

# Temporal Conformity-aware Hawkes Graph Network for Recommendations

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## INTRODUCTION

### Decision-making

- Decision =
- User interest +
- Conformity behavior

### Conformity Behavior

- Informational Conformity
  - Lack of relevant knowledge
- Normative Conformity
  - Fear of isolation/missing out

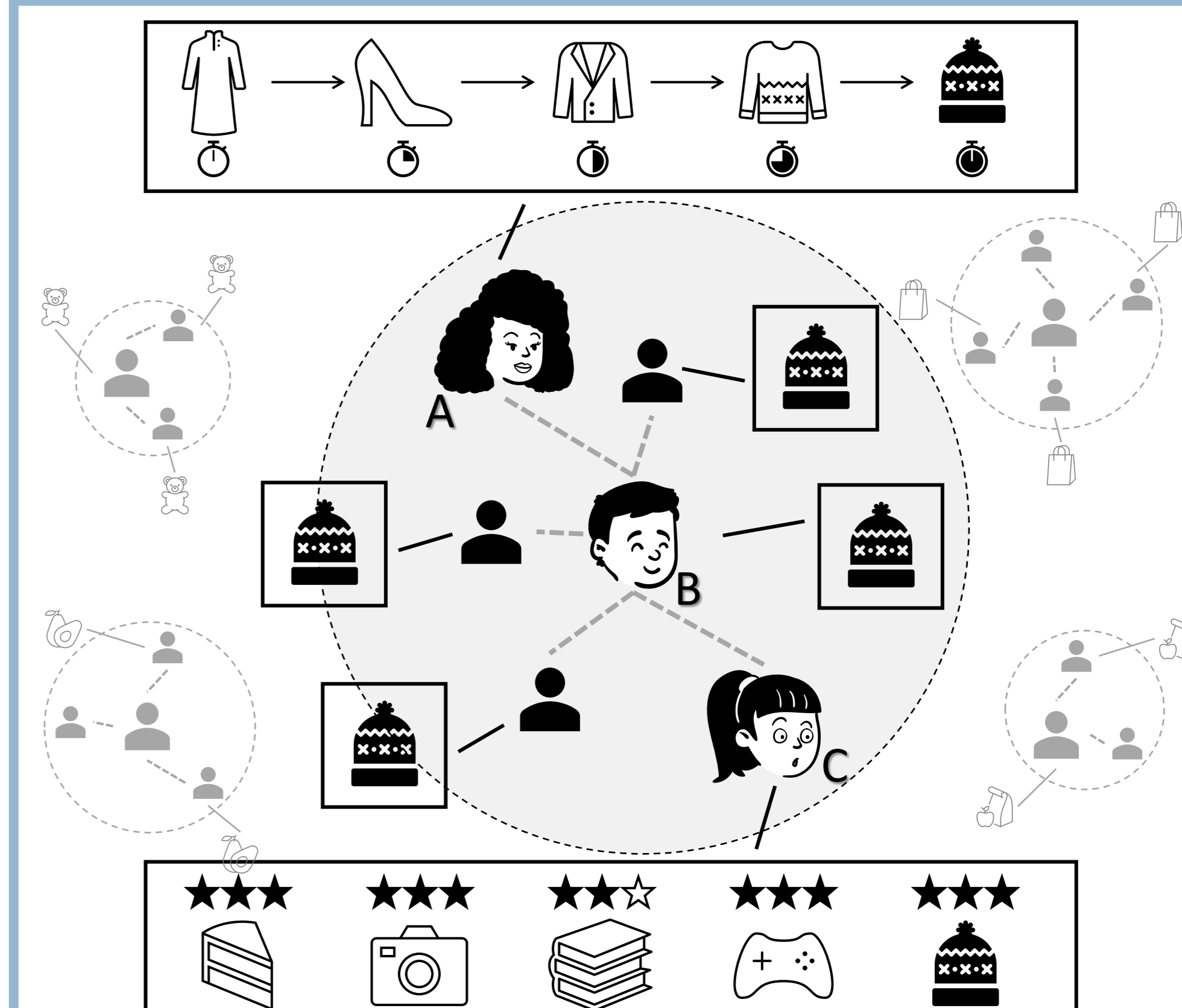
### Recommendations

- Conformity Modeling
- Interest/Conformity Evolution
- Recommendation Generation

### Motivations:

- ❑ Individuals may conform to the majority even if it goes against their **own beliefs**.
- ❑ Conformity Behavior does **NOT** necessarily reflect **User Interest**.
- ❑ Conformity Behavior is **NOT** necessarily a **Negative Factor**.
- ❑ Conformity Bias is **NOT** necessarily equivalent to **Popularity Bias**.
- ❑ Interest and Conformity can be **dynamically** transformed into each other.

## DECISION-MAKING



- A: buy the hat due to her **self-interest**
- B: buy the hat due to **informational conformity**
- C: buy the hat due to **normative conformity**

## TEMPORAL CONFORMITY-AWARE HAWKES NETWORK

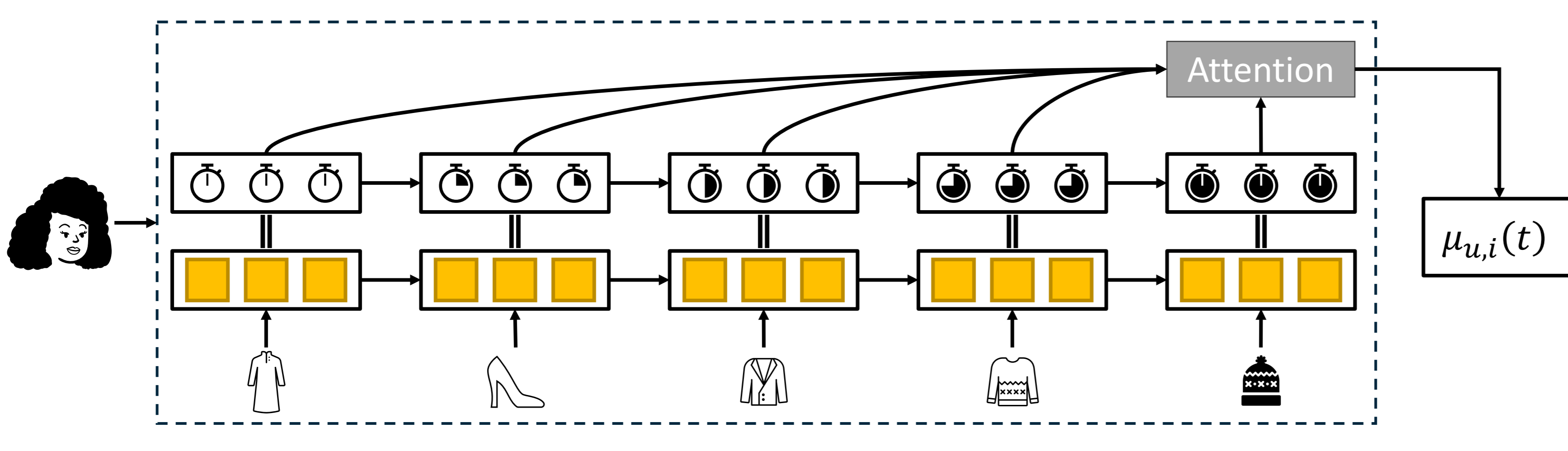
### Preference of user $u$ on item $i$ :

$$\lambda_{u,i}(t) = \mu_{u,i}(t) + \sum_{v \in U} \alpha_{u,v}(t) \kappa_{u,v}(\Delta t) + \sum_{i' \in I} \beta_{i,i'}(t) \kappa_{i,i'}(\Delta t)$$

### Self-interest $\mu_{u,i}(t)$ :

The base intensity of user  $u$ 's preference on item  $i$  is determined by her intrinsic interest.

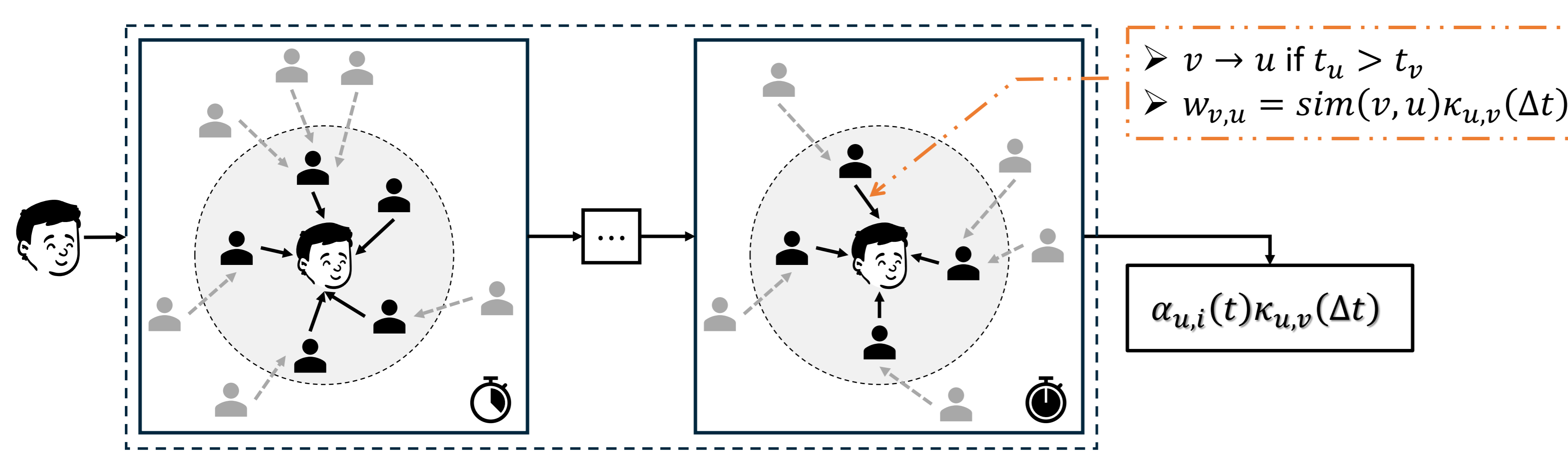
**Solution:** Capturing users' **temporal attention** given their **own** interaction history.



### Informational Conformity $\alpha_{u,i}(t) \kappa_{u,v}(\Delta t)$ :

Informational conformity reflects the aggregated preferences of other **like-minded users**.

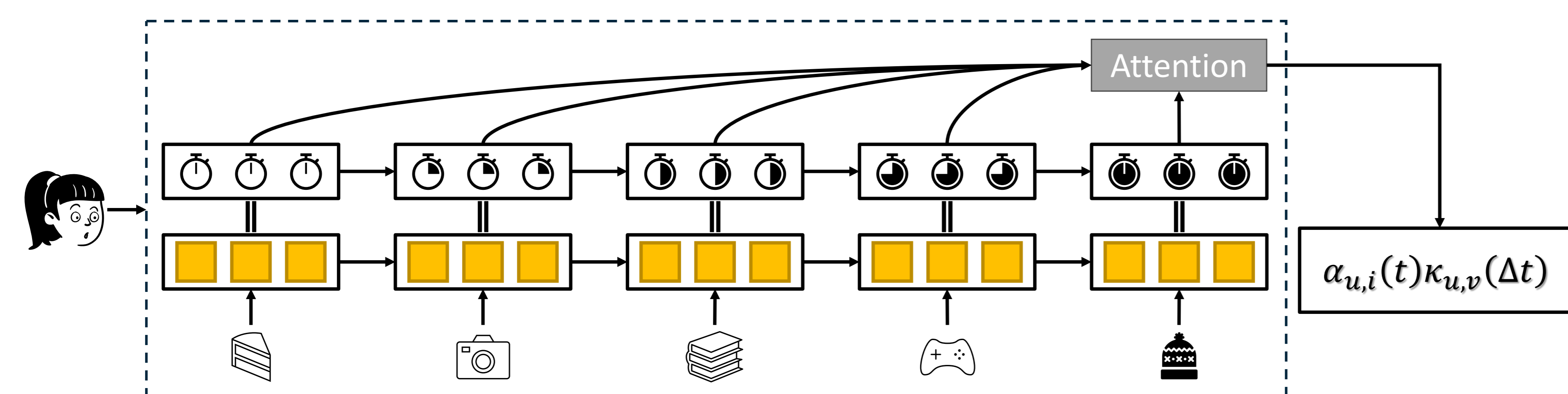
**Solution:** Modeling the **propagation of influence** between users in an interaction graph.



### Normative Conformity $\beta_{i,i'}(t) \kappa_{i,i'}(\Delta t)$ :

Normative conformity reflects the aggregated preference on recently popular items.

**Solution:** Capturing users' **temporal attention** on **recent popular items**.

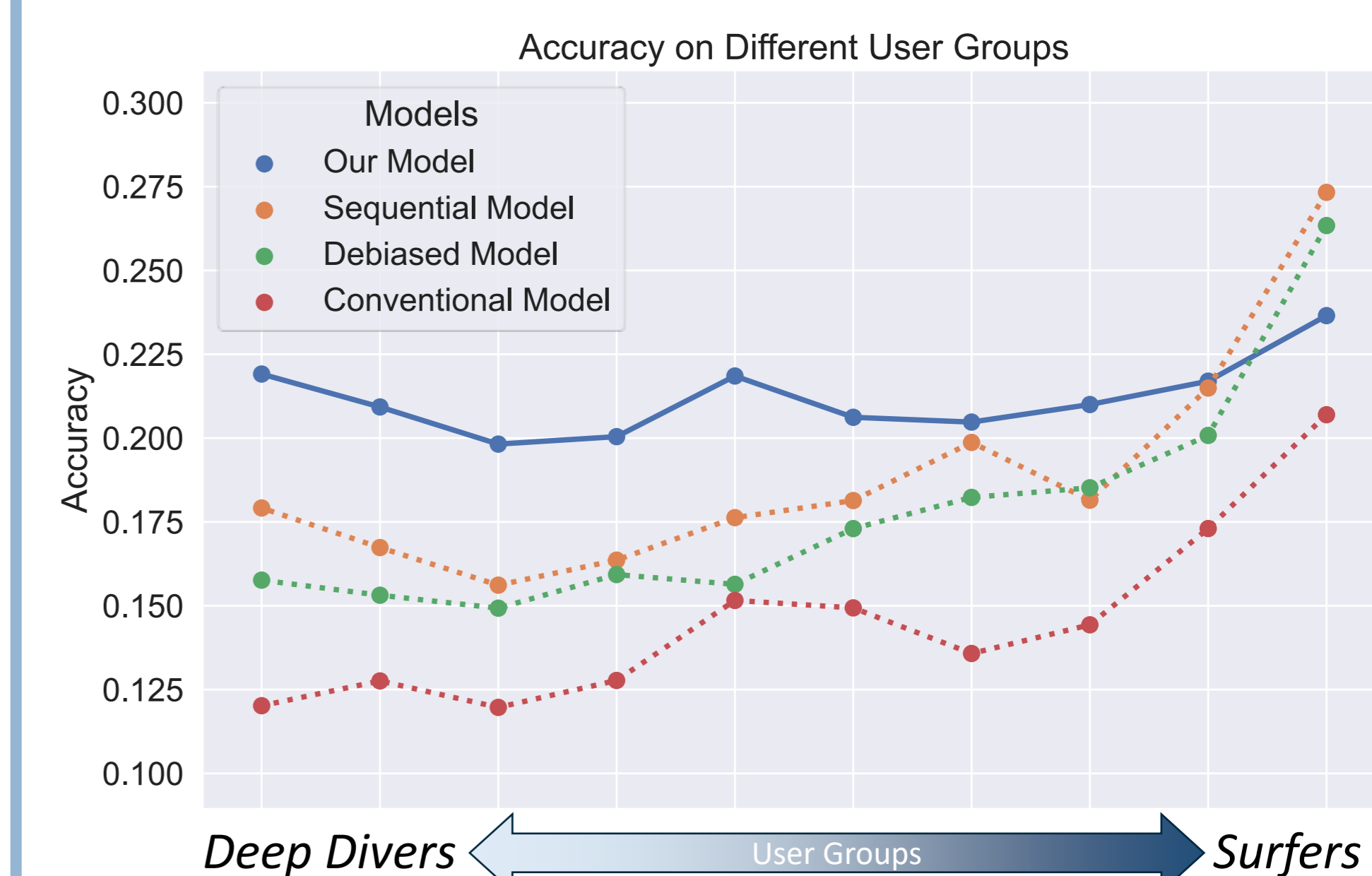


## RELATED WORK

Model	Conf.	Neg. Fac.	Static	Pop. Bias
IPS-MF <sup>[1]</sup>	WSDM'20	✓	✓	✓
DICE <sup>[2]</sup>	WWW'21	✓	✓	✓
PDA <sup>[3]</sup>	SIGIR'21	✗	✓	✓
MACR <sup>[4]</sup>	SIGKDD'21	✓	✓	✓

- **Neg. Fac.:** is Conformity a **Negative Factor**?
- **Static:** is Conformity **Static** over time?
- **Pop. Bias:** is Conformity equivalent to **Popularity Bias**?

## EXPERIMENT RESULT



### User Groups:

- **Deep divers:** who are less influenced by others
- **Surfers:** who prefer popular items and follow trends

## CONCLUSIONS

- ❑ Identify two flavors of conformity behavior
  - Informational Conformity
  - Normative Conformity
- ❑ Utilize conformity signal to generate personalized recommendations
- ❑ Balance accuracy and diversity of recommendations
- ❑ Fairly benefit various user groups

## REFERENCES

- [1] Y. Saito, et al., Unbiased recommender learning from missing-not-at-random implicit feedback. *WSDM'20*.
- [2] Y. Zheng, et al., Disentangling user interest and conformity for recommendation with causal embedding. *WWW'21*.
- [3] Y. Zhang, et al., Causal intervention for leveraging popularity bias in recommendation. *SIGIR'21*.
- [4] T. Wei, et al., Model-agnostic counterfactual reasoning for eliminating popularity bias in recommender system. *SIGKDD'21*.