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GIFT: Graph-guided Feature Transfer for Cold-Start Video Click-Through Rate Prediction

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Background

- Short videos have witnessed rapid development in Taobao.
- To ensure the freshness of the content, platforms need to release a large number of new videos every day.



Short videos in the homepage of Taobao App

Item-side cold-start recommendation

Cold-start problem:

1. Lack of historical interactions
2. Domain bias between cold-start and warmed-up videos

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Challenge:

1. Unmeaningful id representation & statistical features
2. Model focuses more on non-cold-start videos (90%) (representations & statistical features)

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Current efforts in industry:

Add more side information to compensate for the id representation and statistical features
(category, text caption, image, and video content representation, etc.)

Graph-guided Feature Transfer (GIFT) System

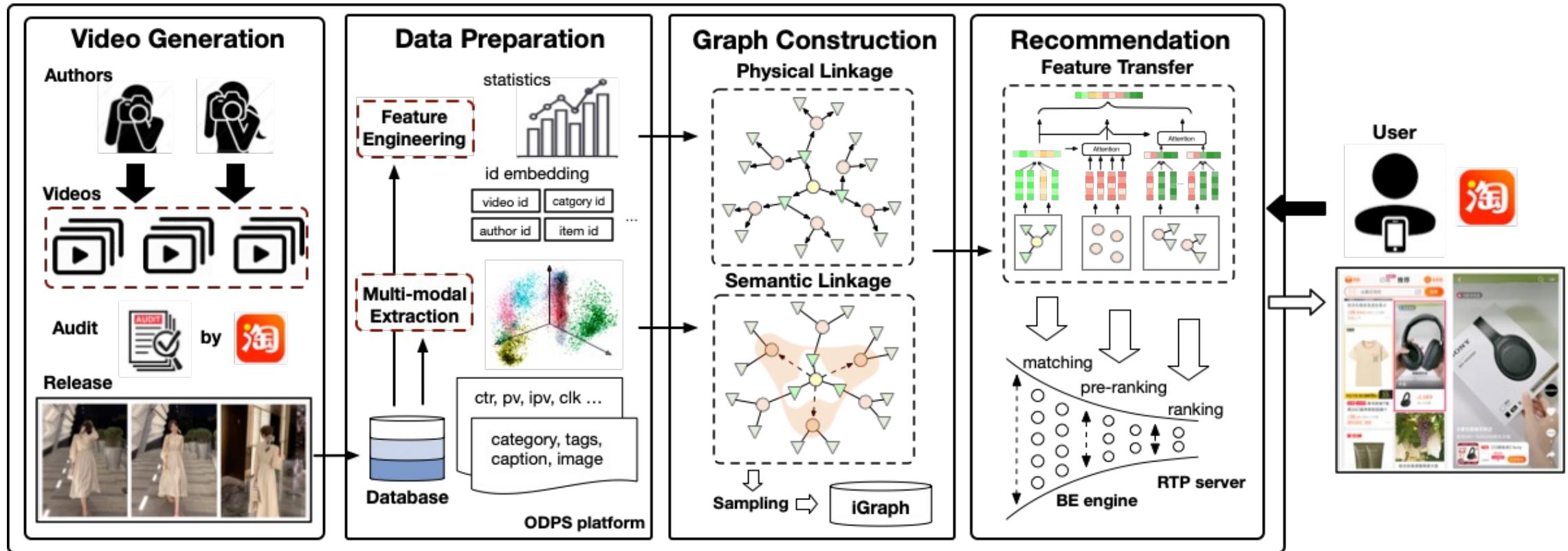


Construct linkages to guide feature transfer from warmed-up videos to cold-start ones

Graph-guided Feature Transfer (GIFT) System



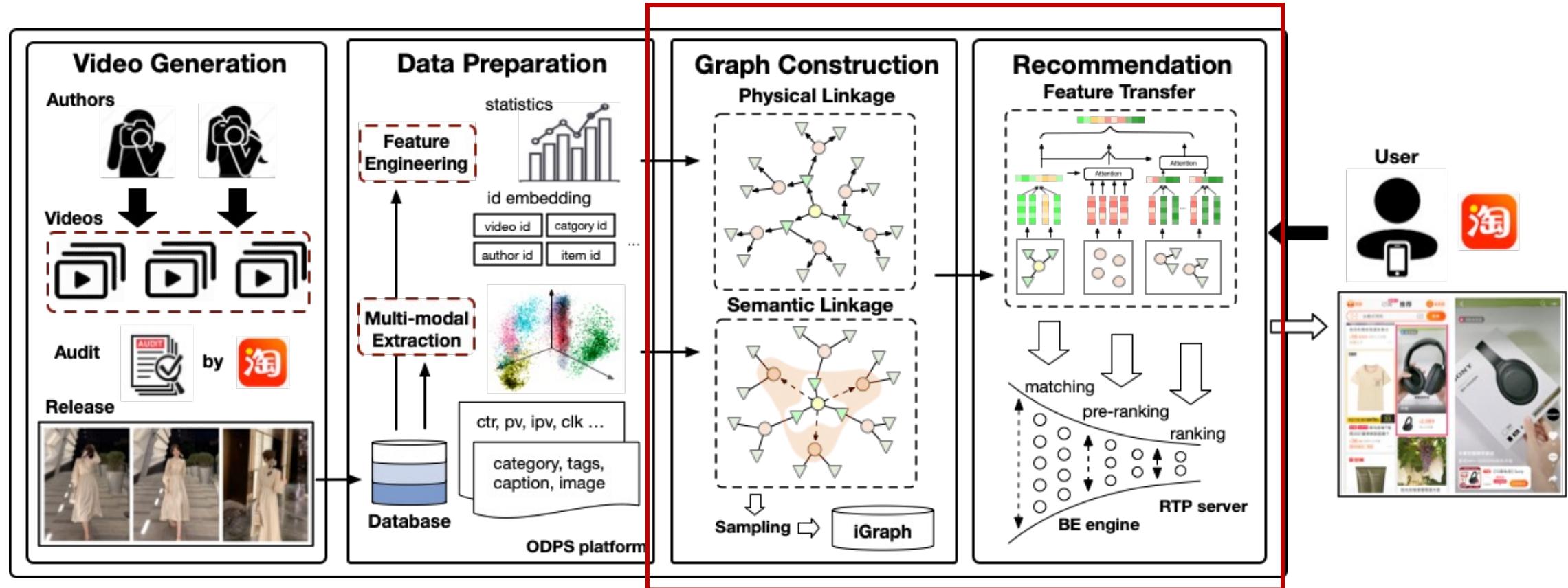
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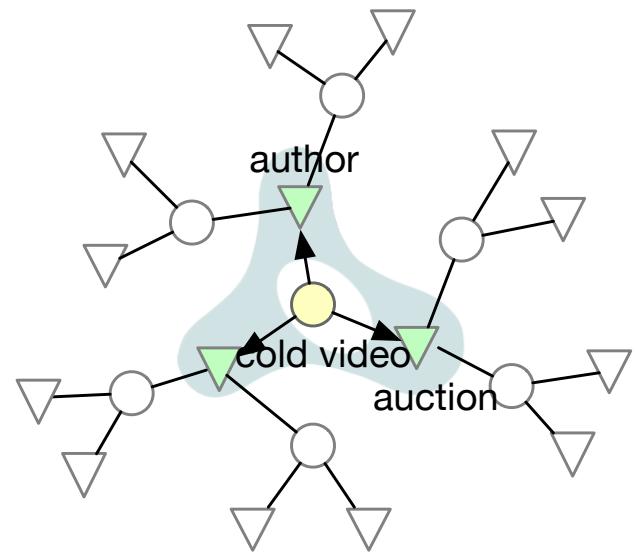
Construct linkages to guide feature transfer from warmed-up videos to cold-start ones



- No requirement for user-interaction logs for cold-start video.
- **6.82%** improvement of click-through-rate (CTR) in Taobao's online environment.

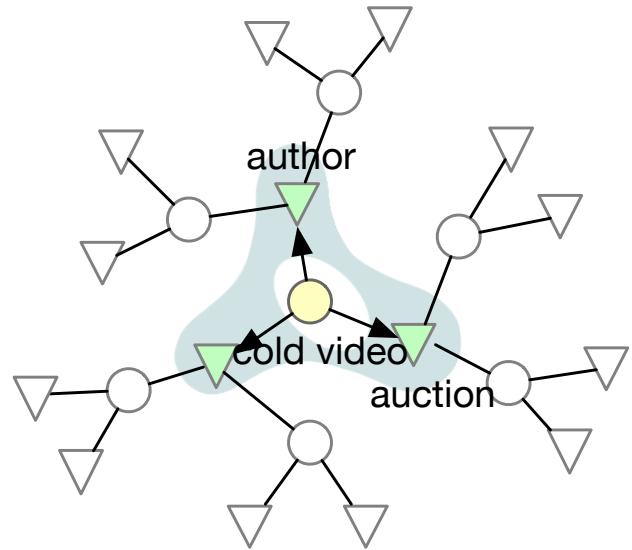
Graph Construction: Physical Linkage

One-hop

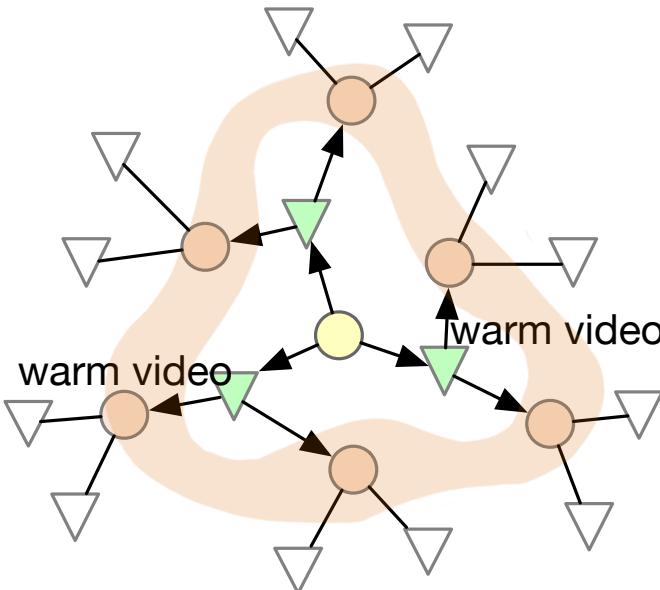


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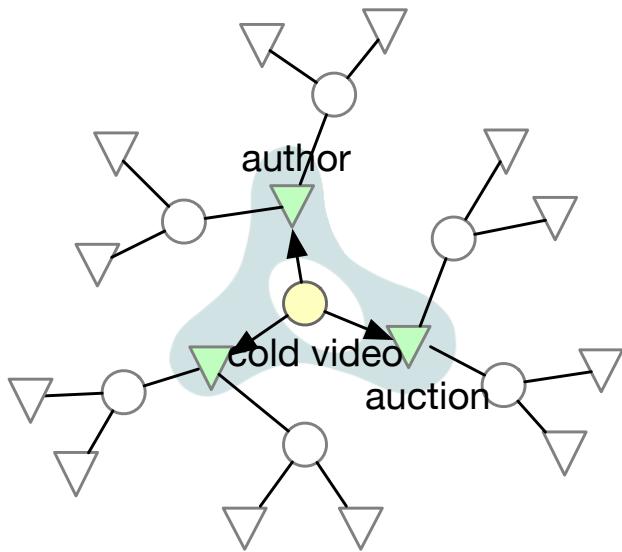


Two-hop

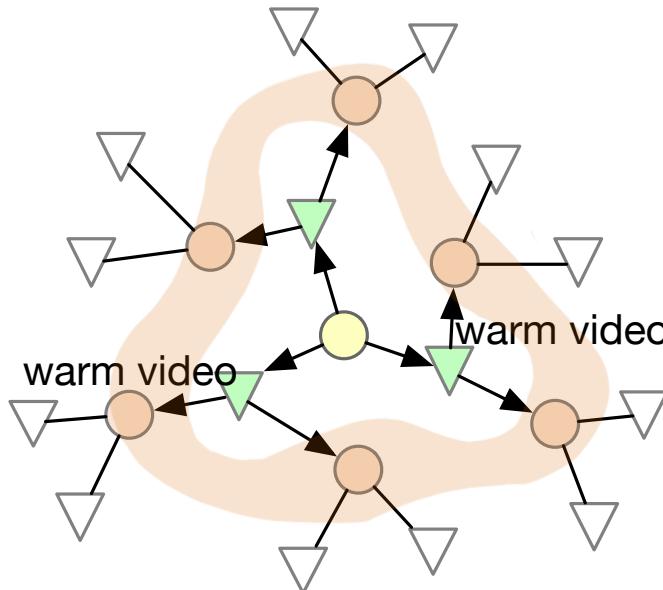


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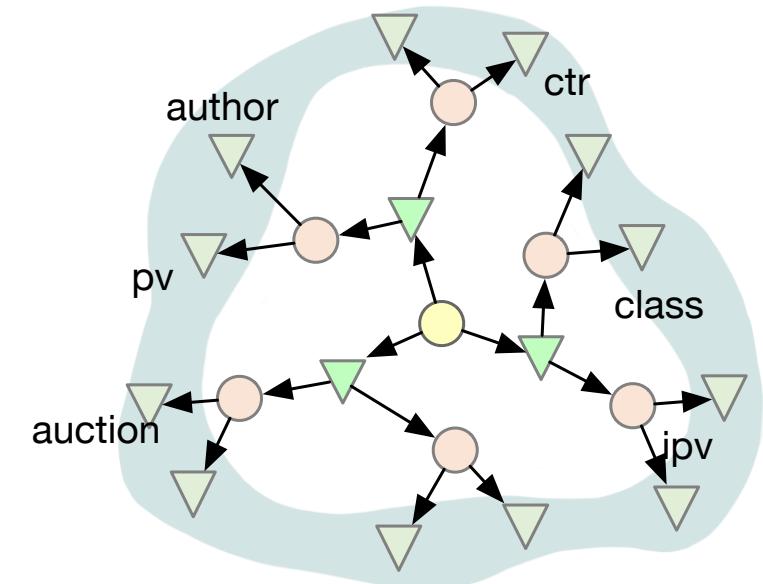
One-hop



Two-hop

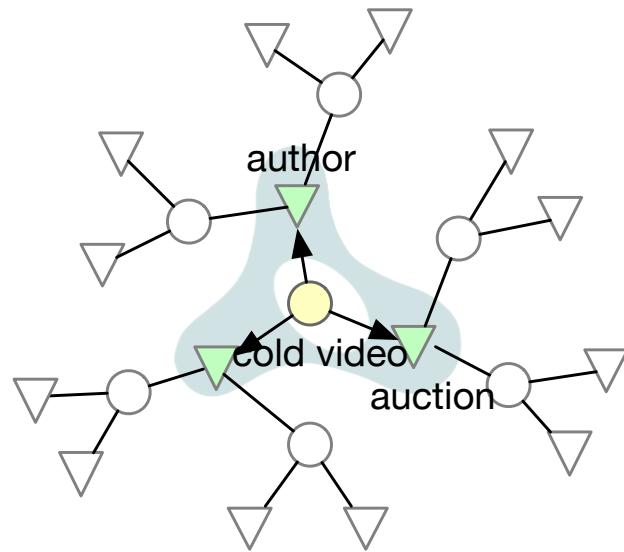


Three-hop

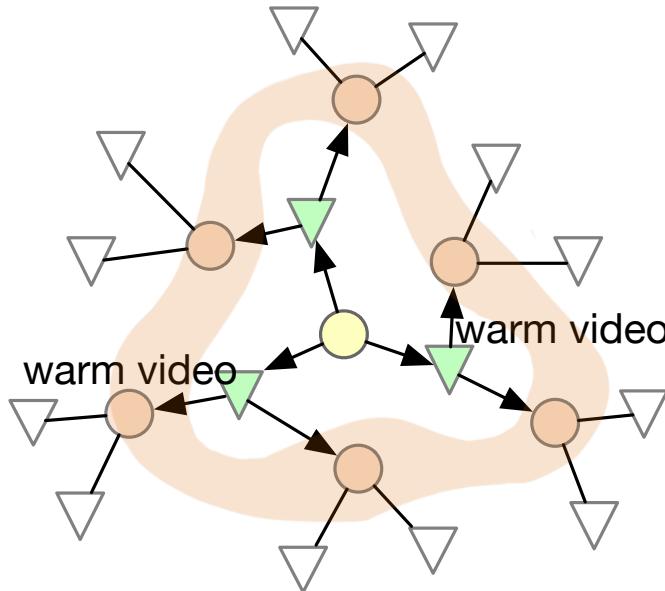


Graph Construction: Physical Linkage

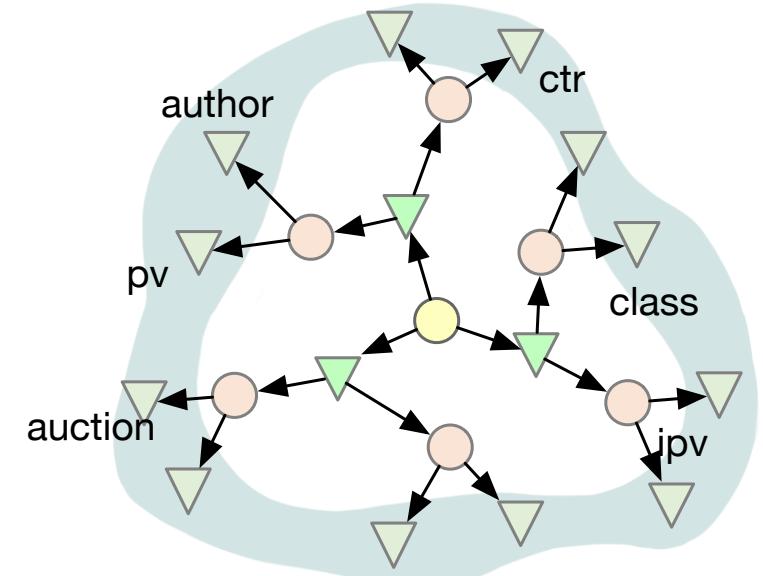
One-hop



Two-hop



Three-hop



Pros:

- Can link 95% cold videos to at least one warm video.
- Share similar content or style with neighbored videos.

Cons:

- Cannot assure all cold-videos can link to enough warm videos (≥ 5)
- Cannot guarantee the highest semantic similarity

Graph Construction: Semantic Linkage

Tile & Cover image



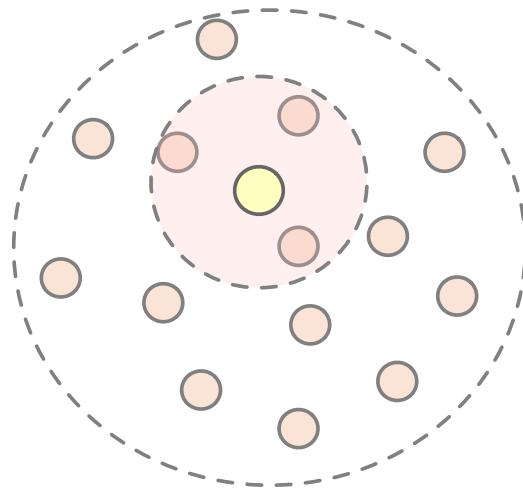
Tan, Hao, and Mohit Bansal. "Lxmert: Learning cross-modality encoder representations from transformers." *arXiv preprint arXiv:1908.07490* (2019).

Graph Construction: Semantic Linkage

Tile & Cover image



Semantic embedding



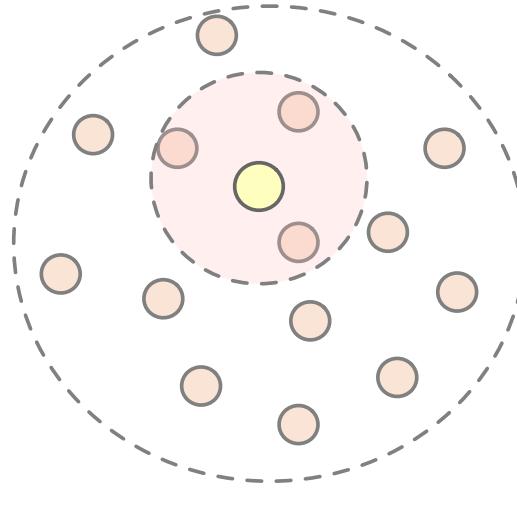
Top-k similarity
in semantic space

Graph Construction: Semantic Linkage

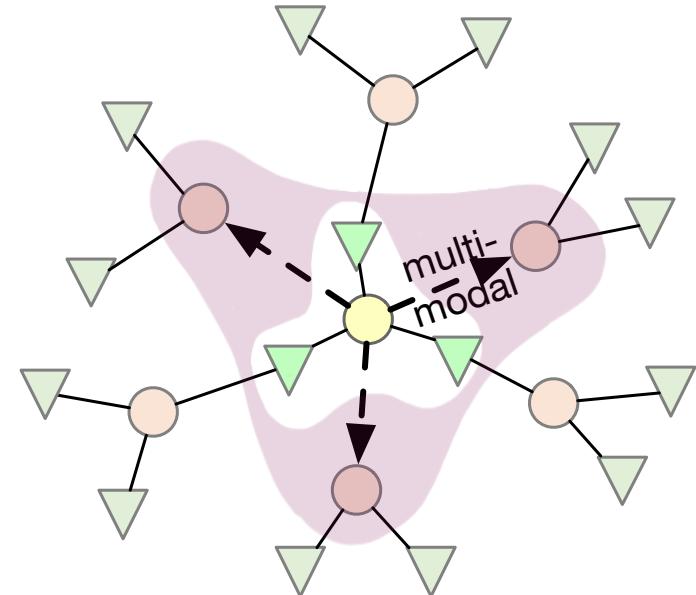
Tile & Cover image



Semantic embedding



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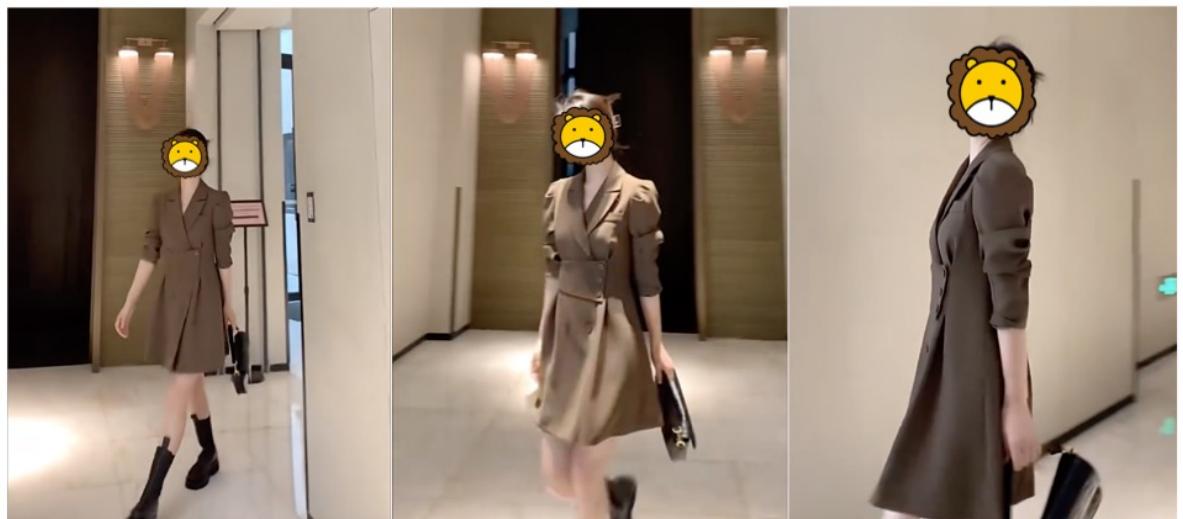
A case study



(a) Target Video



(b) Same Item

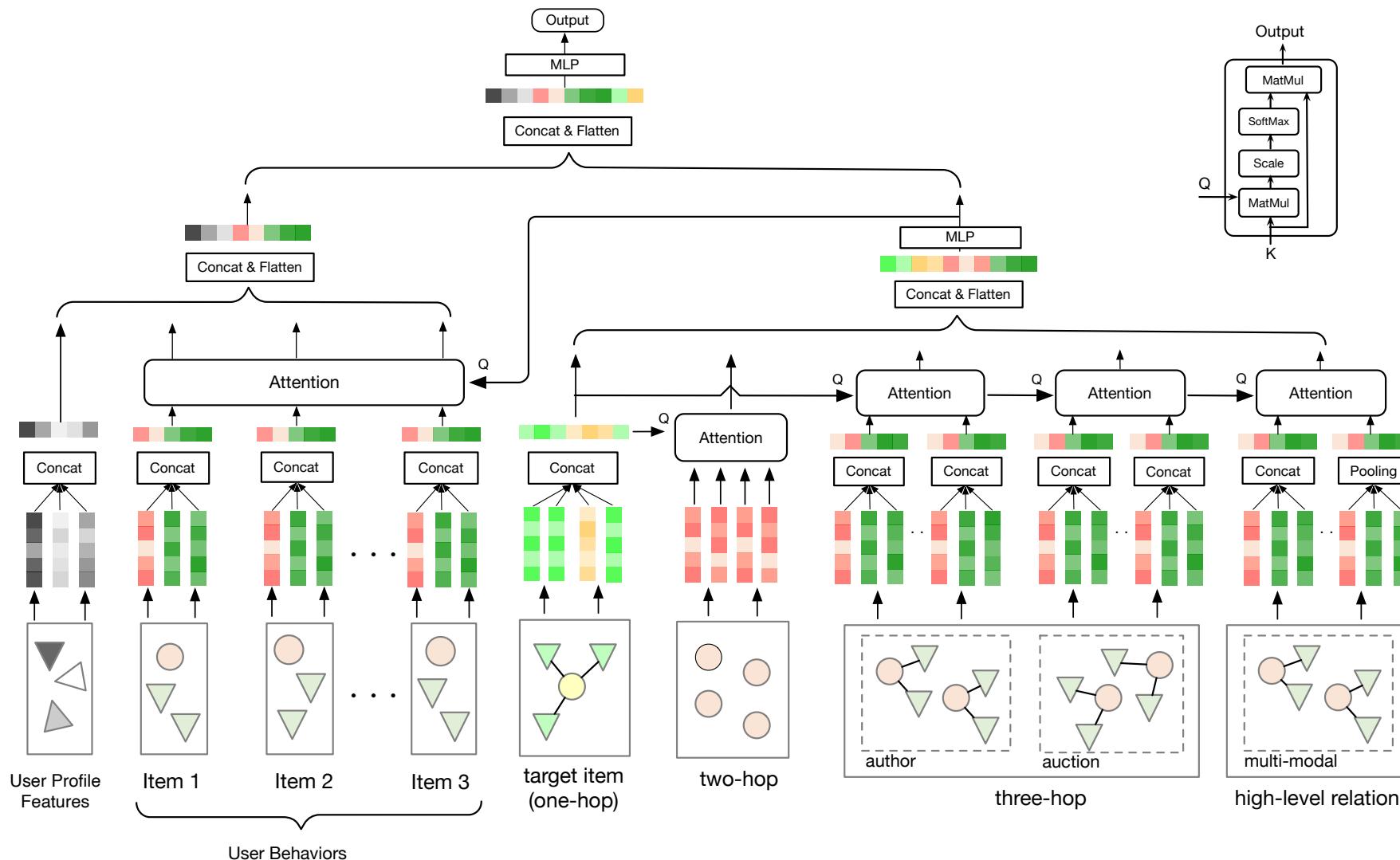


(c) Same Author



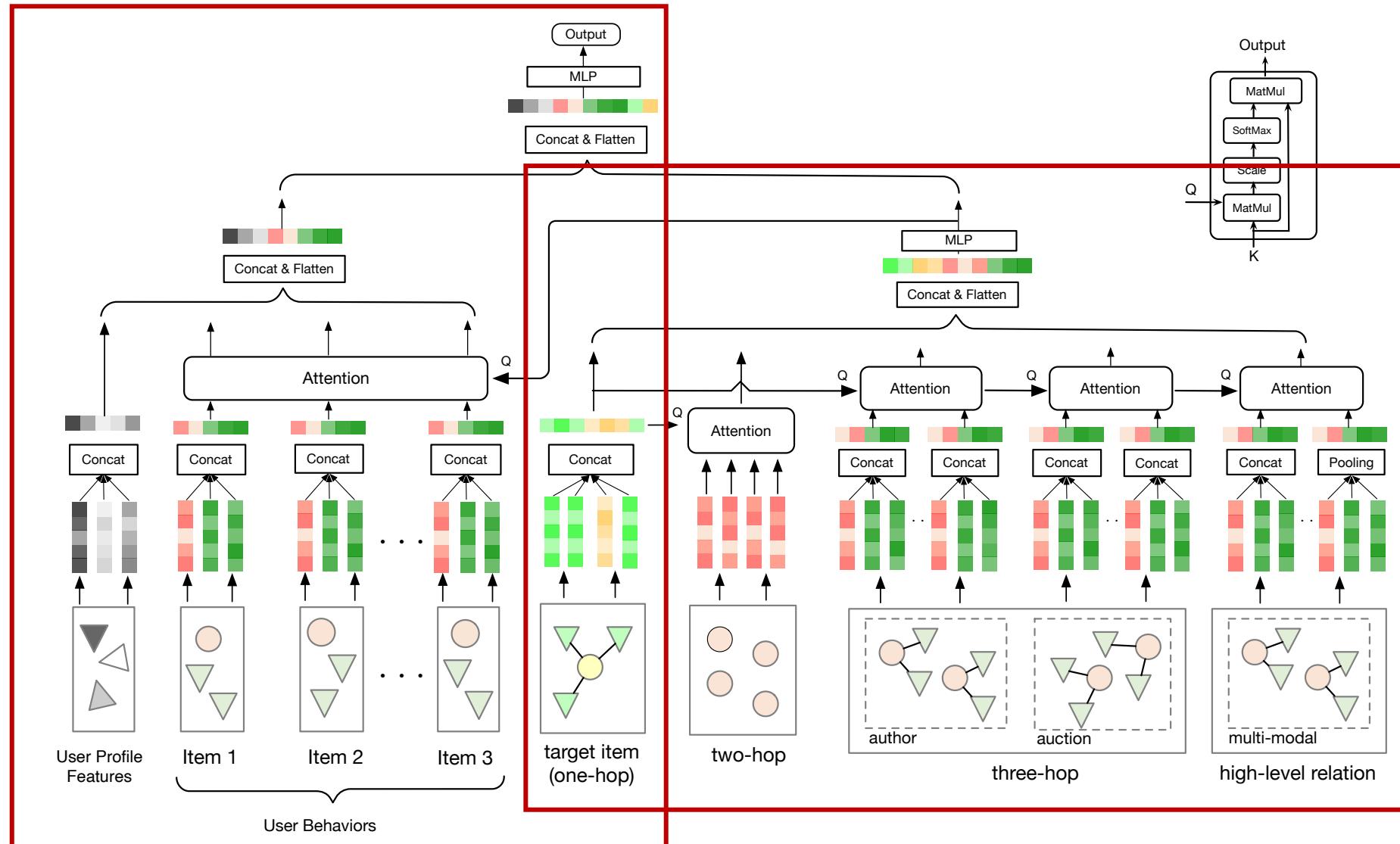
(d) Semantic Similar

GIFT: Graph-guided Feature Transfer Network



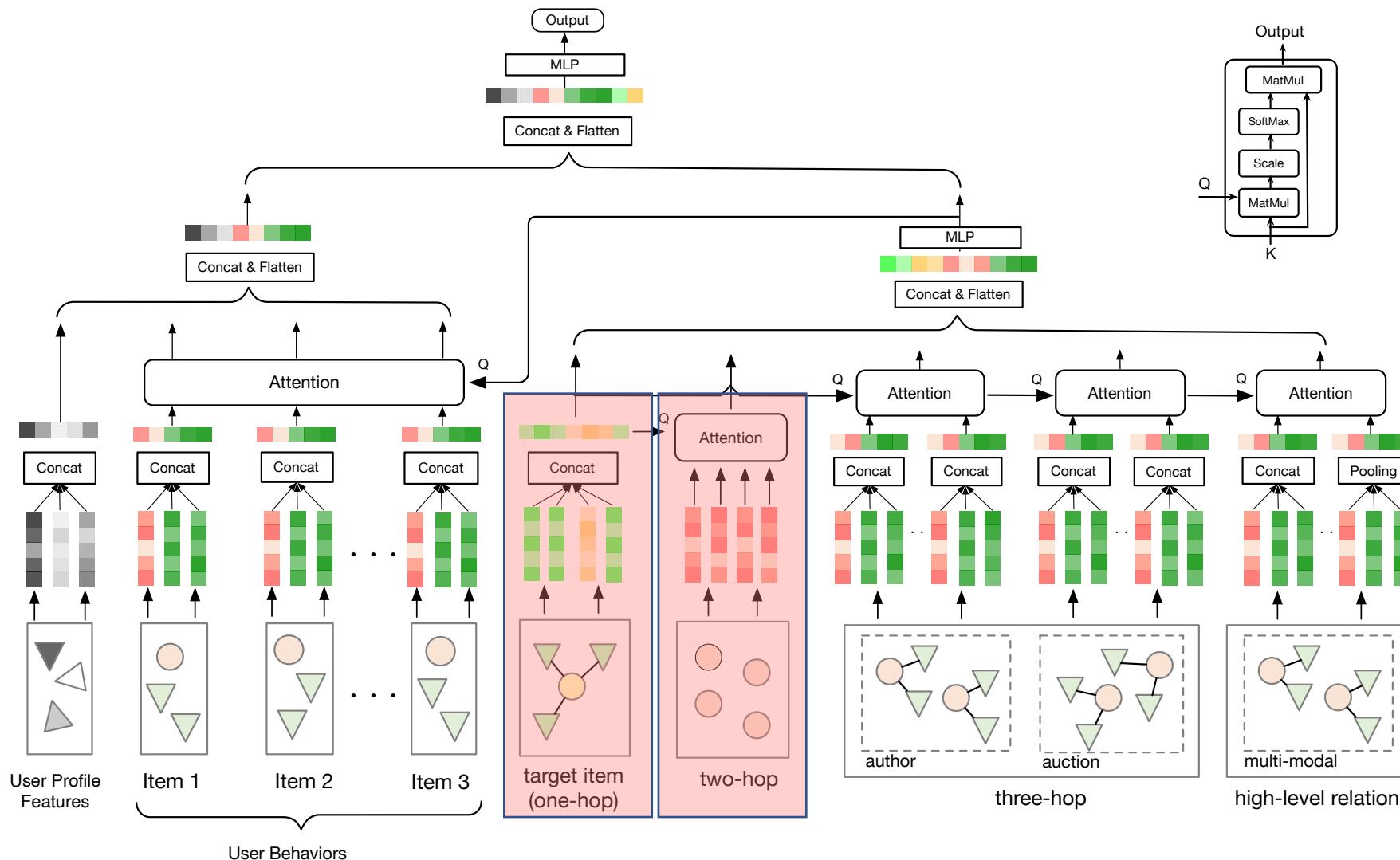
Graph-guided Feature Transfer (GIFT) network

GIFT: Graph-guided Feature Transfer Network



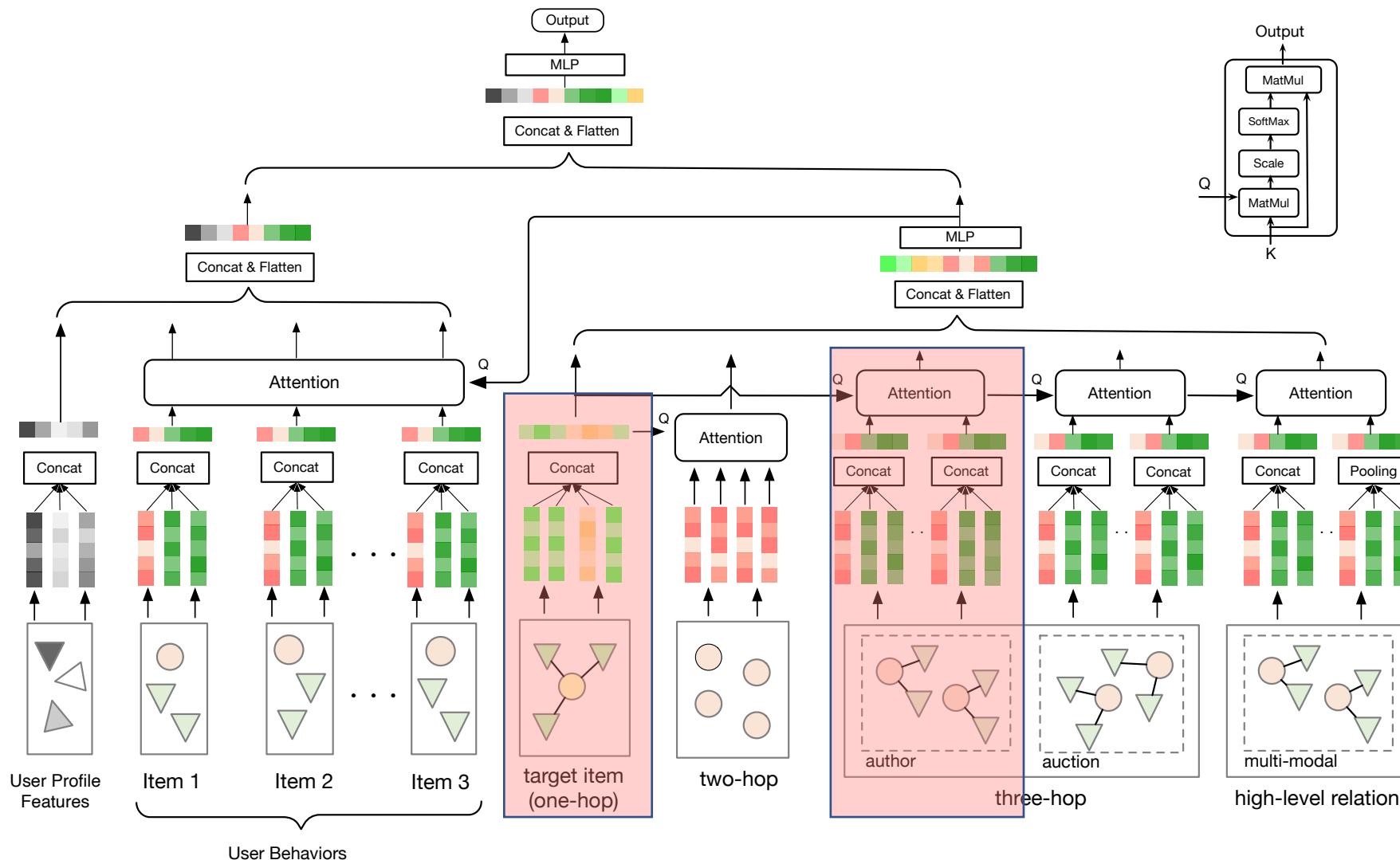
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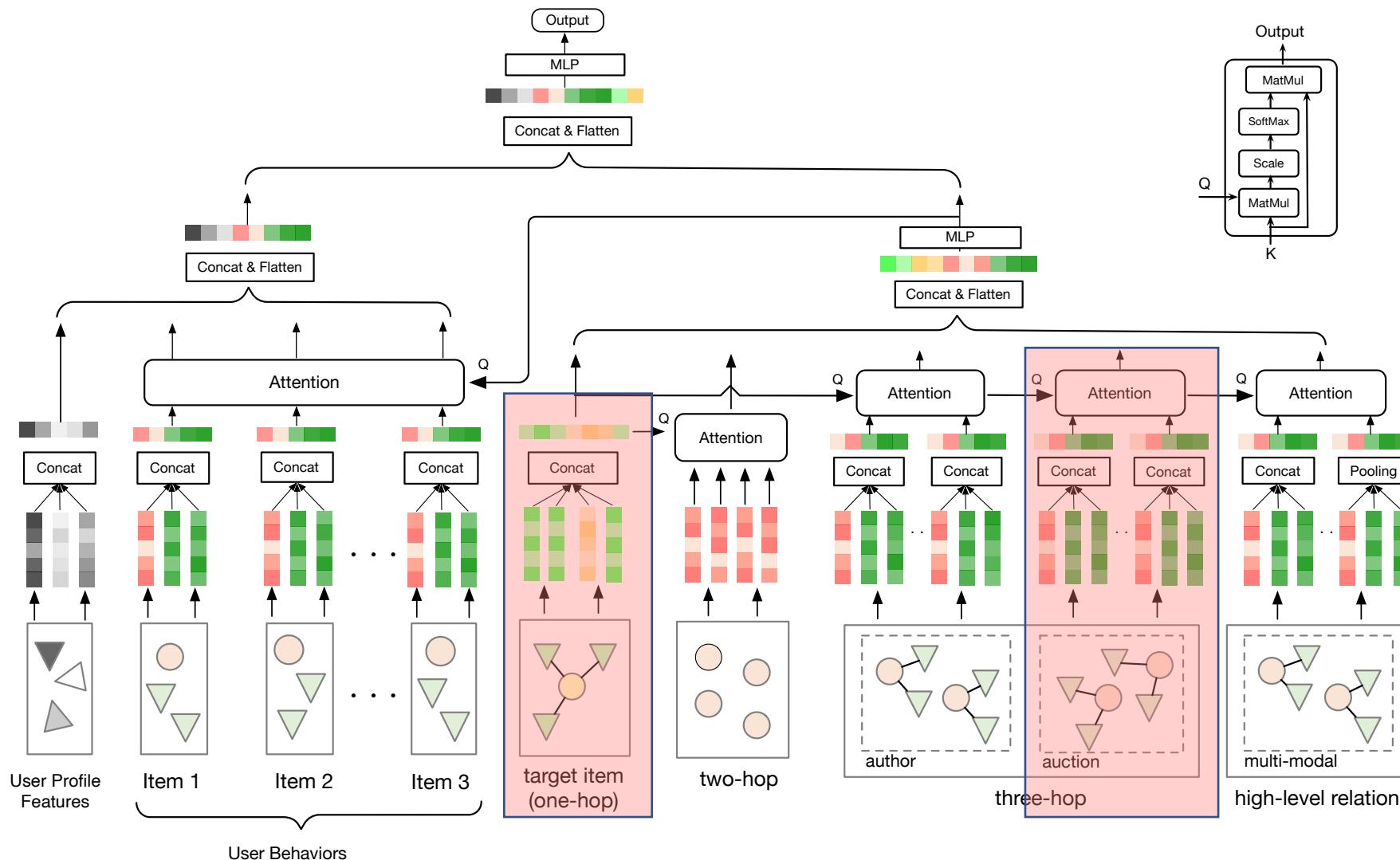
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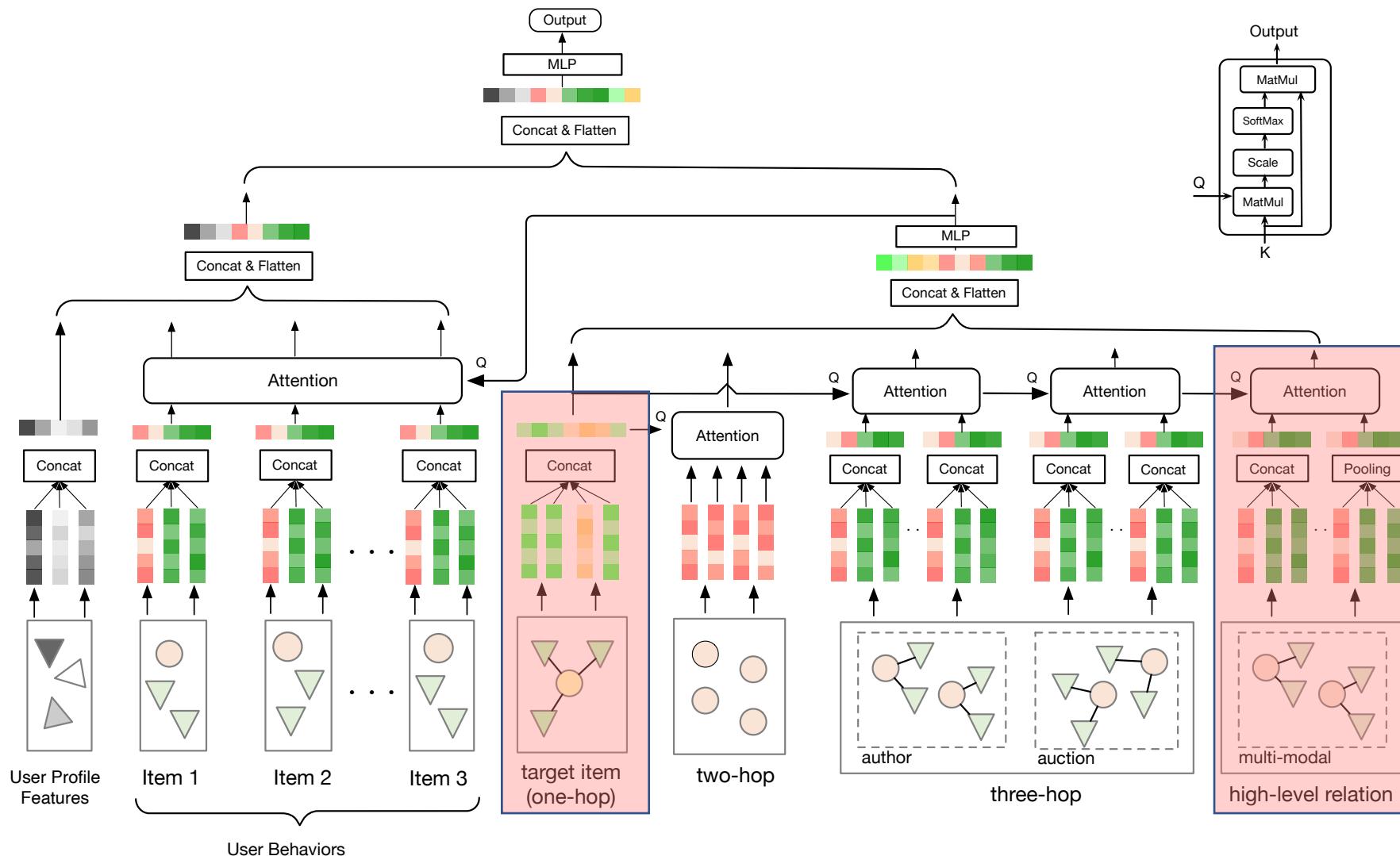
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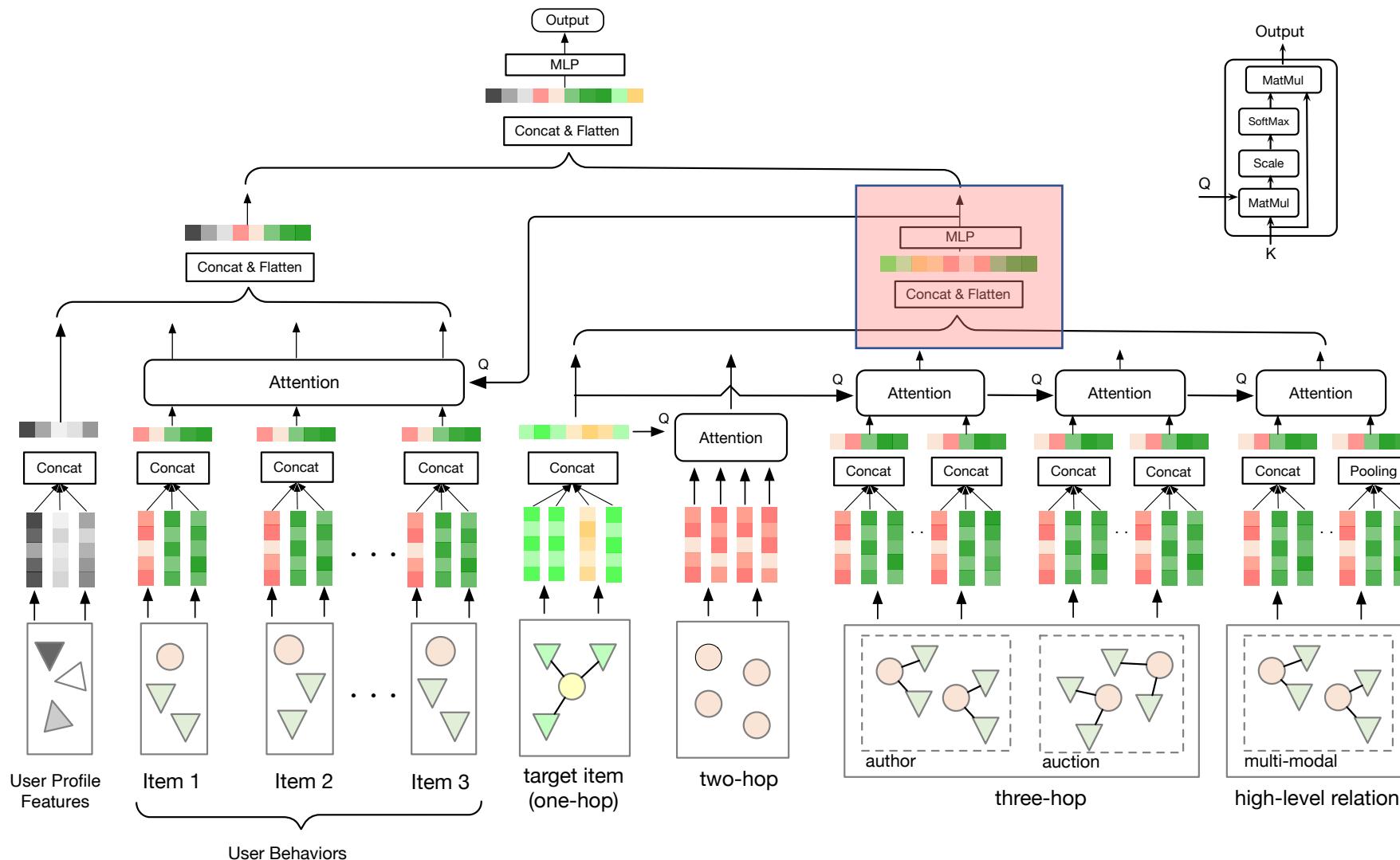
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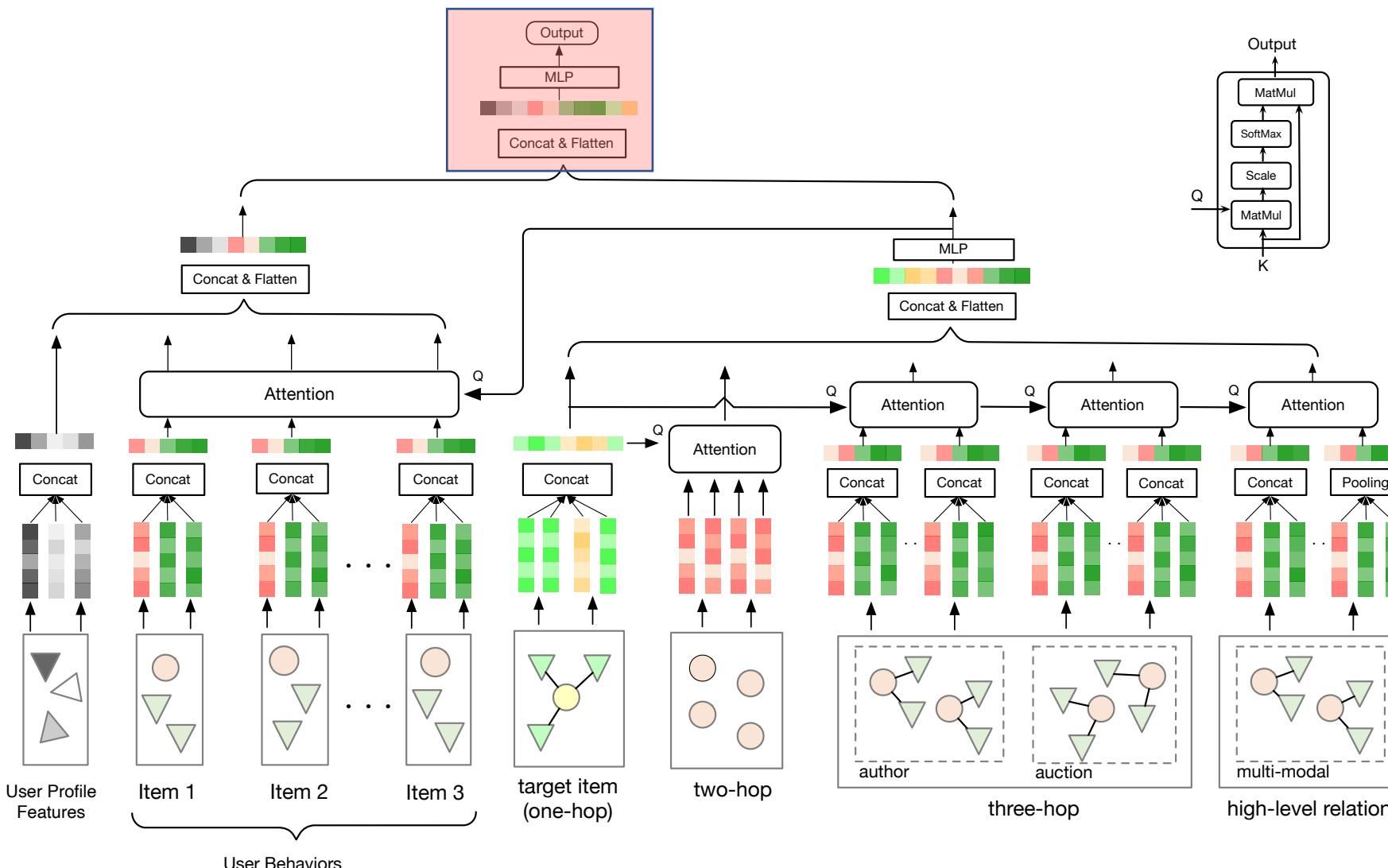
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Graph-guided Feature Transfer (GIFT) network

System Implementation and Deployment

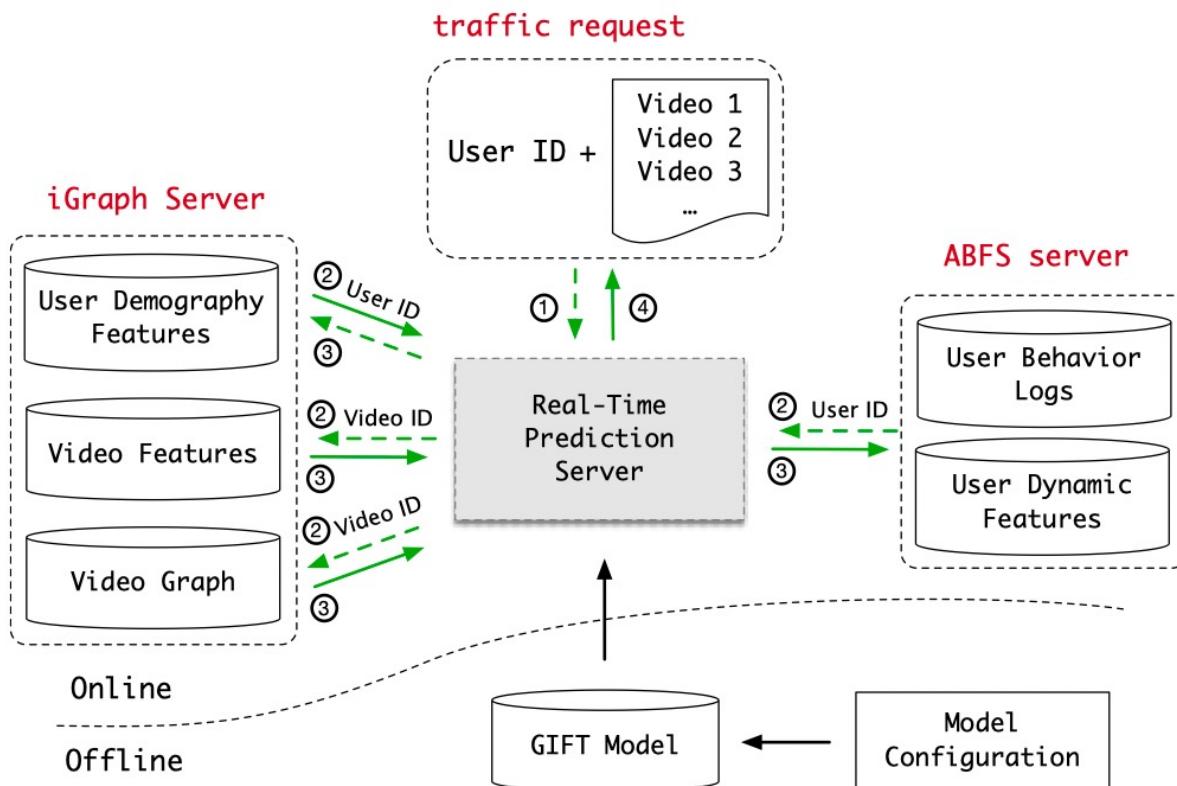


Figure 5: The overall framework of GIFT system deployed in Taobao.

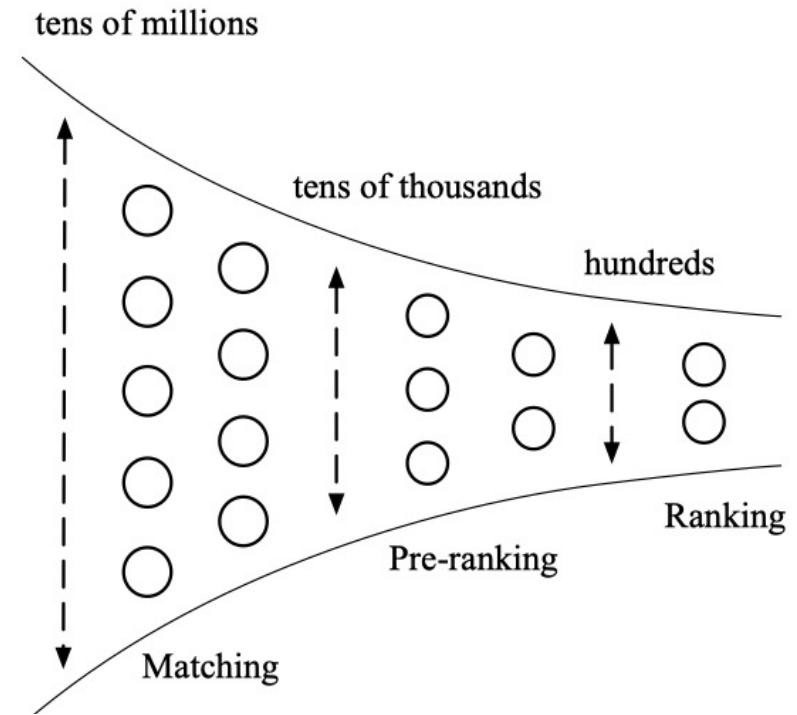


Figure 4: The cascade architecture of industrial recommendation system.

Experiments

Dataset

Table 1: Statistics of Taobao Dataset

Dataset	# Users	# Items	# Samples	Edge Type	# Edges	Path Type	# Paths	
Taobao	full	4.98×10^7	2.2×10^7	5.78×10^8	V-A	2.2×10^7	V-A-V	1.9×10^8
	cold	3.0×10^7	4.8×10^5	1.38×10^8	V-P	2.1×10^7	V-P-V	5.7×10^7
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Comparison

Table 2: Performance Comparison

Methods	Metrics	AUC	RelaImpr
Handcrafted Features	LR	0.7218	-13.63%
	SVM	0.7339	-8.92%
	GBDT	0.7377	-7.44%
DNNs	DNN	0.7423	-5.65%
	Wide&Deep	0.7465	-4.01%
	DeepFM	0.7508	-2.33%
	DIN	<u>0.7568</u>	<u>0.00%</u>
Cold-Start Methods	DropOutNet	0.7573	0.19%
	ACCM	0.7550	-0.70%
Ours	GIFT	0.7670	3.97%
	GIFT ¹	0.7693	4.87%

Experiments

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Experiments: extend to other methods

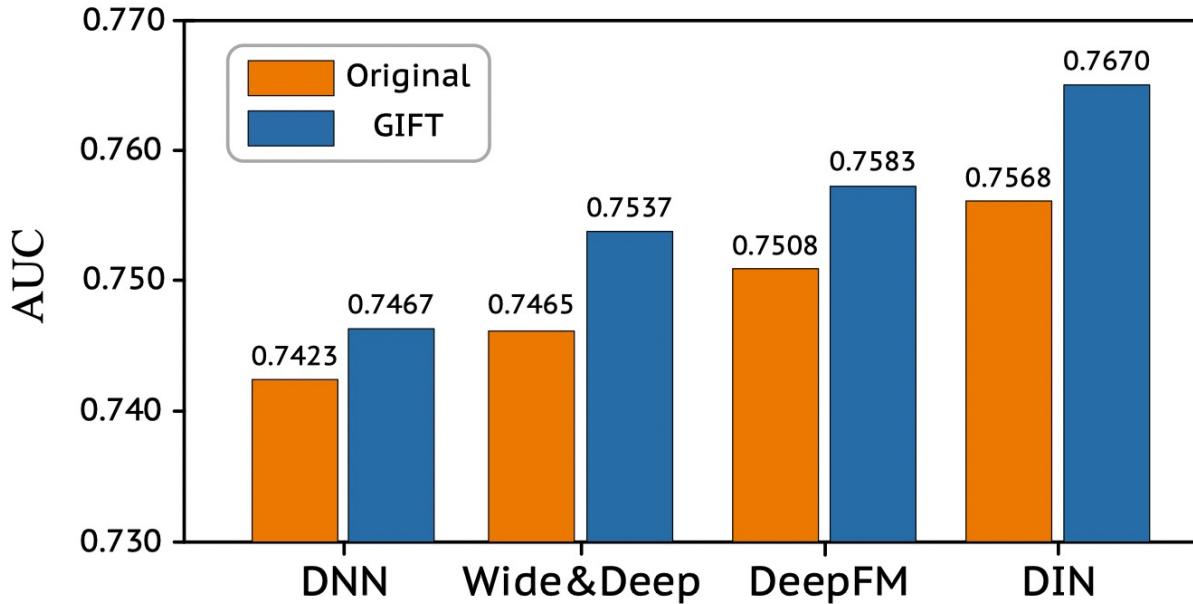


Figure 6: Performance (AUC) comparison of different models enhanced by our GIFT method on Taobao dataset.

Production Environment Experiment

Online A/B Test (Sep. 21, 2020, to Sep. 27, 2020, in the homepage of Taobao App)

Click Through Rate

Baseline	GIFT	Impr.
4.180%	4.465%	6.82%

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Online A/B Test (Sep. 21, 2020, to Sep. 27, 2020, in the homepage of Taobao App)

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Response Time

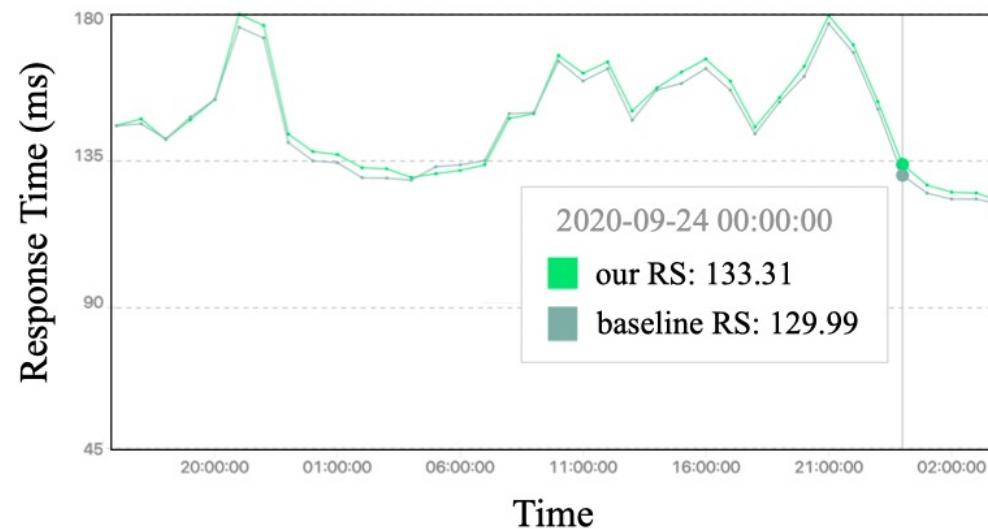


Figure 7: Comparison of Online Response Time

Thanks for Listening