

# Experiments

## Methods Compared

- CML (metric learning method): models users' preference to items with a metric instead of inner product.
- SML (metric learning method): state-of-the-art method enhancing CML by including a item-centric metric and trainable margins.
- NTF: utilizes timestamp of interaction to capture user's periodical behaviors by extending tensor factorization with a neural network.
- Caser: sequential recommender system based on CNNs to extract local features from the sequence of users' consumption.
- SASRec: consider pair-wise interaction between items in the sequence of users' consumption via self-attention mechanism.
- TiSARec: extends SASRec by exploiting the time interval between two consecutive in the sequence of users' consumption.
- HGN: state-of-the-art sequential recommender system based on a hierarchical gating network to capture long/short term interaction
- $CRIS^{reg}$
- $CRIS^{wt}$ : straightforward method to utilize the ISS with the learning method.  $\rightarrow Score(u, i) = (p_i)^\lambda \cdot (-d(u, i))$
- CRIS

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TABLE II: Performance comparison.  $\Delta H$  and  $\Delta S$  are the relative improvements (%) of CRIS over HGN and SML, respectively, with the statistical significance  $p < 0.001$  computed using the paired t-test.

## Recommendation Performance Analysis-Performance Comparison with Baseline Methods

Dataset	Metric	BPR	CML	SML	NTF	Caser	SASRec	TiSASRec	HGN	CRIS <sup>reg</sup>	CRIS <sup>wt.</sup>	CRIS	$\Delta_H$	$\Delta_S$
Tools	H@10	0.3314	0.3649	<u>0.3740</u>	0.3449	0.3301	0.3044	0.3264	0.3605	0.3804	0.3953	<b>0.4047</b>	12.3	8.2
	N@10	0.1818	0.2009	0.2016	0.1951	0.1858	0.1660	0.1795	<u>0.2061</u>	0.2118	0.2190	<b>0.2276</b>	10.4	12.9
Toys	H@10	0.3586	0.3881	<u>0.3906</u>	0.3496	0.3426	0.3352	0.3352	0.3848	0.4275	0.4586	<b>0.4602</b>	19.6	17.8
	N@10	0.2155	0.2306	<u>0.2343</u>	0.197	0.1924	0.1870	0.1831	0.2269	0.2561	0.2656	<b>0.2726</b>	20.1	16.3
Cell Phones	H@10	0.4278	0.4547	0.4709	<u>0.5315</u>	0.4711	0.4659	0.4793	0.4763	0.5300	0.4620	<b>0.5642</b>	18.5	19.8
	N@10	0.2675	0.2825	0.2901	<u>0.3190</u>	0.2899	0.2790	0.2930	0.3037	0.3203	0.2863	<b>0.3416</b>	12.5	17.8
Clothing	H@10	0.3657	0.4073	<u>0.4121</u>	0.3809	0.3443	0.3421	0.3340	0.3912	0.4254	0.4016	<b>0.4473</b>	14.3	8.5
	N@10	0.2149	0.2437	<u>0.2443</u>	0.2117	0.1990	0.1959	0.1878	0.2339	0.2511	0.2394	<b>0.2652</b>	13.4	8.6
Sports	H@10	0.4458	0.4909	<u>0.4914</u>	0.4256	0.4366	0.4250	0.4216	0.4659	0.4877	0.4857	<b>0.5171</b>	11.0	5.2
	N@10	0.2637	<u>0.2891</u>	0.2887	0.2433	0.2566	0.2469	0.2430	0.2823	0.2853	0.2878	<b>0.3056</b>	8.3	5.9
Health	H@10	0.4239	0.4713	<u>0.4746</u>	0.4431	0.4336	0.4272	0.4396	0.4586	0.4804	0.4728	<b>0.4985</b>	8.7	5.0
	N@10	0.2501	0.2843	0.2835	0.2717	0.2639	0.2487	0.2632	<u>0.2972</u>	0.2972	0.2825	<b>0.3056</b>	2.8	7.8
Kindle	H@10	0.7136	<u>0.7235</u>	<u>0.7235</u>	0.5945	0.6403	0.6082	0.6497	0.7083	0.7603	0.7214	<b>0.7871</b>	11.1	8.8
	N@10	0.4672	0.4829	<u>0.4834</u>	0.3541	0.4019	0.3748	0.4141	0.4759	0.5171	0.4805	<b>0.5462</b>	14.8	13.0
CDs	H@10	0.6959	<u>0.7104</u>	0.7046	0.6426	0.5815	0.5826	0.6107	0.6591	0.7189	0.6727	<b>0.7389</b>	12.1	4.9
	N@10	0.4470	<u>0.4610</u>	0.4585	0.4003	0.3513	0.3563	0.3764	0.4289	0.4782	0.4404	<b>0.4931</b>	15.0	7.5
Movies	H@10	0.6938	<u>0.7024</u>	0.7020	0.6785	0.6421	0.6597	0.6553	0.6771	0.7056	0.6951	<b>0.7250</b>	7.1	3.3
	N@10	0.4504	0.4543	0.4544	0.4428	0.4111	0.4234	0.4244	<u>0.4549</u>	0.4582	0.4570	<b>0.4686</b>	3.0	3.1
Yelp	H@10	0.8715	0.8853	<u>0.8857</u>	0.8348	0.8052	0.8383	0.8701	0.8658	0.8928	0.8861	<b>0.9070</b>	4.8	2.4
	N@10	0.6031	<u>0.6305</u>	0.6294	0.5578	0.5146	0.5503	0.5829	0.5969	0.6138	0.6300	<b>0.6630</b>	11.1	5.3
GoodReads	H@10	0.7442	<u>0.7541</u>	0.7518	0.7243	0.6997	0.6437	0.7219	0.7381	0.7559	0.7576	<b>0.7920</b>	7.3	5.3
	N@10	0.5005	0.5115	0.5105	0.4906	0.4892	0.4293	0.5067	<u>0.5308</u>	0.5032	0.5144	<b>0.5377</b>	1.3	5.3