



Collective Embedding for Neural Context-Aware Recommender Systems

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Time-aware Recommendations

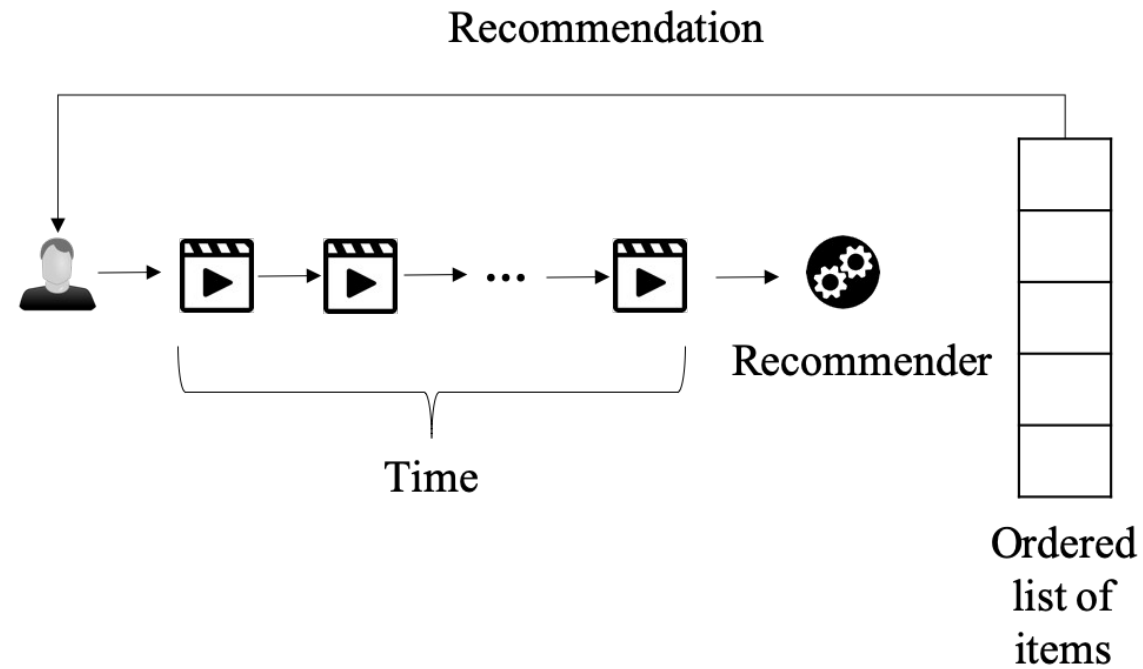


Figure 1. Example of Time-aware Recommendations





Challenge

- ▶ Collective embedding time as contextual feature
 - User-based embedding
 - Item-based embedding



Neural Latent Factor Model for Context-aware Recommender Systems

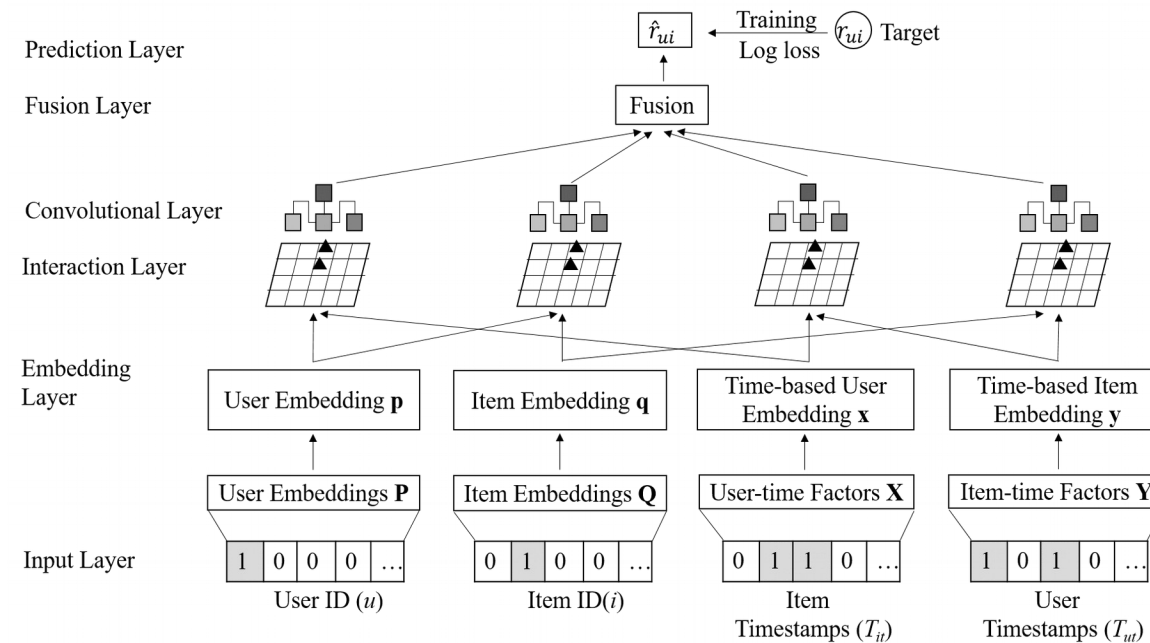


Figure 2. Collective Embedding for Neural Context-aware Recommender Systems.



Experimental Settings

▶ Hyper-parameters

- ▶ Embedding size 64
- ▶ Learning rate 0.05
- ▶ Batch size 512

▶ Evaluation Metrics

- ▶ NDCG
- ▶ HR

▶ Datasets

Statistics	Movielens	Yelp	Pinterest
# of Users	6,040	25,815	55,187
# of Items	3,706	25,677	52,400
# of Interactions	1,000,209	730,791	1,5000,809
Sparsity	95.53%	99.89%	99.73%

Figure 3. Example of Time-aware Recommendations



Results

	Movielens				Yelp				Pinterest			
	HR@N		NDCG@N		HR@N		NDCG@N		HR@N		NDCG@N	
	N=10	N=20	N=10	N=20	N=10	N=20	N=10	N=20	N=10	N=20	N=10	N=20
CAMF	0.4816	0.4929	0.1999	0.2517	0.0535	0.1006	0.0514	0.0591	0.5738	0.5911	0.3337	0.3619
TF	0.5395	0.5548	0.3076	0.4189	0.0991	0.2061	0.0953	0.0982	0.6914	0.7028	0.4574	0.4777
CHNMF	0.5500	0.5711	0.3244	0.4365	0.1121	0.2150	0.1001	0.1013	0.7164	0.7502	0.4918	0.5009
BPR	0.5841	0.6573	0.3664	0.4395	0.1558	0.2607	0.1042	0.1379	0.7464	0.8025	0.5119	0.5371
NeuMF	0.6774	0.7300	0.4133	0.4470	0.1841	0.2967	0.1095	0.1538	0.7593	0.8770	0.5324	0.5520
ConvMF	0.6801	0.7558	0.4171	0.4494	0.1937	0.3005	0.1102	0.1547	0.7921	0.8995	0.5383	0.5636
CoNCARS	0.6974	0.8422	0.4235	0.4596	0.2442	0.3751	0.1220	0.1588	0.8801	0.9621	0.5588	0.5749

Table 1. Top-N recommendation performance at N = 10 and N = 20.



Results

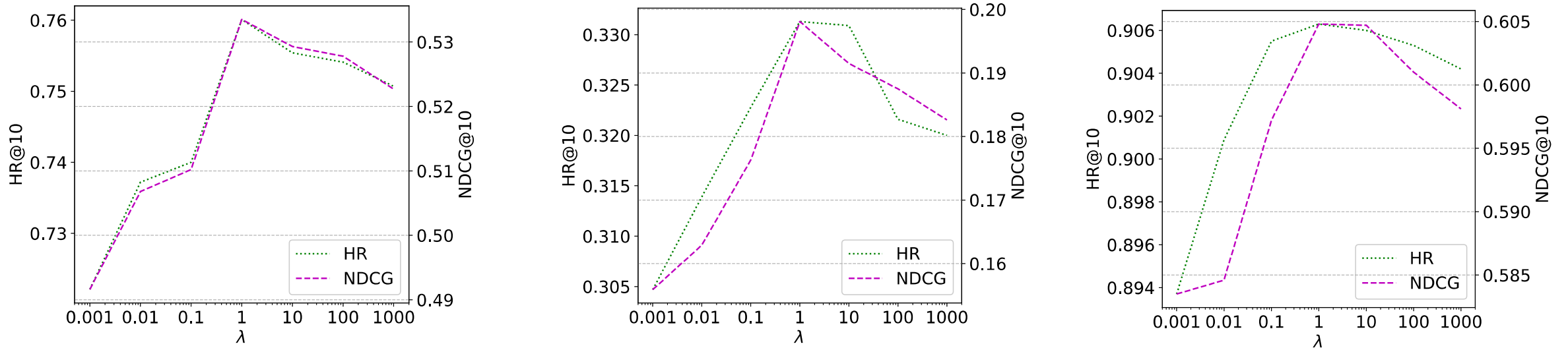


Figure 4. Performance of CoNCARS regarding the hyper-parameter λ on Movielens (left), Yelp (center), and Pinterest (right).



Results

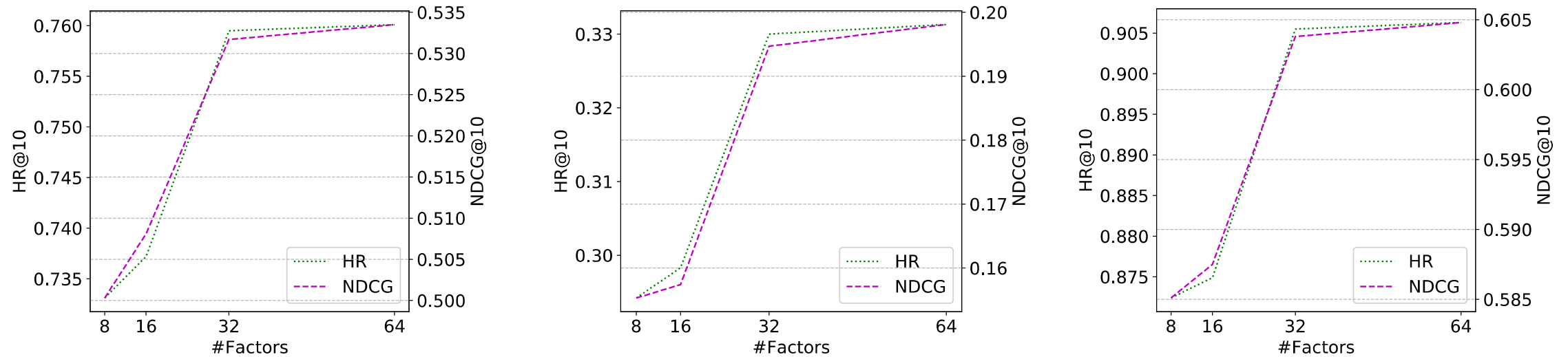


Figure 5. Performance of CoNCARS regarding the number of factors on Movielens (left), Yelp (center), and Pinterest (right).





Contribution

- ▶ Time plays an important role in the recommendation process
- ▶ CNNs are able to learn non-linear correlations among user, item and time
- ▶ CoNCARS suitable for real-world usage
 - ▶ Good convergence for different values λ and \mathbf{c}





Future Directions

- ▶ Investigate other contextual features
- ▶ Investigate the influence of the user's social relations





Thanks

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