

• Supplementary File •

Context-aware API recommendation using tensor factorization

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Table S1 MRR, MAP, SuccessRate, Precision, Recall, NDCG for class-level API recommendation (Top1, Top3)

Context	Metric	Top1			Top3		
		CARTF	RACK	Improvement (%)	CARTF	RACK	Improvement (%)
0%	MRR	0.589	0.366	60.93	0.678	0.484	40.08
	MAP	0.379	0.246	54.07	0.530	0.355	49.30
	SuccessRate	0.589	0.366	60.93	0.794	0.628	26.43
	Precision	0.589	0.366	60.93	0.345	0.242	42.56
	Recall	0.379	0.246	54.07	0.624	0.458	36.24
	NDCG	0.589	0.366	60.93	0.706	0.519	36.03
20%	MRR	0.549	0.353	55.52	0.657	0.465	41.29
	MAP	0.362	0.246	47.15	0.531	0.351	51.28
	SuccessRate	0.549	0.353	55.52	0.794	0.604	31.46
	Precision	0.549	0.353	55.52	0.342	0.228	50.00
	Recall	0.362	0.246	47.15	0.640	0.454	40.97
	NDCG	0.549	0.353	55.52	0.691	0.499	38.48
40%	MRR	0.496	0.293	69.28	0.588	0.395	48.86
	MAP	0.379	0.236	60.59	0.500	0.328	52.44
	SuccessRate	0.496	0.293	69.28	0.701	0.526	33.27
	Precision	0.496	0.293	69.28	0.275	0.188	46.28
	Recall	0.379	0.236	60.59	0.592	0.437	35.47
	NDCG	0.496	0.293	69.28	0.615	0.428	43.69
60%	MRR	0.450	0.210	114.29	0.539	0.304	77.30
	MAP	0.391	0.190	105.79	0.493	0.278	77.34
	SuccessRate	0.450	0.210	114.29	0.648	0.424	52.83
	Precision	0.391	0.210	86.19	0.238	0.146	63.01
	Recall	0.391	0.190	105.79	0.590	0.385	53.25
	NDCG	0.450	0.210	114.29	0.565	0.335	68.66
80%	MRR	0.378	0.180	110.00	0.470	0.261	80.08
	MAP	0.368	0.177	107.91	0.461	0.257	79.38
	SuccessRate	0.378	0.180	110.00	0.587	0.365	60.82
	Precision	0.378	0.180	110.00	0.197	0.121	62.81
	Recall	0.368	0.177	107.91	0.575	0.360	59.72
	NDCG	0.378	0.180	110.00	0.500	0.288	73.61
Average	MRR	0.492	0.280	82.00	0.586	0.382	57.52
	MAP	0.376	0.219	75.10	0.503	0.314	61.95
	SuccessRate	0.492	0.280	82.00	0.705	0.509	40.96
	Precision	0.481	0.280	76.39	0.279	0.185	52.93
	Recall	0.376	0.219	75.10	0.604	0.419	45.13
	NDCG	0.492	0.280	82.00	0.615	0.414	52.09

Table S2 MRR, MAP, SuccessRate, Precision, Recall, NDCG for class-level API recommendation (Top5, Top10)

Context	Metric	Top5			Top10		
		CARTF	RACK	Improvement (%)	CARTF	RACK	Improvement (%)
0%	MRR	0.695	0.515	34.95	0.706	0.528	33.71
	MAP	0.563	0.392	43.62	0.589	0.417	41.25
	SuccessRate	0.871	0.762	14.30	0.947	0.849	11.54
	Precision	0.245	0.189	29.63	0.146	0.118	23.73
	Recall	0.719	0.586	22.70	0.824	0.697	18.22
	NDCG	0.729	0.571	27.67	0.747	0.595	25.55
20%	MRR	0.671	0.495	35.56	0.682	0.508	34.25
	MAP	0.560	0.385	45.45	0.582	0.409	42.30
	SuccessRate	0.854	0.735	16.19	0.938	0.827	13.42
	Precision	0.237	0.176	34.66	0.139	0.110	26.36
	Recall	0.720	0.578	24.57	0.825	0.689	19.74
	NDCG	0.713	0.549	29.87	0.733	0.575	27.48
40%	MRR	0.611	0.425	43.76	0.622	0.441	41.04
	MAP	0.529	0.361	46.54	0.551	0.382	44.24
	SuccessRate	0.801	0.659	21.55	0.885	0.773	14.49
	Precision	0.196	0.147	33.33	0.115	0.092	25.00
	Recall	0.695	0.564	23.23	0.804	0.680	18.24
	NDCG	0.655	0.482	35.89	0.678	0.517	31.14
60%	MRR	0.559	0.337	65.88	0.570	0.358	59.22
	MAP	0.520	0.312	66.67	0.534	0.332	60.84
	SuccessRate	0.738	0.570	29.47	0.821	0.717	14.50
	Precision	0.169	0.121	39.67	0.095	0.077	23.70
	Recall	0.694	0.528	31.44	0.780	0.664	17.47
	NDCG	0.601	0.396	51.77	0.627	0.444	41.22
80%	MRR	0.497	0.300	65.67	0.510	0.320	59.38
	MAP	0.488	0.294	65.99	0.503	0.315	59.68
	SuccessRate	0.703	0.532	32.14	0.798	0.679	17.53
	Precision	0.142	0.106	33.96	0.081	0.068	19.12
	Recall	0.691	0.520	32.88	0.788	0.667	18.14
	NDCG	0.547	0.357	53.22	0.579	0.406	42.61
Average	MRR	0.607	0.414	49.16	0.618	0.431	45.52
	MAP	0.532	0.349	53.65	0.552	0.371	49.66
	SuccessRate	0.793	0.652	22.73	0.878	0.769	14.30
	Precision	0.198	0.148	34.25	0.115	0.093	23.58
	Recall	0.704	0.555	26.96	0.804	0.679	18.36
	NDCG	0.649	0.471	39.68	0.673	0.507	33.60

Table S3 MRR, MAP, SuccessRate, Precision, Recall, NDCG for method-level API recommendation (Top1, Top3)

Context	Metric	Top1			Top3		
		CARTF	BIKER	Improvement (%)	CARTF	BIKER	Improvement (%)
0%	MRR	0.473	0.386	22.54	0.560	0.490	14.29
	MAP	0.267	0.241	10.79	0.384	0.324	18.52
	SuccessRate	0.473	0.386	22.54	0.672	0.620	8.39
	Precision	0.473	0.386	22.54	0.299	0.232	28.88
	Recall	0.267	0.241	10.79	0.460	0.403	14.14
	NDCG	0.473	0.386	22.54	0.587	0.521	12.67
20%	MRR	0.450	0.369	21.95	0.536	0.472	13.56
	MAP	0.266	0.240	10.83	0.384	0.322	19.25
	SuccessRate	0.450	0.369	21.95	0.643	0.602	6.81
	Precision	0.450	0.369	21.95	0.284	0.223	27.35
	Recall	0.266	0.240	10.83	0.453	0.400	13.25
	NDCG	0.450	0.369	21.95	0.564	0.504	11.90
40%	MRR	0.413	0.319	29.47	0.496	0.413	20.10
	MAP	0.273	0.232	17.67	0.384	0.307	25.08
	SuccessRate	0.413	0.319	29.47	0.604	0.532	13.53
	Precision	0.413	0.319	29.47	0.248	0.188	31.91
	Recall	0.273	0.232	17.67	0.466	0.387	20.41
	NDCG	0.413	0.319	29.47	0.523	0.443	18.06
60%	MRR	0.351	0.235	49.36	0.423	0.309	36.89
	MAP	0.281	0.201	39.80	0.370	0.262	41.22
	SuccessRate	0.351	0.235	49.36	0.519	0.400	29.75
	Precision	0.351	0.235	49.36	0.20	0.135	49.63
	Recall	0.281	0.201	39.80	0.450	0.334	34.73
	NDCG	0.351	0.235	49.36	0.448	0.332	34.94
80%	MRR	0.289	0.189	52.91	0.357	0.243	46.91
	MAP	0.265	0.181	46.41	0.335	0.230	45.65
	SuccessRate	0.289	0.189	52.91	0.440	0.310	41.94
	Precision	0.289	0.189	52.91	0.154	0.103	49.51
	Recall	0.265	0.181	46.41	0.411	0.290	41.72
	NDCG	0.289	0.189	52.91	0.378	0.260	45.38
Average	MRR	0.395	0.300	35.25	0.474	0.385	26.35
	MAP	0.270	0.219	25.10	0.371	0.289	29.95
	SuccessRate	0.395	0.300	35.25	0.576	0.493	20.08
	Precision	0.395	0.300	35.25	0.237	0.176	37.46
	Recall	0.270	0.219	25.10	0.448	0.363	24.85
	NDCG	0.395	0.300	35.25	0.500	0.412	24.59

Table S4 MRR, MAP, SuccessRate, Precision, Recall, NDCG for method-level API recommendation (Top5, Top10)

Context	Metric	Top5			Top10		
		CARTF	BIKER	Improvement (%)	CARTF	BIKER	Improvement (%)
0%	MRR	0.576	0.515	11.84	0.588	0.526	11.79
	MAP	0.418	0.345	21.16	0.438	0.362	20.99
	SuccessRate	0.744	0.727	2.34	0.829	0.812	2.09
	Precision	0.223	0.168	32.74	0.132	0.103	28.16
	Recall	0.546	0.479	13.99	0.634	0.571	11.03
	NDCG	0.613	0.565	8.50	0.638	0.585	9.06
20%	MRR	0.558	0.497	12.27	0.569	0.508	12.01
	MAP	0.421	0.341	23.46	0.437	0.357	22.41
	SuccessRate	0.740	0.709	4.37	0.824	0.791	4.17
	Precision	0.217	0.161	34.78	0.126	0.097	29.90
	Recall	0.559	0.476	17.44	0.637	0.564	12.94
	NDCG	0.601	0.548	9.67	0.627	0.567	10.58
40%	MRR	0.514	0.435	18.16	0.528	0.447	18.12
	MAP	0.409	0.325	25.85	0.425	0.338	25.74
	SuccessRate	0.683	0.626	9.11	0.779	0.710	9.72
	Precision	0.179	0.134	33.58	0.105	0.080	31.25
	Recall	0.545	0.458	19.00	0.631	0.540	16.85
	NDCG	0.554	0.481	15.18	0.584	0.506	15.42
60%	MRR	0.440	0.327	34.56	0.451	0.337	33.83
	MAP	0.392	0.278	41.01	0.403	0.288	39.93
	SuccessRate	0.594	0.478	24.27	0.672	0.553	21.52
	Precision	0.145	0.099	46.46	0.083	0.058	43.10
	Recall	0.525	0.399	31.58	0.594	0.467	27.19
	NDCG	0.478	0.364	31.32	0.504	0.387	30.23
80%	MRR	0.374	0.258	44.96	0.388	0.267	45.32
	MAP	0.352	0.245	43.67	0.366	0.255	43.53
	SuccessRate	0.517	0.375	37.87	0.615	0.443	38.83
	Precision	0.109	0.075	45.33	0.065	0.045	44.44
	Recall	0.488	0.354	37.85	0.584	0.423	38.06
	NDCG	0.410	0.287	42.86	0.442	0.309	43.04
Average	MRR	0.492	0.406	24.36	0.505	0.417	24.21
	MAP	0.398	0.307	31.03	0.414	0.320	30.52
	SuccessRate	0.656	0.583	15.59	0.744	0.662	15.27
	Precision	0.175	0.127	38.58	0.102	0.077	35.37
	Recall	0.533	0.433	23.97	0.616	0.513	21.22
	NDCG	0.531	0.449	21.50	0.559	0.471	21.67