
Conclusion:

- Our model can reflect the time-evolving feature
- Differentiate direct and indirect influence
- Public Channel is very effective
- Reflect the user personality feature (persistency)

Future Work

- Update the discrete computation model
- Capture more user features

8. End



Q & A

