



清華大學
Tsinghua University

Microsoft Research
微软亚洲研究院

HieRec: Hierarchical User Interest Modeling for Personalized News Recommendation

Tao Qi¹, Fangzhao Wu², Chuhan Wu¹, Peiru Yang¹, Yu Yang²,
Xing Xie², Yongfeng Huang¹

¹Department of Electronic Engineering & BNRist, Tsinghua University, Beijing 100084, China

²Microsoft Research Asia, Beijing 100080, China

taoqi.qt@gmail.com

Personalized News Recommendation

- Online news platforms become popular for people to read news
- News recommendation is important for online news platforms

The screenshot displays a news recommendation interface. At the top left is a large featured article with a photo of a man holding a portrait of a man. The headline reads "Ethiopia's PM Abiy: From peace prize to grinding war" and is attributed to AFP. Below this are several smaller article tiles, each with a logo, headline, and thumbnail image. The tiles include:

- BBC News:** "World Bank rejects El Salvador Bitcoin request" with a thumbnail of a man and the text "got bitcoin?".
- Daily Mail:** "'It was a good day for Russia': Trump says Biden capitulated to..." with a thumbnail of Trump and Biden.
- Business Insider:** "Boxer, attorney, and former reality TV star Joey Gilbert was at..." with a thumbnail of a man.
- The Hill:** "China sends first astronauts to its self-developed space..." with a thumbnail of the Chinese flag.
- The New York Times:** "Biden and Putin spar even as they move to ease tensions" with a thumbnail of Biden and Putin.

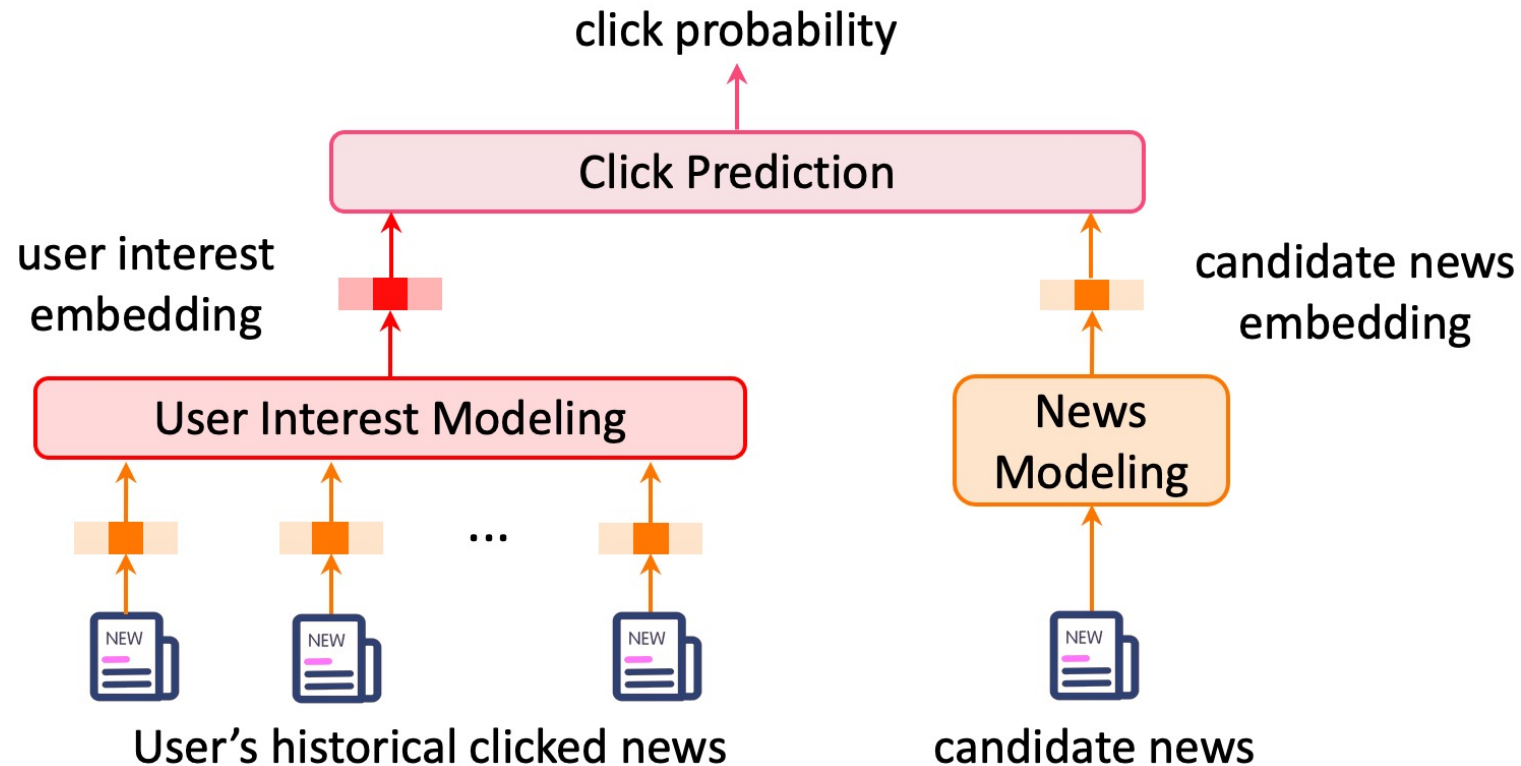
On the right side, there is a "TRENDING STORIES" section with a list of five items, each with a number, a headline, a source logo, and a time ago:

1. Biden and Putin spar even as they move to ease...
The New York Times · 3h
2. US likely claims hottest place on Earth as heat...
NBC News · 3h
3. Claudette is likely to form and make landfall in the ...
CNN · 4h
4. Mother of decuplets accuses the father of tryl...
Daily Mail · 12h
5. Sports Media World Reacts To The Robert Griffin News
The Spun · 10h

Below the trending stories is a "See more trending stories" link. Further down, there are more article tiles, including one from INSIDER titled "Digital sex crime victims in South Korea..." and one from CNET titled "Disney Plus: What's coming in July 2021?". At the bottom left, there is an advertisement for Grammarly with the text "Write Confidently in English" and "Ad Grammarly".

Personalized News Recommendation

- User interest modeling is the core task of news recommendation
- Most existing methods encode user interest via a single embedding



Framework of mainstream methods

Challenge

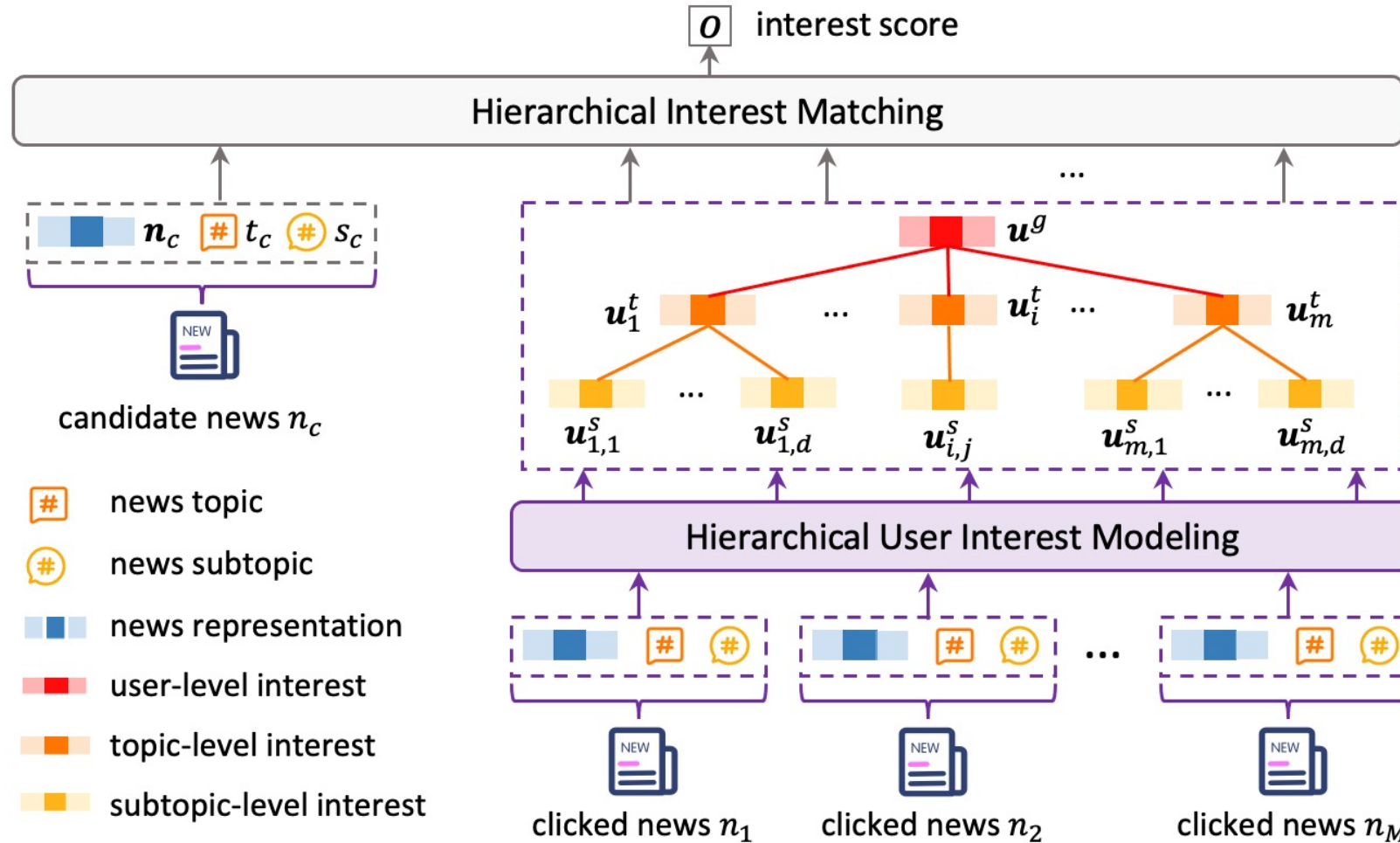
- User interest is usually diverse and multi-grained
 - A single embedding is difficult to effectively model user interest in different aspects and granularities

ID	Click	Topic	Subtopic	Title
1	✓	Movies	Celebrity	Ben Affleck breaks silence after “slip” in sobriety.
2	✓	Sports	Football	Myles Garrett suspended indefinitely by the NFL.
3	✓	Sports	Football	Jaguars veteran cornerback Josh Robinson retires suddenly.
4	✗	Sports	Basketball	Trey Lyles off to a good start with Spurs.
5	✗	Sports	Golf	Can an amateur win again on the PGA Tour?
6	✓	Finance	Stocks	3M is a dog of the Dow -- and it may not get better in 2020.
7	✓	Finance	Taxes	New Trump tax documents show major inconsistencies.
8	✓	Health	Fitness	This guy lost 30 pounds and gained a rock-hard pack.
9	✗	Lifestyle	Food	Candy Corn has tired to the Metro East.

Historical click and non-click behaviors of an example user.

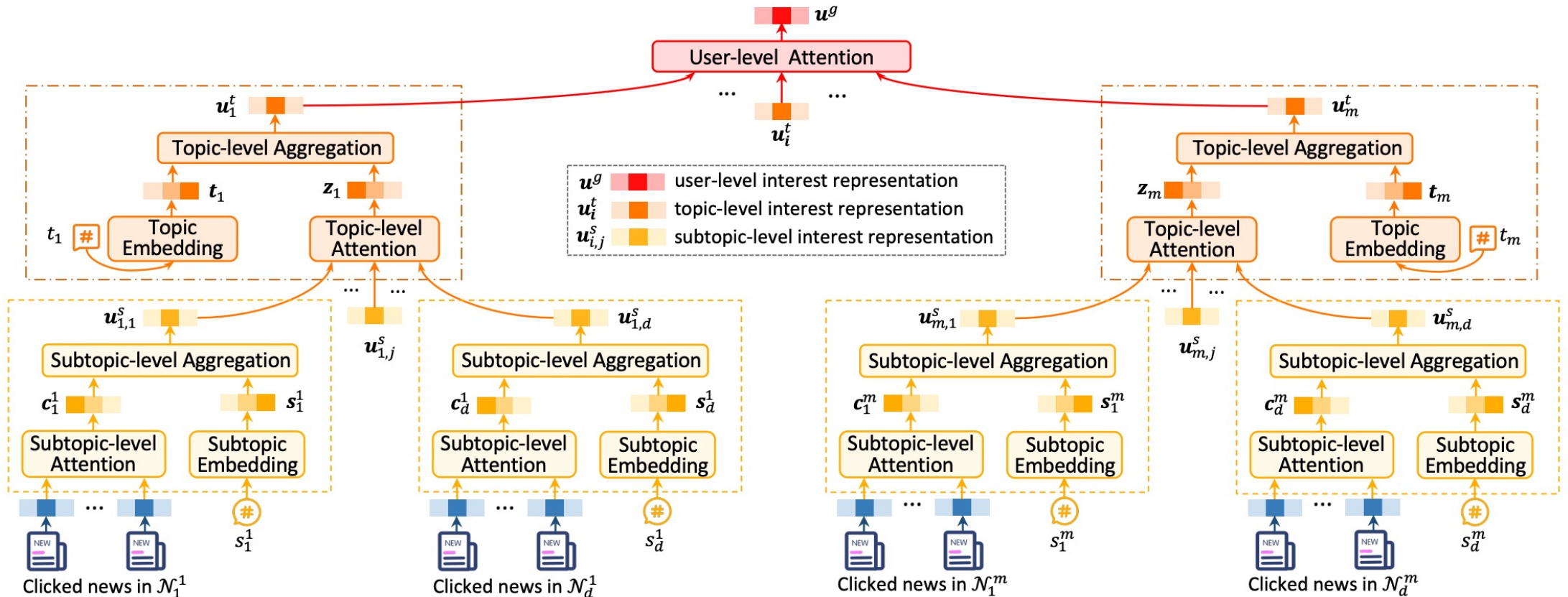
HieRec

- Overall framework



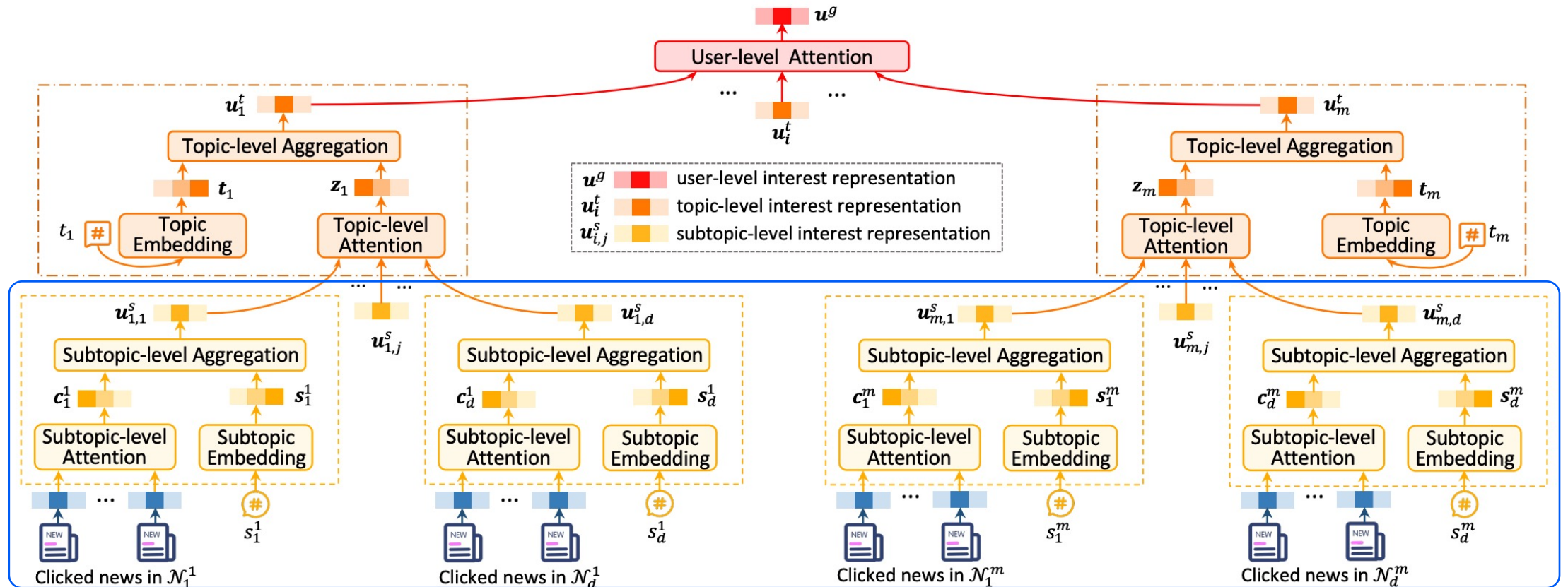
Hierarchical User Interest Modeling

- Learn hierarchical user interest representation to model diverse and multi-grained user interest



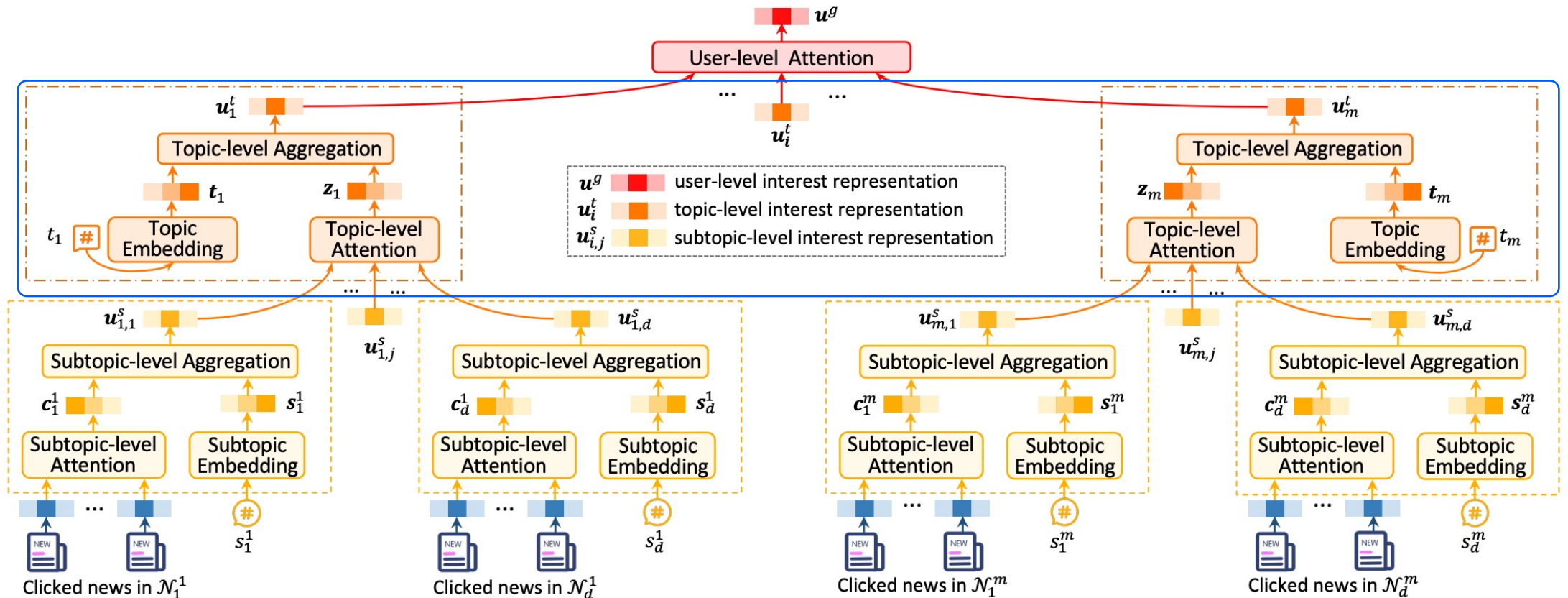
Hierarchical User Interest Modeling

- Learn hierarchical user interest representation to model diverse and multi-grained user interest



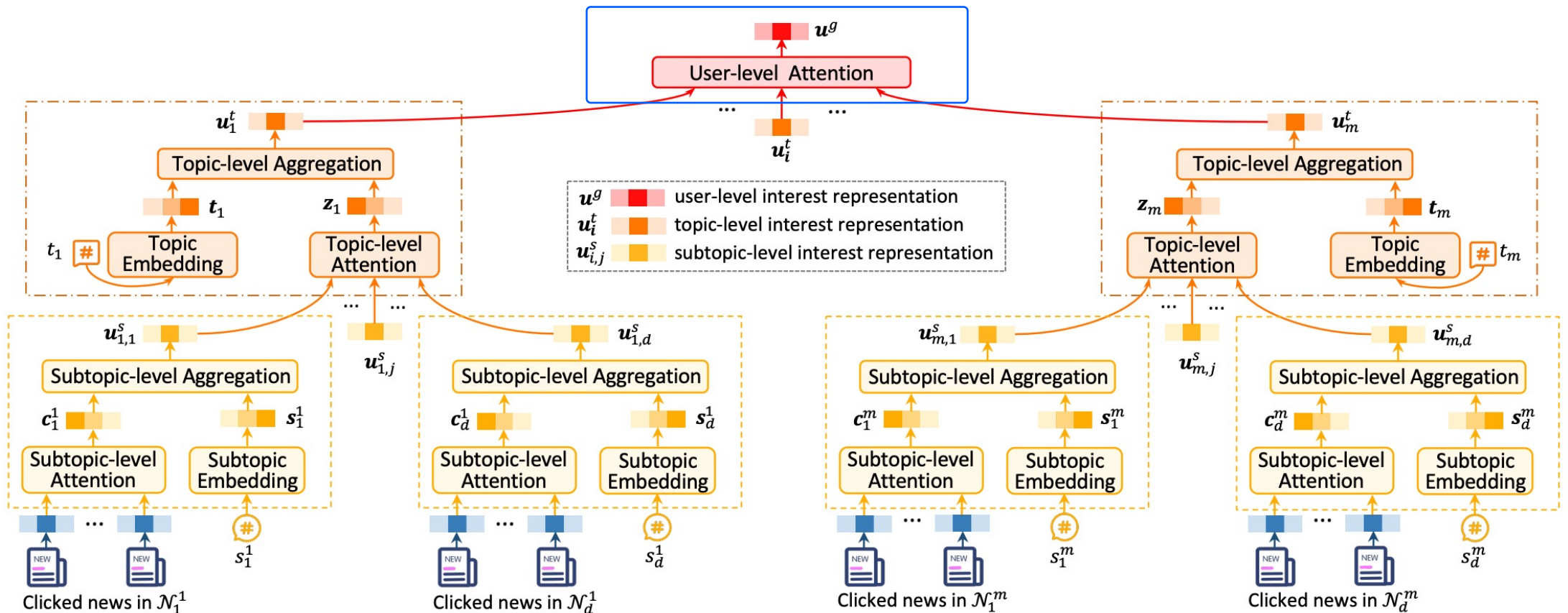
Hierarchical User Interest Modeling

- Learn hierarchical user interest representation to model diverse and multi-grained user interest



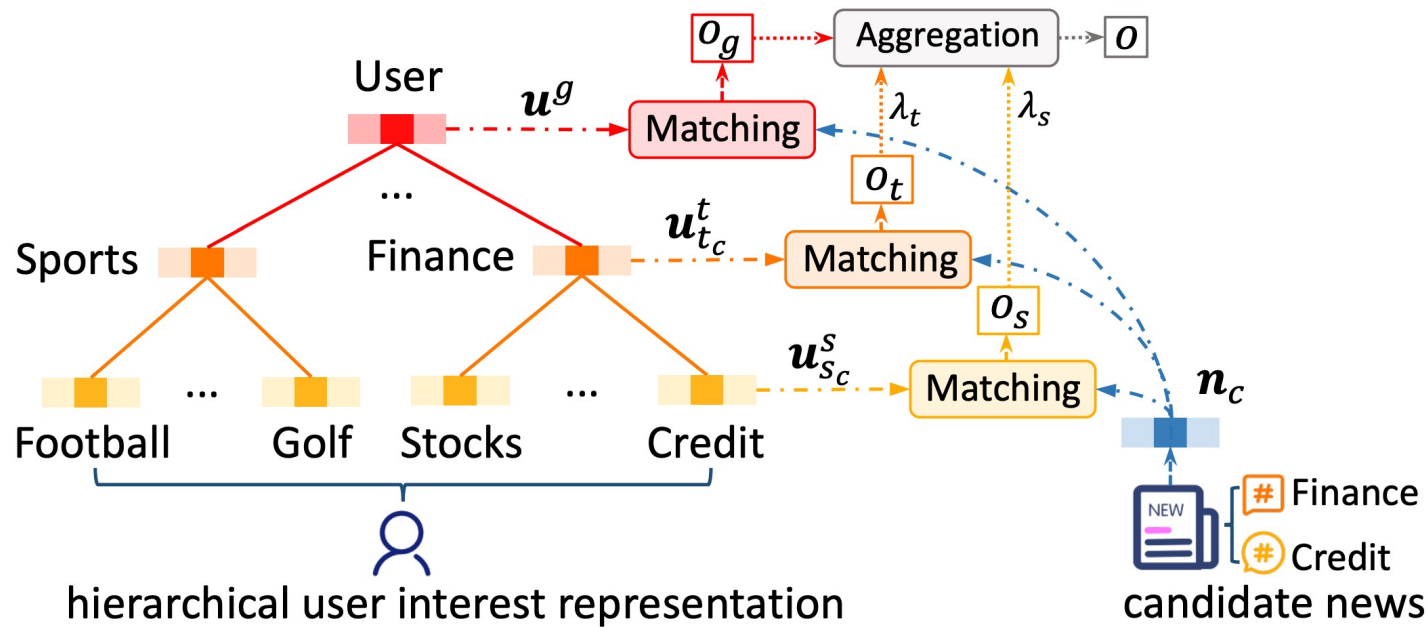
Hierarchical User Interest Modeling

- Learn hierarchical user interest representation to model diverse and multi-grained user interest



Hierarchical Interest Matching

- Match candidate news and user from different interest granularities

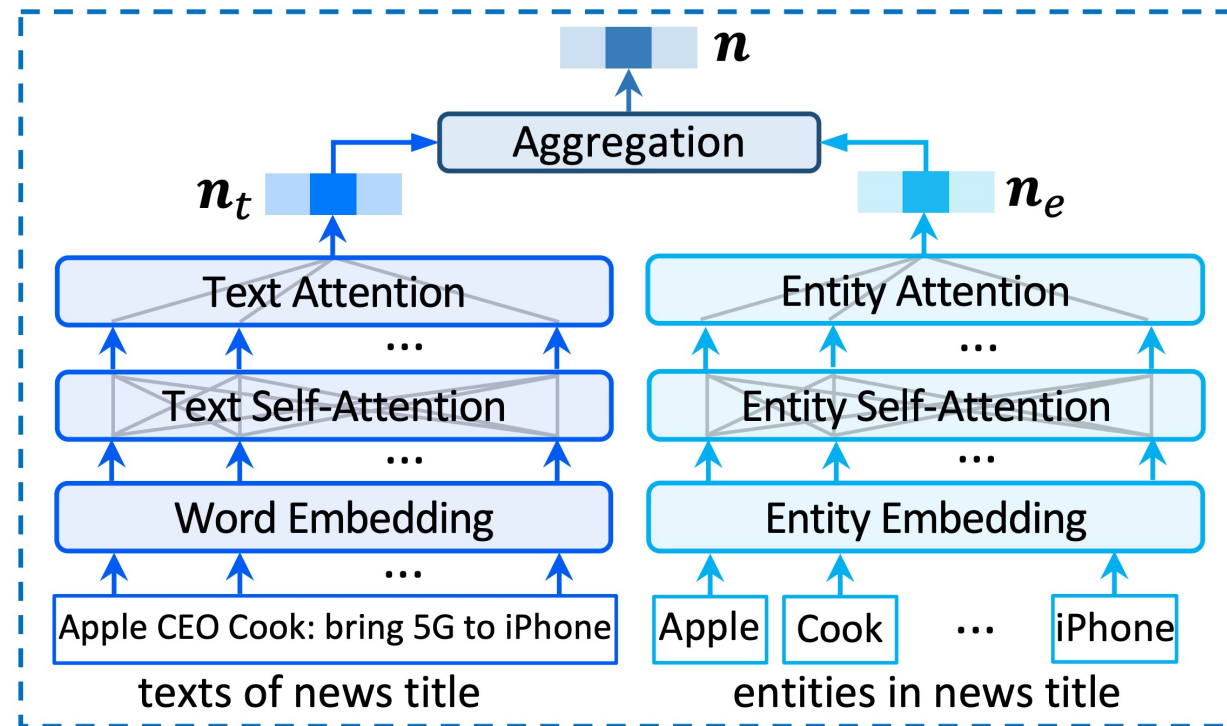


- Subtopic-level: $o_s = \mathbf{n}_c^T \cdot \mathbf{u}_{s_c}^s$
- Topic-level: $o_t = \mathbf{n}_c^T \cdot \mathbf{u}_{t_c}^t$
- User-level: $o_g = \mathbf{n}_c^T \cdot \mathbf{u}^g$
- Overall interest score:

$$o = \lambda_t o_t + \lambda_s o_s + (1 - \lambda_t - \lambda_s) o_g$$

News Encoder

- Learn news representation from both news texts and entities



Datasets

- MIND:
 - A public news recommendation dataset based on Microsoft News
 - Constructed by user logs from 2019.10.19 to 2019.11.15 (6 weeks)
- Feeds:
 - A private news recommendation dataset
 - Constructed by user logs on a news feeds in Microsoft
 - Constructed by user logs from 2020.01.23 to 2020.04.23 (13 weeks)

	# News	# Topics	# Subtopics	# Users	# Clicks
<i>MIND</i>	65,238	18	270	94,057	347,727
<i>Feeds</i>	1,126,508	28	-	50,605	473,697

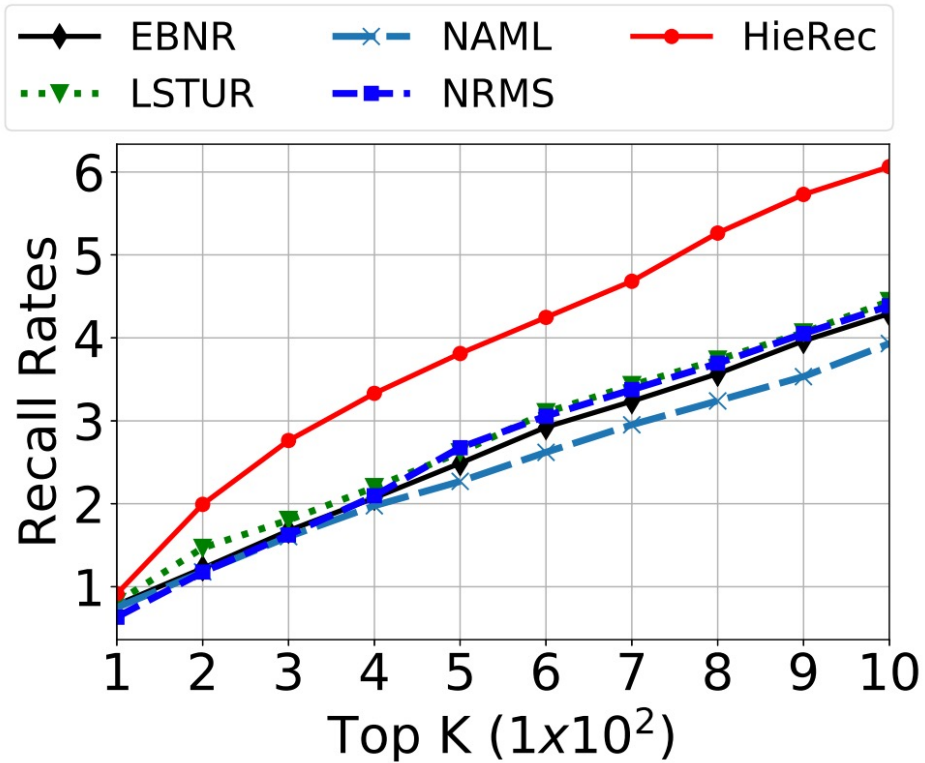
Performance Comparison

	<i>MIND</i>				<i>Feeds</i>			
	AUC	MRR	nDCG@5	nDCG@10	AUC	MRR	nDCG@5	nDCG@10
EBNR	61.62±0.15	28.07±0.18	30.55±0.22	37.07±0.21	63.48±0.32	28.01±0.18	32.05±0.23	37.64±0.22
DKN	63.99±0.23	28.95±0.08	31.73±0.14	38.38±0.17	62.94±0.22	28.05±0.26	32.15±0.34	37.68±0.36
DAN	64.68±0.13	29.78±0.13	32.63±0.21	39.27±0.15	62.67±0.49	27.75±0.34	31.74±0.44	37.42±0.43
NAML	64.30±0.30	29.81±0.17	32.64±0.24	39.11±0.20	64.48±0.24	28.99±0.13	33.37±0.16	38.90±0.18
NPA	64.28±0.53	29.64±0.33	32.28±0.37	38.93±0.39	64.02±0.63	28.71±0.39	33.01±0.50	38.55±0.47
LSTUR	65.68±0.35	30.44±0.39	33.49±0.45	39.95±0.39	65.01±0.13	29.28±0.06	33.74±0.09	39.16±0.11
NRMS	65.43±0.15	30.74±0.18	33.13±0.17	39.66±0.15	65.27±0.19	29.40±0.15	33.89±0.16	39.34±0.15
KRED	65.89±0.31	30.80±0.32	33.78±0.27	40.23±0.26	65.51±0.11	29.57±0.06	34.04±0.06	39.60±0.05
GNewsRec	65.91±0.21	30.50±0.21	33.56±0.21	40.13±0.18	65.23±0.16	29.36±0.11	33.87±0.13	39.44±0.12
FIM	64.65±0.14	29.70±0.17	32.51±0.25	39.30±0.16	65.41±0.23	29.57±0.18	34.08±0.25	39.56±0.23
HieRec	67.95±0.14	32.87±0.08	36.36±0.07	42.53±0.10	66.23±0.10	29.82±0.11	34.42±0.13	39.94±0.13

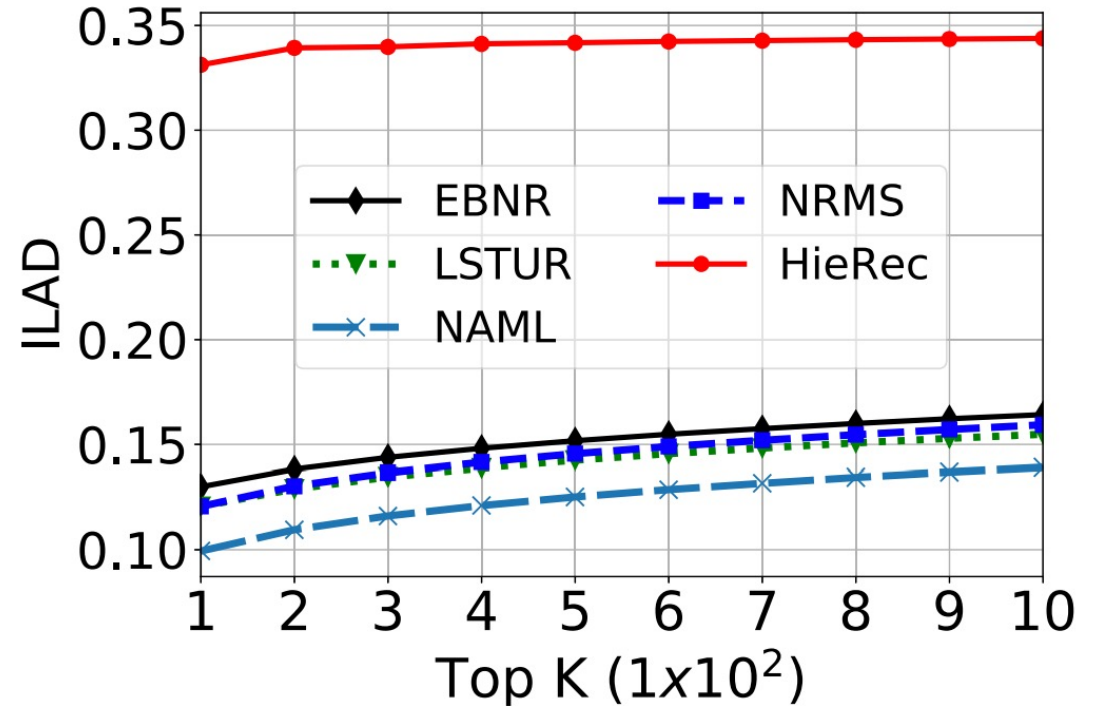
Effectiveness in User Modeling

	AUC	MRR	nDCG@5	nDCG@10
NAML	65.81±0.27	30.89±0.21	34.16±0.30	40.55±0.24
DKN	66.03±0.27	31.17±0.25	34.47±0.33	40.85±0.29
EBNR	65.90±0.27	30.86±0.21	34.14±0.30	40.58±0.24
LSTUR	66.02±0.14	31.16±0.15	34.37±0.15	40.83±0.12
GNewsRec	66.16±0.14	31.19±0.05	34.40±0.09	40.82±0.10
NRMS	66.04±0.21	31.20±0.19	34.53±0.22	40.89±0.18
HieRec	67.95±0.14	32.87±0.08	36.36±0.07	42.53±0.10

Performance on News Recall

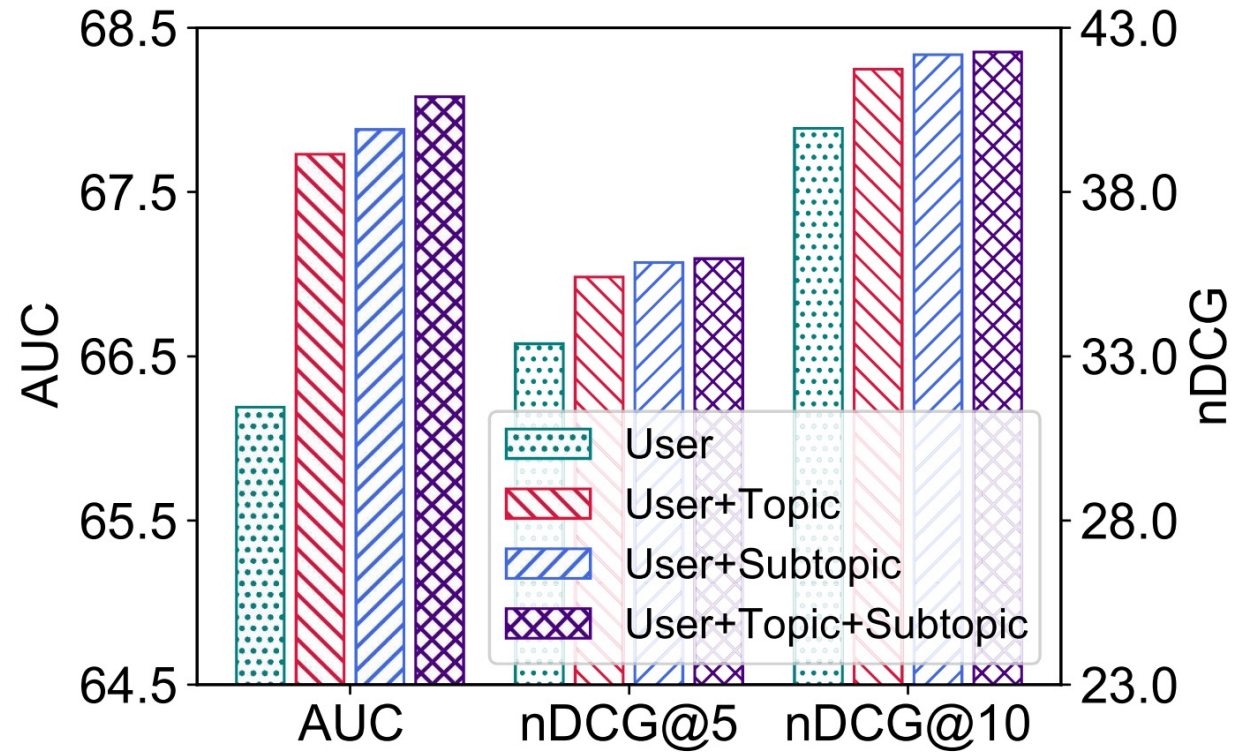


Recall rates



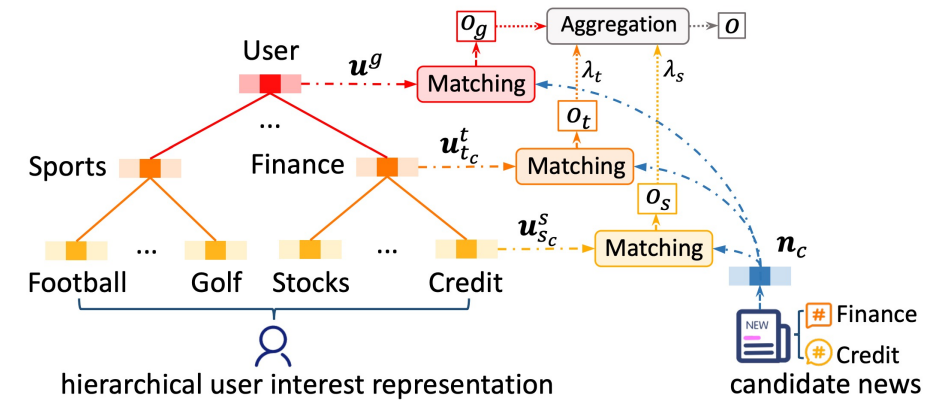
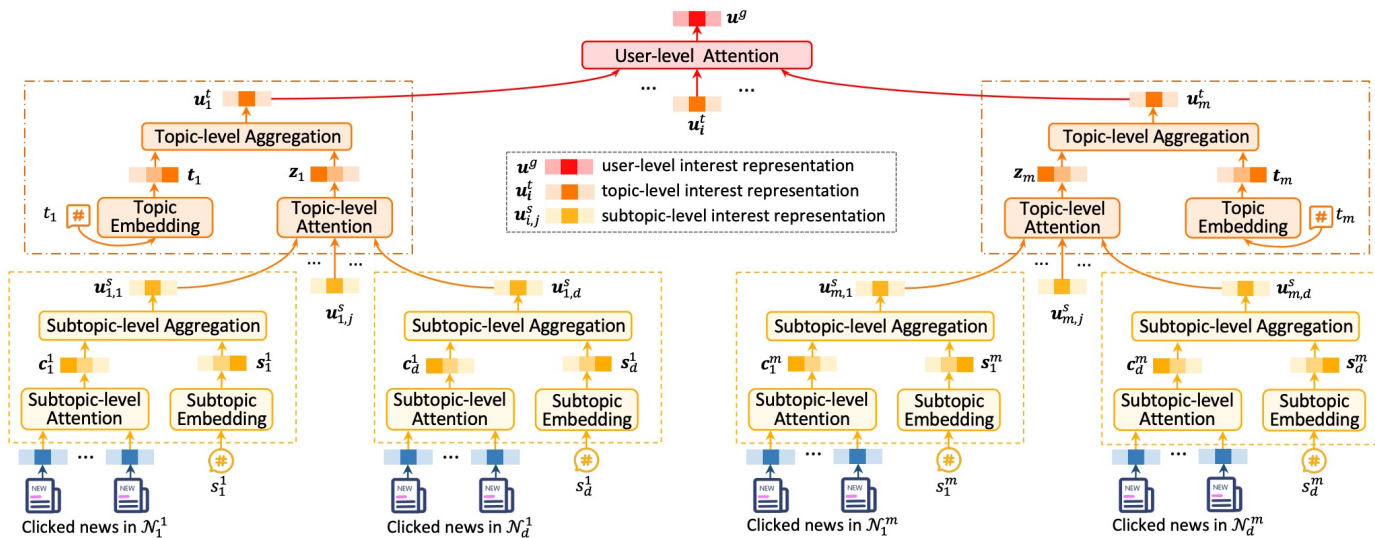
Recall diversity

Ablation study



Conclusion

- A HieRec model for news recommendation which can model diverse and multi-grained user interest in news
 - Hierarchical user interest modeling framework
 - Hierarchical user interest matching framework
- Improve accuracy and diversity of news recommendation



*Thank
you*



Tao Qi

taoqi.qt@gmail.com