System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
APACHE	$0.5806^{+24.4\%}$	$0.6792^{+38.9\%\dagger}$	$0.5202^{+0.3\%}$	$0.8268^{+0.7\%}$	$0.9667^{+81.2\%\dagger}$	$0.8682^{+186.5\%\dagger}$	$0.4389^{+56.3\%\dagger}$	$0.2632^{+1.6\%}$
7Z	$0.8000^{+90.5\%\dagger}$	$0.8081^{+76.9\%\dagger}$	$0.7481^{+50.1\%\dagger}$	$0.9143^{+12.6\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.8192^{+175.2\%\dagger}$	$0.5640^{+103.1\%\dagger}$	$0.3284^{+26.8\%\dagger}$
DCONVERT	$0.7200^{+66.2\%\star}$	$0.6252^{+32.0\%\dagger}$	$0.6665^{+31.3\%\dagger}$	$0.8798^{+7.8\%\dagger}$	$0.7667^{+53.3\%\star}$	$0.5095^{+80.8\%\dagger}$	$0.5020^{+90.7\%\dagger}$	$0.3270^{+28.6\%\dagger}$
DEEPARCH	$0.3733^{-11.8\%}$	$0.4271^{-14.4\%\star}$	$0.4880^{-6.9\%\star}$	$0.8154^{-0.8\%}$	$0.0000^{-100.0\%\dagger}$	$0.0693^{-78.3\%\dagger}$	$0.1155^{-59.5\%\dagger}$	$0.2387^{-8.7\%\star}$
EXASTENCILS	$0.6533^{+71.9\%\dagger}$	$0.4470^{-4.6\%}$	$0.6327^{+24.6\%\dagger}$	$0.8430^{+3.7\%\dagger}$	$0.9333^{+133.3\%\dagger}$	$0.2986^{-2.5\%}$	$0.4634^{+62.3\%\dagger}$	$0.2974^{+14.8\%\dagger}$
HADOOP	$0.8850^{+73.5\%\dagger}$	$0.8882^{+83.1\%\dagger}$	$0.8251^{+62.3\%\dagger}$	$0.9418^{+15.1\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.7982^{+198.5\%\dagger}$	$0.3891^{+52.7\%\dagger}$
MARIADB	$0.4200^{-20.8\%}$	$0.4350^{-15.0\%\dagger}$	$0.5105^{-4.7\%}$	$0.8169^{-1.5\%\star}$	$0.5333^{-15.8\%}$	$0.2231^{-38.6\%\dagger}$	$0.2358^{-24.9\%\star}$	$0.2542^{-5.5\%\star}$
MONGODB	$0.9700^{+85.4\%\dagger}$	$0.9714^{+95.6\%\dagger}$	$0.9092^{+77.5\%\dagger}$	$0.9719^{+18.2\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.7978^{+183.0\%\dagger}$	$0.4144^{+59.0\%\dagger}$
POSTGRESQL	$0.5000^{+23.0\%}$	$0.5018^{+6.8\%}$	$0.5181^{-1.1\%}$	$0.8248^{+0.7\%}$	$1.0000^{+130.8\%\dagger}$	$0.3719^{+25.8\%\star}$	$0.3743^{+32.2\%\dagger}$	$0.2923^{+11.1\%\dagger}$
REDIS	$0.9000^{+86.2\%\dagger}$	$0.8850^{+74.7\%\dagger}$	$0.8590^{+63.1\%\dagger}$	$0.9426^{+14.2\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8787^{+167.3\%\dagger}$	$0.7238^{+149.4\%\dagger}$	$0.3461^{+31.8\%\dagger}$
SPARK	$0.3100^{-21.2\%}$	$0.4262^{-13.7\%\star}$	$0.4728^{-10.9\%\star}$	$0.8005^{-2.6\%\star}$	$0.1667^{-64.3\%\star}$	$0.1523^{-55.6\%\dagger}$	$0.1654^{-47.3\%\dagger}$	$0.2319^{-13.9\%\dagger}$
STORM	$0.8583^{+120.1\%\dagger}$	$0.9418^{+100.3\%\dagger}$	$0.8548^{+65.2\%\dagger}$	$0.9389^{+14.9\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.9863^{+240.6\%\dagger}$	$0.7768^{+179.5\%\dagger}$	$0.3676^{+41.7\%\dagger}$
HSMGP	$0.8167^{+58.1\%\dagger}$	$0.8415^{+59.5\%\dagger}$	$0.7762^{+43.7\%\dagger}$	$0.9220^{+11.0\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.9322^{+152.3\%\dagger}$	$0.7011^{+124.0\%\dagger}$	$0.3607^{+34.8\%\dagger}$
XGBOOST	$0.4000^{+16.5\%}$	$0.4702^{-1.4\%}$	$0.4762^{-8.8\%\dagger}$	$0.8075^{-1.2\%}$	$0.0000^{-100.0\%\dagger}$	$0.0764^{-74.2\%\dagger}$	$0.0682^{-76.7\%\dagger}$	$0.1990^{-24.7\%\dagger}$
HIPACC	$0.6367^{+35.5\%\star}$	$0.6582^{+40.9\%\dagger}$	$0.6641^{+31.6\%\dagger}$	$0.8849^{+8.5\%\dagger}$	$0.5667^{+6.2\%}$	$0.3652^{+28.0\%\star}$	$0.3304^{+26.3\%\star}$	$0.2937^{+14.9\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.8734^{+90.3\%\dagger}$	$0.7160^{+40.8\%\dagger}$	$0.9053^{+11.2\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.8237^{+199.7\%\dagger}$	$0.5036^{+90.3\%\dagger}$	$0.3042^{+18.6\%\dagger}$
JAVAGC	$0.0000^{-100.0\%\dagger}$	$0.5614^{+16.0\%\star}$	$0.5932^{+14.5\%\dagger}$	$0.8279^{+0.9\%}$	$0.0000^{-100.0\%\dagger}$	$0.4175^{+52.0\%\dagger}$	$0.4176^{+63.4\%\dagger}$	$0.2982^{+17.2\%\dagger}$
POLLY	$1.0000^{+141.9\%\dagger}$	$0.8091^{+70.0\%\dagger}$	$0.7914^{+53.1\%\dagger}$	$0.9336^{+14.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.6871^{+142.5\%\dagger}$	$0.5883^{+119.7\%\dagger}$	$0.3573^{+37.8\%\dagger}$
Average	$\mathbf{0.6513}^{+46.6\%\dagger}$	$\mathbf{0.6805}^{+40.6\%\dagger}$	$\mathbf{0.6679}^{+29.0\%\dagger}$	$\mathbf{0.8777}^{+7.1\%\dagger}$	$\mathbf{0.7185}^{+49.8\%\dagger}$	$\mathbf{0.5822}^{+88.7\%\dagger}$	$\mathbf{0.4758}^{+68.8\%\dagger}$	$\mathbf{0.3091}^{+18.6\%\dagger}$

Table 1: Performance comparison for feature combination FBD+CL on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
APACHE	$0.5500^{+17.9\%}$	$0.6269^{+28.2\%\dagger}$	$0.5783^{+11.5\%\dagger}$	$0.8308^{+1.2\%\star}$	$0.8000^{+50.0\%\star}$	$0.7291^{+140.6\%\dagger}$	$0.4815^{+71.5\%\dagger}$	$0.2714^{+4.8\%\star}$
7Z	$0.9000^{+114.3\%\dagger}$	$0.8297^{+81.7\%\dagger}$	$0.7719^{+54.8\%\dagger}$	$0.9184^{+13.1\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.7789^{+161.7\%\dagger}$	$0.6113^{+120.1\%\dagger}$	$0.3293^{+27.2\%\dagger}$
DCONVERT	$0.8000^{+84.6\%\dagger}$	$0.6712^{+41.7\%\dagger}$	$0.6527^{+28.6\%\dagger}$	$0.8878^{+8.8\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.6107^{+116.7\%\dagger}$	$0.4704^{+78.6\%\dagger}$	$0.3350^{+31.7\%\dagger}$
DEEPARCH	$0.4000^{-5.5\%}$	$0.3622^{-27.4\%\dagger}$	$0.4401^{-16.0\%\dagger}$	$0.8012^{-2.5\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0124^{-96.1\%\dagger}$	$0.0709^{-75.1\%\dagger}$	$0.2266^{-13.4\%\dagger}$
EXASTENCILS	$0.0000^{-100.0\%\dagger}$	$0.3739^{-20.2\%\dagger}$	$0.5511^{+8.6\%\star}$	$0.8084^{-0.6\%}$	$0.0000^{-100.0\%\dagger}$	$0.2366^{-22.7\%\star}$	$0.3590^{+25.8\%\star}$	$0.2797^{+8.0\%\dagger}$
HADOOP	$0.9000^{+76.5\%\dagger}$	$0.8466^{+74.5\%\dagger}$	$0.8770^{+72.5\%\dagger}$	$0.9409^{+15.0\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.9304^{+247.9\%\dagger}$	$0.4104^{+61.1\%\dagger}$
MARIADB	$0.4833^{-8.8\%}$	$0.5043^{-1.4\%}$	$0.5524^{+3.1\%}$	$0.8305^{+0.1\%}$	$0.9667^{+52.6\%\star}$	$0.4205^{+15.8\%}$	$0.3559^{+13.4\%\star}$	$0.2826^{+5.0\%\star}$
MONGODB	$1.0000^{+91.1\%\dagger}$	$0.9599^{+93.3\%\dagger}$	$0.9031^{+76.3\%\dagger}$	$0.9687^{+17.8\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.8775^{+211.2\%\dagger}$	$0.4113^{+57.9\%\dagger}$
POSTGRESQL	$0.5000^{+23.0\%}$	$0.5059^{+7.6\%}$	$0.5395^{+3.0\%}$	$0.8239^{+0.6\%}$	$1.0000^{+130.8\%\dagger}$	$0.3348^{+13.3\%}$	$0.3111^{+9.9\%}$	$0.2587^{-1.7\%}$
REDIS	$0.9000^{+86.2\%\dagger}$	$0.9215^{+81.9\%\dagger}$	$0.8209^{+55.9\%\dagger}$	$0.9345^{+13.3\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.9111^{+177.2\%\dagger}$	$0.6590^{+127.1\%\dagger}$	$0.3223^{+22.7\%\dagger}$
SPARK	$0.8800^{+123.7\%\dagger}$	$0.4872^{-1.4\%}$	$0.5736^{+8.2\%\star}$	$0.8435^{+2.6\%\star}$	$0.9667^{+107.1\%\dagger}$	$0.1282^{-62.6\%\dagger}$	$0.2058^{-34.4\%\dagger}$	$0.2456^{-8.8\%\star}$
STORM	$0.9000^{+130.8\%\dagger}$	$0.6220^{+32.3\%\dagger}$	$0.6538^{+26.3\%\dagger}$	$0.8788^{+7.5\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.4702^{+62.4\%\dagger}$	$0.4725^{+70.0\%\dagger}$	$0.3277^{+26.4\%\dagger}$
HSMGP	$0.6083^{+17.7\%}$	$0.7224^{+36.9\%\dagger}$	$0.6963^{+28.9\%\dagger}$	$0.8858^{+6.6\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.6632^{+79.5\%\dagger}$	$0.5370^{+71.6\%\dagger}$	$0.3115^{+16.4\%\dagger}$
XGBOOST	$0.3533^{+2.9\%}$	$0.4722^{-1.0\%}$	$0.4580^{-12.3\%\dagger}$	$0.8027^{-1.8\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0855^{-71.1\%\dagger}$	$0.0575^{-80.3\%\dagger}$	$0.1961^{-25.8\%\dagger}$
HIPACC	$0.6900^{+46.8\%\star}$	$0.7630^{+63.3\%\dagger}$	$0.8073^{+59.9\%\dagger}$	$0.9196^{+12.7\%\dagger}$	$0.8333^{+56.2\%\star}$	$0.6735^{+136.1\%\dagger}$	$0.6505^{+148.7\%\dagger}$	$0.3786^{+48.1\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.9847^{+114.5\%\dagger}$	$0.7108^{+39.8\%\dagger}$	$0.9094^{+11.7\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$1.0000^{+263.8\%\dagger}$	$0.5010^{+89.3\%\dagger}$	$0.3016^{+17.5\%\dagger}$
JAVAGC	$0.3333^{-31.0\%\star}$	$0.6443^{+33.2\%\dagger}$	$0.6555^{+26.6\%\dagger}$	$0.8595^{+4.8\%\dagger}$	$0.3333^{-37.5\%}$	$0.5677^{+106.7\%\dagger}$	$0.4957^{+94.0\%\dagger}$	$0.3116^{+22.4\%\dagger}$
POLLY	$1.0000^{+141.9\%\dagger}$	$0.7791^{+63.7\%\dagger}$	$0.7685^{+48.7\%\dagger}$	$0.9220^{+12.6\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.6152^{+117.1\%\dagger}$	$0.5533^{+106.6\%\dagger}$	$0.3414^{+31.7\%\dagger}$
Average	$\mathbf{0.6721}^{+51.3\%\dagger}$	$\mathbf{0.6709}^{+38.6\%\dagger}$	$\mathbf{0.6673}^{+28.8\%\dagger}$	$\mathbf{0.8759}^{+6.9\%\dagger}$	$\mathbf{0.7722}^{+61.0\%\dagger}$	$\mathbf{0.5688}^{+84.4\%\dagger}$	$\mathbf{0.4778}^{+69.5\%\dagger}$	$\mathbf{0.3079}^{+18.2\%\dagger}$

Table 2: Performance comparison for feature combination FBD+MIE on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.6000^{+28.6\%\star}$	$0.6594^{+34.9\%\dagger}$	$0.5475^{+5.5\%}$	$0.8329^{+1.5\%\star}$	$1.0000^{+87.5\%\dagger}$	$0.7876^{+159.9\%\dagger}$	$0.4282^{+52.5\%\dagger}$	$0.2679^{+3.4\%}$
7z	$0.8300^{+97.6\%\dagger}$	$0.8751^{+91.6\%\dagger}$	$0.7687^{+54.2\%\dagger}$	$0.9211^{+13.4\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.8896^{+198.9\%\dagger}$	$0.6438^{+131.8\%\dagger}$	$0.3337^{+28.9\%\dagger}$
DConvert	$0.4817^{+11.2\%}$	$0.5211^{+10.0\%\star}$	$0.5917^{+16.5\%\dagger}$	$0.8531^{+4.6\%\dagger}$	$0.7333^{+46.7\%}$	$0.3841^{+36.3\%\dagger}$	$0.3991^{+51.6\%\dagger}$	$0.3192^{+25.5\%\dagger}$
DeepArch	$0.4000^{-5.5\%}$	$0.3808^{-23.6\%\dagger}$	$0.4171^{-20.4\%\dagger}$	$0.8017^{-2.5\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0165^{-94.8\%\dagger}$	$0.0471^{-83.5\%\dagger}$	$0.2243^{-14.2\%\dagger}$
ExaStencils	$0.1400^{-63.2\%\dagger}$	$0.4408^{-6.0\%}$	$0.5971^{+17.6\%\dagger}$	$0.8339^{+2.6\%\dagger}$	$0.2000^{-50.0\%}$	$0.3033^{-1.0\%}$	$0.4310^{+51.0\%\dagger}$	$0.3063^{+18.3\%\dagger}$
Hadoop	$0.9000^{+76.5\%\dagger}$	$0.8636^{+78.0\%\dagger}$	$0.8694^{+71.0\%\dagger}$	$0.9452^{+15.6\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.8827^{+230.1\%\dagger}$	$0.4064^{+59.5\%\dagger}$
MariaDB	$0.4300^{-18.9\%}$	$0.4424^{-13.5\%\star}$	$0.5180^{-3.3\%}$	$0.8244^{-0.6\%}$	$0.7667^{+21.1\%}$	$0.2814^{-22.5\%\star}$	$0.2794^{-11.0\%}$	$0.2822^{+4.9\%\star}$
MongoDB	$0.9000^{+72.0\%\dagger}$	$0.9526^{+91.8\%\dagger}$	$0.8865^{+73.0\%\dagger}$	$0.9612^{+16.9\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.8728^{+209.6\%\dagger}$	$0.4180^{+60.5\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5669^{+20.6\%\star}$	$0.5844^{+11.5\%\dagger}$	$0.8370^{+2.2\%\star}$	$1.0000^{+130.8\%\dagger}$	$0.5404^{+82.8\%\dagger}$	$0.4543^{+60.5\%\dagger}$	$0.2854^{+8.5\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8784^{+73.5\%\dagger}$	$0.8983^{+70.6\%\dagger}$	$0.9464^{+14.7\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8524^{+159.3\%\dagger}$	$0.7548^{+160.1\%\dagger}$	$0.3568^{+35.8\%\dagger}$
Spark	$0.4467^{+13.6\%}$	$0.5428^{+9.9\%}$	$0.5670^{+6.9\%\star}$	$0.8329^{+1.3\%}$	$0.3000^{-35.7\%}$	$0.2913^{-15.1\%}$	$0.2709^{-13.6\%}$	$0.2546^{-5.5\%}$
Storm	$0.8433^{+116.2\%\dagger}$	$0.8682^{+84.7\%\dagger}$	$0.7850^{+51.7\%\dagger}$	$0.9256^{+13.2\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.8997^{+210.7\%\dagger}$	$0.7033^{+153.0\%\dagger}$	$0.3627^{+39.9\%\dagger}$
HSMGP	$0.5983^{+15.8\%}$	$0.7987^{+51.4\%\dagger}$	$0.7412^{+37.2\%\dagger}$	$0.9093^{+9.5\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.9077^{+145.7\%\dagger}$	$0.6239^{+99.3\%\dagger}$	$0.3610^{+34.9\%\dagger}$
XGBoost	$0.2200^{-35.9\%}$	$0.4198^{-12.0\%\star}$	$0.4250^{-18.6\%\dagger}$	$0.7798^{-4.6\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0688^{-76.7\%\dagger}$	$0.0430^{-85.3\%\dagger}$	$0.1858^{-29.7\%\dagger}$
HIPAcc	$0.8500^{+80.9\%\dagger}$	$0.7767^{+66.2\%\dagger}$	$0.7378^{+46.2\%\dagger}$	$0.9163^{+12.3\%\dagger}$	$0.9667^{+81.2\%\dagger}$	$0.7438^{+160.7\%\dagger}$	$0.5555^{+112.4\%\dagger}$	$0.3519^{+37.7\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.7324^{+59.6\%\dagger}$	$0.7134^{+40.3\%\dagger}$	$0.8903^{+9.3\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.5677^{+106.6\%\dagger}$	$0.4542^{+71.6\%\dagger}$	$0.2980^{+16.1\%\dagger}$
JavaGC	$0.4328^{-10.5\%}$	$0.5436^{+12.3\%\star}$	$0.6241^{+20.5\%\dagger}$	$0.8448^{+3.0\%\star}$	$0.4333^{-18.8\%}$	$0.3900^{+42.0\%\dagger}$	$0.4518^{+76.8\%\dagger}$	$0.3018^{+18.6\%\dagger}$
Polly	$0.9867^{+138.7\%\dagger}$	$0.8327^{+75.0\%\dagger}$	$0.7922^{+53.3\%\dagger}$	$0.9337^{+14.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7258^{+156.2\%\dagger}$	$0.5929^{+121.4\%\dagger}$	$0.3565^{+37.5\%\dagger}$
Average	$\mathbf{0.6311}^{+42.1\%\dagger}$	$\mathbf{0.6720}^{+38.9\%\dagger}$	$\mathbf{0.6702}^{+29.4\%\dagger}$	$\mathbf{0.8772}^{+7.0\%\dagger}$	$\mathbf{0.7444}^{+55.2\%\dagger}$	$\mathbf{0.5917}^{+91.8\%\dagger}$	$\mathbf{0.4938}^{+75.1\%\dagger}$	$\mathbf{0.3151}^{+21.0\%\dagger}$

Table 3: Performance comparison for feature combination FBD+NBC on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.4122^{-11.7\%}$	$0.3300^{-32.5\%\dagger}$	$0.3894^{-24.9\%\dagger}$	$0.7643^{-6.9\%\dagger}$	$0.5000^{-6.2\%}$	$0.1013^{-66.6\%\dagger}$	$0.1349^{-52.0\%\dagger}$	$0.2043^{-21.1\%\dagger}$
7z	$0.8367^{+99.2\%\dagger}$	$0.7036^{+54.0\%\dagger}$	$0.7026^{+40.9\%\dagger}$	$0.8985^{+10.6\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.5876^{+97.4\%\dagger}$	$0.4749^{+71.0\%\dagger}$	$0.3056^{+18.0\%\dagger}$
DConvert	$1.0000^{+130.8\%\dagger}$	$0.6032^{+27.3\%\dagger}$	$0.5818^{+14.6\%\dagger}$	$0.8684^{+6.5\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.4796^{+70.2\%\dagger}$	$0.3509^{+33.3\%\dagger}$	$0.2967^{+16.7\%\dagger}$
DeepArch	$0.3267^{-22.8\%}$	$0.3431^{-31.2\%\dagger}$	$0.4465^{-14.8\%\dagger}$	$0.7984^{-2.9\%\star}$	$0.0333^{-90.9\%\star}$	$0.0401^{-87.5\%\dagger}$	$0.0960^{-66.3\%\dagger}$	$0.2346^{-10.3\%\dagger}$
ExaStencils	$0.5833^{+53.5\%\star}$	$0.4513^{-3.7\%}$	$0.6202^{+22.2\%\dagger}$	$0.8479^{+4.3\%\dagger}$	$0.8333^{+108.3\%\dagger}$	$0.3245^{+6.0\%}$	$0.4481^{+57.0\%\dagger}$	$0.3091^{+19.4\%\dagger}$
Hadoop	$0.9067^{+77.8\%\dagger}$	$0.8686^{+79.1\%\dagger}$	$0.8968^{+76.4\%\dagger}$	$0.9484^{+16.0\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9722^{+216.5\%\dagger}$	$0.9316^{+248.3\%\dagger}$	$0.4091^{+60.6\%\dagger}$
MariaDB	$0.4967^{-6.3\%}$	$0.4438^{-13.3\%\dagger}$	$0.4598^{-14.2\%\dagger}$	$0.8061^{-2.8\%\dagger}$	$0.9667^{+52.6\%\star}$	$0.2814^{-22.5\%\star}$	$0.1994^{-36.4\%\dagger}$	$0.2406^{-10.5\%\dagger}$
MongoDB	$0.9700^{+85.4\%\dagger}$	$0.9437^{+90.0\%\dagger}$	$0.8934^{+74.4\%\dagger}$	$0.9634^{+17.2\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9357^{+181.1\%\dagger}$	$0.8212^{+191.3\%\dagger}$	$0.4034^{+54.9\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.6066^{+29.0\%\dagger}$	$0.6188^{+18.1\%\dagger}$	$0.8479^{+3.5\%\dagger}$	$1.0000^{+130.8\%\dagger}$	$0.8331^{+181.8\%\dagger}$	$0.6874^{+142.9\%\dagger}$	$0.3346^{+27.2\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.9260^{+82.8\%\dagger}$	$0.8982^{+70.6\%\dagger}$	$0.9495^{+15.1\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.9517^{+189.5\%\dagger}$	$0.7620^{+162.6\%\dagger}$	$0.3528^{+34.3\%\dagger}$
Spark	$0.5500^{+39.8\%\star}$	$0.5986^{+21.2\%\star}$	$0.5654^{+6.6\%\star}$	$0.8471^{+3.0\%\star}$	$0.5000^{+7.1\%}$	$0.3309^{-3.5\%}$	$0.2490^{-20.6\%}$	$0.2571^{-4.5\%}$
Storm	$0.8933^{+129.1\%\dagger}$	$0.7741^{+64.6\%\dagger}$	$0.7418^{+43.4\%\dagger}$	$0.9103^{+11.4\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.7296^{+151.9\%\dagger}$	$0.5991^{+115.6\%\dagger}$	$0.3411^{+31.6\%\dagger}$
HSMGP	$0.8567^{+65.8\%\dagger}$	$0.8629^{+63.6\%\dagger}$	$0.7891^{+46.1\%\dagger}$	$0.9273^{+11.6\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.9967^{+169.8\%\dagger}$	$0.7085^{+126.3\%\dagger}$	$0.3694^{+38.0\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.4481^{-6.0\%}$	$0.4682^{-10.3\%\dagger}$	$0.8013^{-2.0\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0198^{-93.3\%\dagger}$	$0.0472^{-83.9\%\dagger}$	$0.1941^{-26.6\%\dagger}$
HIPAcc	$0.8533^{+81.6\%\dagger}$	$0.8558^{+83.1\%\dagger}$	$0.8566^{+69.7\%\dagger}$	$0.9415^{+15.4\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.9364^{+228.2\%\dagger}$	$0.8430^{+222.3\%\dagger}$	$0.4112^{+60.9\%\dagger}$
SQL	$0.8867^{+116.3\%\dagger}$	$0.9731^{+112.0\%\dagger}$	$0.7094^{+39.5\%\dagger}$	$0.9078^{+11.5\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$1.0000^{+263.8\%\dagger}$	$0.5123^{+93.6\%\dagger}$	$0.3077^{+19.9\%\dagger}$
JavaGC	$0.6389^{+32.2\%}$	$0.7373^{+52.4\%\dagger}$	$0.6796^{+31.2\%\dagger}$	$0.8777^{+7.0\%\dagger}$	$0.6667^{+25.0\%}$	$0.7195^{+162.0\%\dagger}$	$0.5563^{+117.7\%\dagger}$	$0.3225^{+26.7\%\dagger}$
Polly	$0.9900^{+139.5\%\dagger}$	$0.9325^{+96.0\%\dagger}$	$0.8155^{+57.8\%\dagger}$	$0.9433^{+15.2\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.9250^{+226.5\%\dagger}$	$0.6736^{+151.5\%\dagger}$	$0.3616^{+39.5\%\dagger}$
Average	$\mathbf{0.7223}^{+62.6\%\dagger}$	$\mathbf{0.6890}^{+42.4\%\dagger}$	$\mathbf{0.6741}^{+30.2\%\dagger}$	$\mathbf{0.8805}^{+7.4\%\dagger}$	$\mathbf{0.8056}^{+68.0\%\dagger}$	$\mathbf{0.6203}^{+101.1\%\dagger}$	$\mathbf{0.5053}^{+79.2\%\dagger}$	$\mathbf{0.3142}^{+20.6\%\dagger}$

Table 4: Performance comparison for feature combination FBD+PLO on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.5933^{+27.1\%\star}$	$0.6698^{+37.0\%\dagger}$	$0.5381^{+3.7\%}$	$0.8313^{+1.3\%\star}$	$1.0000^{+87.5\%\dagger}$	$0.8507^{+180.7\%\dagger}$	$0.4773^{+70.0\%\dagger}$	$0.2698^{+4.2\%\star}$
7z	$0.8033^{+91.3\%\dagger}$	$0.8784^{+92.3\%\dagger}$	$0.7637^{+53.2\%\dagger}$	$0.9225^{+13.6\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.9106^{+205.9\%\dagger}$	$0.5995^{+115.9\%\dagger}$	$0.3352^{+29.4\%\dagger}$
DConvert	$0.6333^{+46.2\%\star}$	$0.6072^{+28.2\%\dagger}$	$0.6157^{+21.3\%\dagger}$	$0.8683^{+6.4\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.4463^{+58.4\%\dagger}$	$0.4079^{+54.9\%\dagger}$	$0.3077^{+21.0\%\dagger}$
DeepArch	$0.4000^{-5.5\%}$	$0.4308^{-13.6\%\star}$	$0.4941^{-5.7\%\star}$	$0.8191^{-0.3\%}$	$0.0000^{-100.0\%\dagger}$	$0.0277^{-91.3\%\dagger}$	$0.0995^{-65.1\%\dagger}$	$0.2354^{-10.0\%\dagger}$
ExaStencils	$0.6067^{+59.6\%\star}$	$0.4304^{-8.2\%}$	$0.5699^{+12.3\%\dagger}$	$0.8313^{+2.2\%\dagger}$	$0.8667^{+116.7\%\dagger}$	$0.2981^{-2.6\%}$	$0.3773^{+32.2\%\dagger}$	$0.2951^{+13.9\%\dagger}$
Hadoop	$0.8833^{+73.2\%\dagger}$	$0.8575^{+76.8\%\dagger}$	$0.8274^{+62.8\%\dagger}$	$0.9395^{+14.9\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.8195^{+206.4\%\dagger}$	$0.3998^{+56.9\%\dagger}$
MariaDB	$0.4167^{-21.4\%}$	$0.4021^{-21.4\%\dagger}$	$0.4845^{-9.6\%\dagger}$	$0.8126^{-2.0\%\star}$	$0.1667^{-73.7\%\dagger}$	$0.1194^{-67.1\%\dagger}$	$0.1843^{-41.3\%\dagger}$	$0.2475^{-8.0\%\dagger}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9763^{+96.6\%\dagger}$	$0.8578^{+67.4\%\dagger}$	$0.9632^{+17.2\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.7397^{+162.4\%\dagger}$	$0.3996^{+53.4\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5000^{+6.4\%}$	$0.5044^{-3.7\%}$	$0.8152^{-0.5\%}$	$1.0000^{+130.8\%\dagger}$	$0.5368^{+81.6\%\dagger}$	$0.4193^{+48.2\%\dagger}$	$0.2909^{+10.6\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8765^{+73.1\%\dagger}$	$0.8385^{+59.3\%\dagger}$	$0.9346^{+13.3\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8530^{+159.5\%\dagger}$	$0.6821^{+135.1\%\dagger}$	$0.3343^{+27.2\%\dagger}$
Spark	$0.6900^{+75.4\%\dagger}$	$0.6016^{+21.8\%\star}$	$0.5928^{+11.8\%\star}$	$0.8516^{+3.6\%\star}$	$0.7000^{+50.0\%}$	$0.3512^{+2.4\%}$	$0.2941^{-6.3\%}$	$0.2583^{-4.1\%}$
Storm	$0.8633^{+121.4\%\dagger}$	$0.9579^{+103.7\%\dagger}$	$0.7728^{+49.4\%\dagger}$	$0.9277^{+13.5\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.9897^{+241.8\%\dagger}$	$0.5956^{+114.3\%\dagger}$	$0.3431^{+32.3\%\dagger}$
HSMGP	$0.7433^{+43.9\%\star}$	$0.8300^{+57.3\%\dagger}$	$0.8126^{+50.5\%\dagger}$	$0.9281^{+11.7\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.9434^{+155.4\%\dagger}$	$0.7418^{+137.0\%\dagger}$	$0.3808^{+42.3\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.5098^{+6.9\%}$	$0.5131^{-1.7\%}$	$0.8224^{+0.6\%}$	$0.0000^{-100.0\%\dagger}$	$0.1021^{-65.5\%\dagger}$	$0.0905^{-69.1\%\dagger}$	$0.2083^{-21.3\%\dagger}$
HIPAcc	$0.5267^{+12.1\%}$	$0.6339^{+35.7\%\dagger}$	$0.6780^{+34.3\%\dagger}$	$0.8788^{+7.7\%\dagger}$	$0.4000^{-25.0\%}$	$0.4050^{+42.0\%\star}$	$0.4207^{+60.9\%\dagger}$	$0.3031^{+18.6\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.6996^{+52.4\%\dagger}$	$0.6578^{+29.4\%\dagger}$	$0.8763^{+7.6\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.5320^{+93.5\%\dagger}$	$0.3748^{+41.6\%\dagger}$	$0.2787^{+8.6\%\dagger}$
JavaGC	$0.0000^{-100.0\%\dagger}$	$0.5180^{+7.1\%}$	$0.5812^{+12.2\%\dagger}$	$0.8245^{+0.5\%}$	$0.0000^{-100.0\%\dagger}$	$0.3301^{+20.2\%\star}$	$0.3757^{+47.1\%\dagger}$	$0.2896^{+13.8\%\dagger}$
Polly	$0.9600^{+132.3\%\dagger}$	$0.7513^{+57.9\%\dagger}$	$0.7726^{+49.5\%\dagger}$	$0.9212^{+12.5\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.6278^{+121.6\%\dagger}$	$0.6048^{+125.9\%\dagger}$	$0.3547^{+36.8\%\dagger}$
Average	$\mathbf{0.6567}^{+47.8\%\dagger}$	$\mathbf{0.6740}^{+39.3\%\dagger}$	$\mathbf{0.6597}^{+27.4\%\dagger}$	$\mathbf{0.8760}^{+6.9\%\dagger}$	$\mathbf{0.7296}^{+52.1\%\dagger}$	$\mathbf{0.5736}^{+85.9\%\dagger}$	$\mathbf{0.4614}^{+63.6\%\dagger}$	$\mathbf{0.3073}^{+18.0\%\dagger}$

Table 5: Performance comparison for feature combination FDC+CL on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.6100^{+30.7\%\star}$	$0.5893^{+20.5\%\dagger}$	$0.5355^{+3.2\%}$	$0.8234^{+0.3\%}$	$0.9667^{+81.2\%\dagger}$	$0.7330^{+141.9\%\dagger}$	$0.4714^{+67.9\%\dagger}$	$0.2678^{+3.4\%}$
7z	$0.9000^{+114.3\%\dagger}$	$0.8264^{+80.9\%\dagger}$	$0.7846^{+57.4\%\dagger}$	$0.9153^{+12.7\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.7895^{+165.2\%\dagger}$	$0.6224^{+124.1\%\dagger}$	$0.3275^{+26.5\%\dagger}$
DConvert	$0.6667^{+53.8\%\star}$	$0.6157^{+30.0\%\dagger}$	$0.6076^{+19.7\%\dagger}$	$0.8689^{+6.5\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.4873^{+72.9\%\dagger}$	$0.3983^{+51.3\%\dagger}$	$0.3056^{+20.2\%\dagger}$
DeepArch	$0.4000^{-5.5\%}$	$0.3602^{-27.8\%\dagger}$	$0.4524^{-13.7\%\dagger}$	$0.8010^{-2.5\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0003^{-99.9\%\dagger}$	$0.0818^{-71.3\%\dagger}$	$0.2201^{-15.8\%\dagger}$
ExaStencils	$0.0467^{-87.7\%\dagger}$	$0.3703^{-21.0\%\dagger}$	$0.4812^{-5.2\%}$	$0.7968^{-2.0\%\star}$	$0.0667^{-83.3\%\star}$	$0.2416^{-21.1\%\star}$	$0.2568^{-10.0\%}$	$0.2732^{+5.5\%\star}$
Hadoop	$0.8900^{+74.5\%\dagger}$	$0.8300^{+71.1\%\dagger}$	$0.8877^{+74.6\%\dagger}$	$0.9368^{+14.5\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.9721^{+263.5\%\dagger}$	$0.4152^{+63.0\%\dagger}$
MariaDB	$0.4100^{-22.6\%\star}$	$0.4799^{-6.2\%\star}$	$0.5812^{+8.5\%\star}$	$0.8277^{-0.2\%}$	$0.1000^{-84.2\%\dagger}$	$0.2657^{-26.8\%\star}$	$0.3272^{+4.3\%}$	$0.2701^{+0.4\%}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9749^{+96.3\%\dagger}$	$0.8813^{+72.0\%\dagger}$	$0.9659^{+17.5\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.8655^{+207.0\%\dagger}$	$0.4276^{+64.1\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5592^{+19.0\%\star}$	$0.5234^{-0.1\%}$	$0.8219^{+0.3\%}$	$1.0000^{+130.8\%\dagger}$	$0.7548^{+155.3\%\dagger}$	$0.5112^{+80.6\%\dagger}$	$0.2942^{+11.8\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8566^{+69.1\%\dagger}$	$0.7797^{+48.1\%\dagger}$	$0.9182^{+11.3\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.7730^{+135.2\%\dagger}$	$0.5716^{+97.0\%\dagger}$	$0.3083^{+17.3\%\dagger}$
Spark	$0.9000^{+128.8\%\dagger}$	$0.6168^{+24.9\%\dagger}$	$0.6464^{+21.9\%\dagger}$	$0.8768^{+6.6\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.2807^{-18.2\%}$	$0.2741^{-12.6\%}$	$0.2663^{-1.1\%}$
Storm	$0.9000^{+130.8\%\dagger}$	$0.8657^{+84.1\%\dagger}$	$0.7796^{+50.7\%\dagger}$	$0.9311^{+13.9\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.8222^{+183.9\%\dagger}$	$0.6338^{+128.0\%\dagger}$	$0.3663^{+41.3\%\dagger}$
HSMGP	$0.6700^{+29.7\%}$	$0.7299^{+38.4\%\dagger}$	$0.7568^{+40.1\%\dagger}$	$0.9082^{+9.3\%\dagger}$	$0.9333^{+64.7\%\star}$	$0.6354^{+72.0\%\dagger}$	$0.6098^{+94.8\%\dagger}$	$0.3483^{+30.2\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.4875^{+2.3\%}$	$0.4696^{-10.1\%\dagger}$	$0.8105^{-0.9\%}$	$0.0000^{-100.0\%\dagger}$	$0.0908^{-69.3\%\dagger}$	$0.0605^{-79.3\%\dagger}$	$0.1977^{-25.3\%\dagger}$
HIPAcc	$0.8333^{+77.3\%\dagger}$	$0.8838^{+89.1\%\dagger}$	$0.8958^{+77.5\%\dagger}$	$0.9502^{+16.5\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.9796^{+243.4\%\dagger}$	$0.8950^{+242.2\%\dagger}$	$0.4139^{+61.9\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.7079^{+54.2\%\dagger}$	$0.6321^{+24.3\%\dagger}$	$0.8640^{+6.1\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.5387^{+96.0\%\dagger}$	$0.3736^{+41.2\%\dagger}$	$0.2738^{+6.7\%\star}$
JavaGC	$0.3400^{-29.7\%}$	$0.4979^{+2.9\%}$	$0.6068^{+17.2\%\dagger}$	$0.8387^{+2.2\%\star}$	$0.3333^{-37.5\%}$	$0.3012^{+9.7\%}$	$0.3896^{+52.5\%\dagger}$	$0.2907^{+14.2\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.7073^{+48.7\%\dagger}$	$0.7477^{+44.7\%\dagger}$	$0.9045^{+10.5\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.5715^{+101.7\%\dagger}$	$0.5703^{+112.9\%\dagger}$	$0.3383^{+30.5\%\dagger}$
Average	$\mathbf{0.6815}^{+53.4\%\dagger}$	$\mathbf{0.6644}^{+37.3\%\dagger}$	$\mathbf{0.6694}^{+29.3\%\dagger}$	$\mathbf{0.8755}^{+6.8\%\dagger}$	$\mathbf{0.7444}^{+55.2\%\dagger}$	$\mathbf{0.5703}^{+84.9\%\dagger}$	$\mathbf{0.4936}^{+75.1\%\dagger}$	$\mathbf{0.3114}^{+19.5\%\dagger}$

Table 6: Performance comparison for feature combination FDC+MIE on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.5333^{+14.3\%}$	$0.6124^{+25.2\%\dagger}$	$0.5312^{+2.4\%}$	$0.8231^{+0.3\%}$	$0.8333^{+56.2\%\star}$	$0.6723^{+121.8\%\dagger}$	$0.4345^{+54.7\%\dagger}$	$0.2624^{+1.3\%}$
7z	$0.8900^{+111.9\%\dagger}$	$0.8805^{+92.8\%\dagger}$	$0.7994^{+60.3\%\dagger}$	$0.9266^{+14.1\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.8744^{+193.8\%\dagger}$	$0.6881^{+147.8\%\dagger}$	$0.3399^{+31.2\%\dagger}$
DConvert	$0.4700^{+8.5\%}$	$0.5203^{+9.8\%\star}$	$0.5618^{+10.6\%\star}$	$0.8449^{+3.6\%\dagger}$	$0.7000^{+40.0\%}$	$0.3449^{+22.4\%\star}$	$0.3277^{+24.4\%\star}$	$0.3021^{+18.8\%\dagger}$
DeepArch	$0.1600^{-62.2\%\star}$	$0.3383^{-32.2\%\dagger}$	$0.4173^{-20.4\%\dagger}$	$0.7843^{-4.6\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0044^{-98.6\%\dagger}$	$0.0591^{-79.3\%\dagger}$	$0.2175^{-16.9\%\dagger}$
ExaStencils	$0.4667^{+22.8\%}$	$0.4460^{-4.9\%}$	$0.5572^{+9.8\%\dagger}$	$0.8308^{+2.2\%\star}$	$0.6667^{+66.7\%\star}$	$0.2962^{-3.3\%}$	$0.3609^{+26.4\%\star}$	$0.2986^{+15.3\%\dagger}$
Hadoop	$0.9000^{+76.5\%\dagger}$	$0.8692^{+79.2\%\dagger}$	$0.8789^{+72.9\%\dagger}$	$0.9477^{+15.9\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.9323^{+248.6\%\dagger}$	$0.4178^{+64.0\%\dagger}$
MariaDB	$0.4433^{-16.4\%}$	$0.4547^{-11.1\%\star}$	$0.5275^{-1.5\%}$	$0.8197^{-1.2\%}$	$0.4333^{-31.6\%}$	$0.2200^{-39.4\%\dagger}$	$0.2548^{-18.8\%\star}$	$0.2633^{-2.1\%}$
MongoDB	$0.8800^{+68.2\%\dagger}$	$0.9583^{+92.9\%\dagger}$	$0.8658^{+69.0\%\dagger}$	$0.9532^{+16.0\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.8775^{+211.2\%\dagger}$	$0.4130^{+58.5\%\dagger}$
PostgreSQL	$0.5100^{+25.4\%\star}$	$0.5656^{+20.3\%\dagger}$	$0.5287^{+0.9\%}$	$0.8219^{+0.3\%}$	$1.0000^{+130.8\%\dagger}$	$0.8417^{+184.7\%\dagger}$	$0.5255^{+85.7\%\dagger}$	$0.2990^{+13.6\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8682^{+71.4\%\dagger}$	$0.8520^{+61.8\%\dagger}$	$0.9341^{+13.2\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8159^{+148.2\%\dagger}$	$0.6859^{+136.3\%\dagger}$	$0.3306^{+25.8\%\dagger}$
Spark	$0.7800^{+98.3\%\dagger}$	$0.6963^{+41.0\%\dagger}$	$0.6575^{+24.0\%\dagger}$	$0.8801^{+7.1\%\dagger}$	$0.7667^{+64.3\%\star}$	$0.4276^{+24.6\%\star}$	$0.3444^{+9.8\%}$	$0.2727^{+1.2\%}$
Storm	$0.8783^{+125.2\%\dagger}$	$0.9277^{+97.3\%\dagger}$	$0.7977^{+54.2\%\dagger}$	$0.9338^{+14.3\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.9422^{+225.4\%\dagger}$	$0.6556^{+135.9\%\dagger}$	$0.3709^{+43.0\%\dagger}$
HSMGP	$0.5200^{+0.6\%}$	$0.7056^{+33.8\%\dagger}$	$0.7129^{+32.0\%\dagger}$	$0.8929^{+7.5\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.6881^{+86.3\%\dagger}$	$0.5428^{+73.4\%\dagger}$	$0.3420^{+27.8\%\dagger}$
XGBoost	$0.3933^{+14.6\%}$	$0.4840^{+1.5\%}$	$0.4650^{-10.9\%\dagger}$	$0.8016^{-2.0\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0840^{-71.6\%\dagger}$	$0.0589^{-79.9\%\dagger}$	$0.1933^{-26.9\%\dagger}$
HIPAcc	$0.8033^{+70.9\%\dagger}$	$0.8084^{+73.0\%\dagger}$	$0.8017^{+58.8\%\dagger}$	$0.9276^{+13.7\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.9499^{+233.0\%\dagger}$	$0.7563^{+189.2\%\dagger}$	$0.3928^{+53.7\%\dagger}$
SQL	$0.8733^{+113.0\%\dagger}$	$0.7751^{+68.9\%\dagger}$	$0.7106^{+39.8\%\dagger}$	$0.8930^{+9.7\%\dagger}$	$0.9667^{+141.7\%\dagger}$	$0.6261^{+127.8\%\dagger}$	$0.4500^{+70.1\%\dagger}$	$0.3018^{+17.6\%\dagger}$
JavaGC	$0.4967^{+2.8\%}$	$0.4926^{+1.8\%}$	$0.5405^{+4.4\%}$	$0.8287^{+1.0\%}$	$0.4000^{-25.0\%}$	$0.3142^{+14.4\%}$	$0.3327^{+30.2\%\dagger}$	$0.2800^{+10.0\%\dagger}$
Polly	$0.9467^{+129.0\%\dagger}$	$0.8014^{+68.4\%\dagger}$	$0.7605^{+47.1\%\dagger}$	$0.9214^{+12.5\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7190^{+153.8\%\dagger}$	$0.5881^{+119.6\%\dagger}$	$0.3466^{+33.7\%\dagger}$
Average	$\mathbf{0.6581}^{+48.1\%\dagger}$	$\mathbf{0.6781}^{+40.1\%\dagger}$	$\mathbf{0.6648}^{+28.4\%\dagger}$	$\mathbf{0.8759}^{+6.9\%\dagger}$	$\mathbf{0.7648}^{+59.5\%\dagger}$	$\mathbf{0.6012}^{+94.9\%\dagger}$	$\mathbf{0.4931}^{+74.9\%\dagger}$	$\mathbf{0.3136}^{+20.4\%\dagger}$

Table 7: Performance comparison for feature combination FDC+NBC on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.3900^{-16.4\%}$	$0.4189^{-14.3\%\star}$	$0.4312^{-16.9\%\dagger}$	$0.7798^{-5.0\%\dagger}$	$0.7667^{+43.8\%}$	$0.3667^{+21.0\%}$	$0.2682^{-4.5\%}$	$0.2299^{-11.2\%\dagger}$
7z	$0.8667^{+106.3\%\dagger}$	$0.8047^{+76.2\%\dagger}$	$0.7423^{+48.9\%\dagger}$	$0.9116^{+12.2\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.7367^{+147.5\%\dagger}$	$0.5405^{+94.6\%\dagger}$	$0.3151^{+21.7\%\dagger}$
DConvert	$1.0000^{+130.8\%\dagger}$	$0.6063^{+28.0\%\dagger}$	$0.5995^{+18.1\%\dagger}$	$0.8702^{+6.7\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.4365^{+54.9\%\dagger}$	$0.3616^{+37.3\%\dagger}$	$0.2937^{+15.5\%\dagger}$
DeepArch	$0.4000^{-5.5\%}$	$0.3742^{-25.0\%\dagger}$	$0.4513^{-13.9\%\dagger}$	$0.8046^{-2.1\%}$	$0.0000^{-100.0\%\dagger}$	$0.0068^{-97.9\%\dagger}$	$0.0516^{-81.9\%\dagger}$	$0.2191^{-16.2\%\dagger}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.4363^{-6.9\%}$	$0.5452^{+7.4\%\star}$	$0.8301^{+2.1\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.2891^{-5.6\%}$	$0.3185^{+11.6\%}$	$0.2888^{+11.5\%\dagger}$
Hadoop	$0.8967^{+75.8\%\dagger}$	$0.8872^{+82.9\%\dagger}$	$0.9049^{+78.0\%\dagger}$	$0.9508^{+16.2\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9875^{+221.5\%\dagger}$	$0.9427^{+252.5\%\dagger}$	$0.4240^{+66.4\%\dagger}$
MariaDB	$0.4167^{-21.4\%}$	$0.4748^{-7.2\%\star}$	$0.5022^{-6.3\%\star}$	$0.8142^{-1.8\%\star}$	$0.1667^{-73.7\%\dagger}$	$0.2922^{-19.5\%\star}$	$0.2428^{-22.6\%\star}$	$0.2462^{-8.5\%\dagger}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9763^{+96.6\%\dagger}$	$0.8392^{+63.8\%\dagger}$	$0.9580^{+16.5\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.7698^{+173.1\%\dagger}$	$0.4078^{+56.5\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5814^{+23.7\%\dagger}$	$0.5429^{+3.6\%}$	$0.8256^{+0.8\%}$	$1.0000^{+130.8\%\dagger}$	$0.8960^{+203.1\%\dagger}$	$0.5688^{+101.0\%\dagger}$	$0.3129^{+18.9\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8742^{+72.6\%\dagger}$	$0.8564^{+62.6\%\dagger}$	$0.9347^{+13.3\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8002^{+143.4\%\dagger}$	$0.6633^{+128.6\%\dagger}$	$0.3289^{+25.2\%\dagger}$
Spark	$0.6867^{+74.6\%\dagger}$	$0.6980^{+41.3\%\dagger}$	$0.6702^{+26.4\%\dagger}$	$0.8788^{+6.9\%\dagger}$	$0.7333^{+57.1\%\star}$	$0.4869^{+41.9\%\dagger}$	$0.4013^{+27.9\%\star}$	$0.2889^{+7.3\%\star}$
Storm	$0.8567^{+119.7\%\dagger}$	$0.9327^{+98.4\%\dagger}$	$0.7993^{+54.5\%\dagger}$	$0.9338^{+14.3\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.9638^{+232.8\%\dagger}$	$0.6810^{+145.0\%\dagger}$	$0.3669^{+41.5\%\dagger}$
HSMGP	$0.7983^{+54.5\%\dagger}$	$0.8439^{+60.0\%\dagger}$	$0.7927^{+46.8\%\dagger}$	$0.9295^{+11.9\%\dagger}$	$1.0000^{+76.5\%\dagger}$	$0.9660^{+161.5\%\dagger}$	$0.7140^{+128.1\%\dagger}$	$0.3782^{+41.3\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.5010^{+5.1\%}$	$0.4900^{-6.2\%\star}$	$0.8143^{-0.4\%}$	$0.0000^{-100.0\%\dagger}$	$0.0670^{-77.3\%\dagger}$	$0.0662^{-77.4\%\dagger}$	$0.2032^{-23.2\%\dagger}$
HIPAcc	$0.8278^{+76.1\%\dagger}$	$0.8484^{+81.6\%\dagger}$	$0.8759^{+73.5\%\dagger}$	$0.9423^{+15.5\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.9925^{+247.9\%\dagger}$	$0.8899^{+240.2\%\dagger}$	$0.4150^{+62.4\%\dagger}$
SQL	$0.8600^{+109.8\%\dagger}$	$0.9397^{+104.8\%\dagger}$	$0.7059^{+38.9\%\dagger}$	$0.9045^{+11.1\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.9465^{+244.4\%\dagger}$	$0.5008^{+89.3\%\dagger}$	$0.3028^{+18.0\%\dagger}$
JavaGC	$0.8733^{+80.7\%\dagger}$	$0.6057^{+25.2\%\dagger}$	$0.6491^{+25.3\%\dagger}$	$0.8649^{+5.4\%\dagger}$	$0.8667^{+62.5\%\star}$	$0.4002^{+45.7\%\dagger}$	$0.4387^{+71.7\%\dagger}$	$0.3005^{+18.1\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.7654^{+60.9\%\dagger}$	$0.7846^{+51.8\%\dagger}$	$0.9223^{+12.6\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7274^{+156.7\%\dagger}$	$0.6494^{+142.5\%\dagger}$	$0.3545^{+36.7\%\dagger}$
Average	$\mathbf{0.7429}^{+67.2\%\dagger}$	$\mathbf{0.6983}^{+44.3\%\dagger}$	$\mathbf{0.6768}^{+30.7\%\dagger}$	$\mathbf{0.8817}^{+7.6\%\dagger}$	$\mathbf{0.8074}^{+68.3\%\dagger}$	$\mathbf{0.6312}^{+104.6\%\dagger}$	$\mathbf{0.5038}^{+78.7\%\dagger}$	$\mathbf{0.3154}^{+21.0\%\dagger}$

Table 8: Performance comparison for feature combination FDC+PLO on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.5800^{+24.3\%}$	$0.6526^{+33.5\%\dagger}$	$0.5414^{+4.3\%}$	$0.8292^{+1.0\%}$	$0.9000^{+68.8\%\star}$	$0.7314^{+141.4\%\dagger}$	$0.4230^{+50.6\%\dagger}$	$0.2636^{+1.8\%}$
7z	$0.8467^{+101.6\%\dagger}$	$0.9019^{+97.5\%\dagger}$	$0.7601^{+52.5\%\dagger}$	$0.9212^{+13.4\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.9389^{+215.4\%\dagger}$	$0.5793^{+108.6\%\dagger}$	$0.3267^{+26.2\%\dagger}$
DConvert	$0.4800^{+10.8\%}$	$0.5888^{+24.3\%\dagger}$	$0.6351^{+25.1\%\dagger}$	$0.8621^{+5.7\%\dagger}$	$0.8333^{+66.7\%\star}$	$0.4747^{+68.4\%\dagger}$	$0.4949^{+87.9\%\dagger}$	$0.3261^{+28.2\%\dagger}$
DeepArch	$0.0000^{-100.0\%\dagger}$	$0.3346^{-32.9\%\dagger}$	$0.4360^{-16.8\%\dagger}$	$0.7843^{-4.6\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0262^{-91.8\%\dagger}$	$0.0922^{-67.7\%\dagger}$	$0.2319^{-11.3\%\dagger}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.5599^{+19.4\%\dagger}$	$0.6370^{+25.5\%\dagger}$	$0.8631^{+6.2\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.4737^{+54.7\%\dagger}$	$0.4780^{+67.5\%\dagger}$	$0.3281^{+26.7\%\dagger}$
Hadoop	$0.8433^{+65.4\%\dagger}$	$0.8389^{+72.9\%\dagger}$	$0.7891^{+55.2\%\dagger}$	$0.9294^{+13.6\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.7702^{+188.0\%\dagger}$	$0.3883^{+52.4\%\dagger}$
MariaDB	$0.2000^{-62.3\%\dagger}$	$0.3737^{-27.0\%\dagger}$	$0.4745^{-11.4\%\dagger}$	$0.8016^{-3.4\%\dagger}$	$0.0667^{-89.5\%\dagger}$	$0.1392^{-61.7\%\dagger}$	$0.2172^{-30.8\%\dagger}$	$0.2627^{-2.3\%}$
MongoDB	$0.9700^{+85.4\%\dagger}$	$0.9459^{+90.4\%\dagger}$	$0.8994^{+75.5\%\dagger}$	$0.9609^{+16.9\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9967^{+199.4\%\dagger}$	$0.8930^{+216.7\%\dagger}$	$0.4173^{+60.2\%\dagger}$
PostgreSQL	$0.4900^{+20.5\%}$	$0.5110^{+8.7\%}$	$0.5239^{-0.0\%}$	$0.8185^{-0.1\%}$	$0.9000^{+107.7\%\dagger}$	$0.3885^{+31.4\%\star}$	$0.3335^{+17.8\%\star}$	$0.2607^{-0.9\%}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8776^{+73.3\%\dagger}$	$0.8008^{+52.1\%\dagger}$	$0.9301^{+12.7\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8693^{+164.5\%\dagger}$	$0.6469^{+122.9\%\dagger}$	$0.3323^{+26.5\%\dagger}$
Spark	$0.6800^{+72.9\%\dagger}$	$0.5732^{+16.0\%\star}$	$0.5954^{+12.3\%\star}$	$0.8501^{+3.4\%\star}$	$0.6333^{+35.7\%}$	$0.2259^{-34.2\%\star}$	$0.2227^{-29.0\%\star}$	$0.2470^{-8.3\%\star}$
Storm	$0.8067^{+106.8\%\dagger}$	$0.8814^{+87.5\%\dagger}$	$0.8089^{+56.3\%\dagger}$	$0.9290^{+13.7\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.8902^{+207.4\%\dagger}$	$0.6829^{+145.7\%\dagger}$	$0.3667^{+41.4\%\dagger}$
HSMGP	$0.2100^{-59.4\%\dagger}$	$0.4498^{-14.7\%\dagger}$	$0.5827^{+7.9\%\star}$	$0.8370^{+0.8\%}$	$0.0333^{-94.1\%\dagger}$	$0.2087^{-43.5\%\dagger}$	$0.3070^{-1.9\%}$	$0.2969^{+11.0\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.4255^{-10.7\%\star}$	$0.4588^{-12.1\%\dagger}$	$0.7954^{-2.7\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0103^{-96.5\%\dagger}$	$0.0326^{-88.9\%\dagger}$	$0.1850^{-30.0\%\dagger}$
HIPAcc	$0.7567^{+61.0\%\dagger}$	$0.7396^{+58.3\%\dagger}$	$0.7359^{+45.8\%\dagger}$	$0.9091^{+11.5\%\dagger}$	$0.8000^{+50.0\%\star}$	$0.6625^{+132.7\%\dagger}$	$0.5849^{+123.6\%\dagger}$	$0.3575^{+39.9\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.8316^{+81.2\%\dagger}$	$0.7326^{+44.1\%\dagger}$	$0.9023^{+10.8\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7049^{+156.5\%\dagger}$	$0.4812^{+81.9\%\dagger}$	$0.3013^{+17.4\%\dagger}$
JavaGC	$0.5500^{+13.8\%}$	$0.5901^{+22.0\%\star}$	$0.6662^{+28.6\%\dagger}$	$0.8645^{+5.4\%\dagger}$	$0.6333^{+18.8\%}$	$0.4787^{+74.3\%\dagger}$	$0.4933^{+93.1\%\dagger}$	$0.3209^{+26.1\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.8951^{+88.1\%\dagger}$	$0.8127^{+57.2\%\dagger}$	$0.9396^{+14.8\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.8289^{+192.6\%\dagger}$	$0.6551^{+144.6\%\dagger}$	$0.3688^{+42.3\%\dagger}$
Average	$\mathbf{0.6285}^{+41.5\%\dagger}$	$\mathbf{0.6651}^{+37.4\%\dagger}$	$\mathbf{0.6606}^{+27.6\%\dagger}$	$\mathbf{0.8737}^{+6.6\%\dagger}$	$\mathbf{0.7111}^{+48.3\%\dagger}$	$\mathbf{0.5583}^{+81.0\%\dagger}$	$\mathbf{0.4660}^{+65.3\%\dagger}$	$\mathbf{0.3101}^{+19.0\%\dagger}$

Table 11: Performance comparison for feature combination Kur+NBC on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.2925^{-37.3\%\star}$	$0.2992^{-38.8\%\dagger}$	$0.3651^{-29.6\%\dagger}$	$0.7569^{-7.8\%\dagger}$	$0.2000^{-62.5\%\star}$	$0.1109^{-63.4\%\dagger}$	$0.1210^{-56.9\%\dagger}$	$0.2029^{-21.7\%\dagger}$
7z	$0.8033^{+91.3\%\dagger}$	$0.7163^{+56.8\%\dagger}$	$0.7235^{+45.1\%\dagger}$	$0.8988^{+10.7\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.5071^{+70.4\%\dagger}$	$0.4666^{+68.0\%\dagger}$	$0.2976^{+14.9\%\dagger}$
DConvert	$0.9833^{+126.9\%\dagger}$	$0.6556^{+38.4\%\dagger}$	$0.6275^{+23.6\%\dagger}$	$0.8747^{+7.2\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.6208^{+120.3\%\dagger}$	$0.4575^{+73.7\%\dagger}$	$0.3039^{+19.5\%\dagger}$
DeepArch	$0.3867^{-8.7\%}$	$0.3655^{-26.7\%\dagger}$	$0.4619^{-11.8\%\star}$	$0.8013^{-2.5\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0902^{-71.8\%\dagger}$	$0.1155^{-59.5\%\dagger}$	$0.2425^{-7.3\%\star}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.4628^{-1.3\%}$	$0.6078^{+19.7\%\dagger}$	$0.8498^{+4.5\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.3255^{+6.3\%}$	$0.4206^{+47.3\%\dagger}$	$0.3036^{+17.2\%\dagger}$
Hadoop	$0.8933^{+75.2\%\dagger}$	$0.8621^{+77.7\%\dagger}$	$0.8246^{+62.2\%\dagger}$	$0.9389^{+14.8\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.8460^{+216.3\%\dagger}$	$0.4060^{+59.3\%\dagger}$
MariaDB	$0.2467^{-53.5\%\dagger}$	$0.4437^{-13.3\%\star}$	$0.5043^{-5.9\%\star}$	$0.8086^{-2.5\%\star}$	$0.0333^{-94.7\%\dagger}$	$0.2189^{-39.7\%\dagger}$	$0.2225^{-29.1\%\dagger}$	$0.2533^{-5.8\%\star}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9614^{+93.6\%\dagger}$	$0.9054^{+76.7\%\dagger}$	$0.9670^{+17.6\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9827^{+195.2\%\dagger}$	$0.8539^{+202.9\%\dagger}$	$0.4126^{+58.4\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5976^{+27.1\%\dagger}$	$0.5870^{+12.0\%\dagger}$	$0.8377^{+2.3\%\star}$	$1.0000^{+130.8\%\dagger}$	$0.6962^{+135.5\%\dagger}$	$0.5635^{+99.1\%\dagger}$	$0.3077^{+17.0\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8808^{+73.9\%\dagger}$	$0.8038^{+52.7\%\dagger}$	$0.9329^{+13.1\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8416^{+156.0\%\dagger}$	$0.6206^{+113.9\%\dagger}$	$0.3307^{+25.9\%\dagger}$
Spark	$0.8533^{+116.9\%\dagger}$	$0.6703^{+35.7\%\dagger}$	$0.6415^{+20.9\%\dagger}$	$0.8704^{+5.9\%\dagger}$	$0.9333^{+100.0\%\dagger}$	$0.4357^{+27.0\%\star}$	$0.3346^{+6.6\%}$	$0.2649^{-1.6\%}$
Storm	$0.8467^{+117.1\%\dagger}$	$0.7849^{+66.9\%\dagger}$	$0.7526^{+45.4\%\dagger}$	$0.9107^{+11.4\%\dagger}$	$0.9667^{+163.6\%\dagger}$	$0.7365^{+154.3\%\dagger}$	$0.6096^{+119.3\%\dagger}$	$0.3449^{+33.0\%\dagger}$
HSMGP	$0.3400^{-34.2\%\star}$	$0.5454^{+3.4\%}$	$0.6650^{+23.1\%\dagger}$	$0.8582^{+3.3\%\dagger}$	$0.4667^{-17.6\%}$	$0.3876^{+4.9\%}$	$0.4995^{+59.6\%\dagger}$	$0.3320^{+24.1\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.4343^{-8.9\%}$	$0.4795^{-8.2\%\star}$	$0.8022^{-1.9\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0095^{-96.8\%\dagger}$	$0.0482^{-83.5\%\dagger}$	$0.1940^{-26.6\%\dagger}$
HIPAcc	$0.7733^{+64.5\%\dagger}$	$0.7524^{+61.0\%\dagger}$	$0.7925^{+57.0\%\dagger}$	$0.9175^{+12.5\%\dagger}$	$0.9667^{+81.2\%\dagger}$	$0.7796^{+173.3\%\dagger}$	$0.6795^{+159.8\%\dagger}$	$0.3870^{+51.4\%\dagger}$
SQL	$0.8567^{+108.9\%\dagger}$	$0.9712^{+111.6\%\dagger}$	$0.7171^{+41.0\%\dagger}$	$0.9068^{+11.4\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$1.0000^{+263.8\%\dagger}$	$0.5245^{+98.2\%\dagger}$	$0.3042^{+18.6\%\dagger}$
JavaGC	$0.9167^{+89.7\%\dagger}$	$0.7847^{+62.2\%\dagger}$	$0.7412^{+43.1\%\dagger}$	$0.9040^{+10.2\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.7582^{+176.1\%\dagger}$	$0.6147^{+140.6\%\dagger}$	$0.3336^{+31.1\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.8555^{+79.8\%\dagger}$	$0.8430^{+63.1\%\dagger}$	$0.9399^{+14.8\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.8108^{+186.2\%\dagger}$	$0.7240^{+170.4\%\dagger}$	$0.3673^{+41.7\%\dagger}$
Average	$\mathbf{0.7051}^{+58.7\%\dagger}$	$\mathbf{0.6691}^{+38.3\%\dagger}$	$\mathbf{0.6691}^{+29.2\%\dagger}$	$\mathbf{0.8765}^{+6.9\%\dagger}$	$\mathbf{0.7537}^{+57.1\%\dagger}$	$\mathbf{0.5729}^{+85.7\%\dagger}$	$\mathbf{0.4846}^{+71.9\%\dagger}$	$\mathbf{0.3105}^{+19.2\%\dagger}$

Table 12: Performance comparison for feature combination Kur+PLO on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.4800^{+2.9\%}$	$0.5351^{+9.4\%\star}$	$0.4673^{-9.9\%\star}$	$0.7992^{-2.6\%\star}$	$0.9333^{+75.0\%\dagger}$	$0.5095^{+68.1\%\dagger}$	$0.3173^{+13.0\%}$	$0.2370^{-8.5\%\dagger}$
7z	$0.9000^{+114.3\%\dagger}$	$0.8467^{+85.4\%\dagger}$	$0.7944^{+59.3\%\dagger}$	$0.9260^{+14.0\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.8299^{+178.8\%\dagger}$	$0.6556^{+136.1\%\dagger}$	$0.3387^{+30.8\%\dagger}$
DConvert	$0.6567^{+51.5\%\star}$	$0.6525^{+37.7\%\dagger}$	$0.6471^{+27.4\%\dagger}$	$0.8743^{+7.2\%\dagger}$	$0.5000^{0.0\%}$	$0.5180^{+83.8\%\dagger}$	$0.4744^{+80.2\%\dagger}$	$0.3170^{+24.6\%\dagger}$
DeepArch	$0.4500^{+6.3\%}$	$0.5009^{+0.4\%}$	$0.5466^{+4.3\%}$	$0.8347^{+1.6\%}$	$0.2000^{-45.5\%}$	$0.1590^{-50.3\%\dagger}$	$0.2115^{-25.8\%\star}$	$0.2561^{-2.1\%}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.4788^{+2.1\%}$	$0.6503^{+28.1\%\dagger}$	$0.8522^{+4.8\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.3460^{+13.0\%}$	$0.4918^{+72.3\%\dagger}$	$0.3045^{+17.6\%\dagger}$
Hadoop	$0.8933^{+75.2\%\dagger}$	$0.8537^{+76.0\%\dagger}$	$0.8045^{+58.3\%\dagger}$	$0.9393^{+14.8\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.7744^{+189.6\%\dagger}$	$0.4009^{+57.4\%\dagger}$
MariaDB	$0.3500^{-34.0\%\star}$	$0.3944^{-22.9\%\dagger}$	$0.4773^{-10.9\%\dagger}$	$0.8078^{-2.6\%\star}$	$0.6333^{0.0\%}$	$0.1546^{-57.4\%\dagger}$	$0.1613^{-48.6\%\dagger}$	$0.2491^{-7.4\%\dagger}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9714^{+95.6\%\dagger}$	$0.8922^{+74.1\%\dagger}$	$0.9669^{+17.6\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.8085^{+186.8\%\dagger}$	$0.4083^{+56.7\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5263^{+12.0\%}$	$0.5717^{+9.1\%\star}$	$0.8268^{+0.9\%}$	$1.0000^{+130.8\%\dagger}$	$0.5251^{+77.6\%\dagger}$	$0.4897^{+73.0\%\dagger}$	$0.2916^{+10.8\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8875^{+75.2\%\dagger}$	$0.8553^{+62.4\%\dagger}$	$0.9412^{+14.1\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8894^{+170.6\%\dagger}$	$0.6839^{+135.7\%\dagger}$	$0.3372^{+28.3\%\dagger}$
Spark	$0.4100^{+4.2\%}$	$0.4623^{-6.4\%}$	$0.4753^{-10.4\%\star}$	$0.8090^{-1.6\%}$	$0.1000^{-78.6\%\star}$	$0.1779^{-48.1\%\dagger}$	$0.1702^{-45.8\%\dagger}$	$0.2275^{-15.5\%\dagger}$
Storm	$0.8867^{+127.4\%\dagger}$	$0.8419^{+79.1\%\dagger}$	$0.7591^{+46.7\%\dagger}$	$0.9192^{+12.5\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.8040^{+177.7\%\dagger}$	$0.5617^{+102.1\%\dagger}$	$0.3280^{+26.5\%\dagger}$
HSMGP	$0.5000^{-3.2\%}$	$0.5437^{+3.1\%}$	$0.6125^{+13.4\%\dagger}$	$0.8535^{+2.7\%\star}$	$1.0000^{+76.5\%\dagger}$	$0.4369^{+18.3\%}$	$0.3986^{+27.3\%\star}$	$0.3092^{+15.5\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.3904^{-18.1\%\dagger}$	$0.4545^{-13.0\%\dagger}$	$0.7942^{-2.9\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0263^{-91.1\%\dagger}$	$0.0648^{-77.8\%\dagger}$	$0.1990^{-24.8\%\dagger}$
HIPAcc	$0.4967^{+5.7\%}$	$0.7376^{+57.8\%\dagger}$	$0.7717^{+52.9\%\dagger}$	$0.9056^{+11.0\%\dagger}$	$0.2000^{-62.5\%\star}$	$0.5223^{+83.1\%\dagger}$	$0.5385^{+105.9\%\dagger}$	$0.3364^{+31.6\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.7272^{+58.5\%\dagger}$	$0.6788^{+33.5\%\dagger}$	$0.8792^{+8.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.5461^{+98.7\%\dagger}$	$0.4177^{+57.9\%\dagger}$	$0.2813^{+9.6\%\dagger}$
JavaGC	$0.0333^{-93.1\%\dagger}$	$0.5446^{+12.6\%\star}$	$0.5596^{+8.0\%\star}$	$0.8251^{+0.6\%}$	$0.0333^{-93.8\%\dagger}$	$0.3962^{+44.3\%\dagger}$	$0.3689^{+44.4\%\dagger}$	$0.2850^{+12.0\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.9333^{+96.1\%\dagger}$	$0.8336^{+61.3\%\dagger}$	$0.9495^{+16.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.8916^{+214.7\%\dagger}$	$0.6672^{+149.1\%\dagger}$	$0.3719^{+43.4\%\dagger}$
Average	$\mathbf{0.6365}^{+43.3\%\dagger}$	$\mathbf{0.6571}^{+35.8\%\dagger}$	$\mathbf{0.6584}^{+27.1\%\dagger}$	$\mathbf{0.8724}^{+6.4\%\dagger}$	$\mathbf{0.7000}^{+45.9\%\dagger}$	$\mathbf{0.5407}^{+75.3\%\dagger}$	$\mathbf{0.4587}^{+62.7\%\dagger}$	$\mathbf{0.3044}^{+16.8\%\dagger}$

Table 13: Performance comparison for feature combination Ske+CL on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.4800^{+2.9\%}$	$0.4922^{+0.7\%}$	$0.4787^{-7.7\%\star}$	$0.7926^{-3.4\%\dagger}$	$0.9333^{+75.0\%\dagger}$	$0.4348^{+43.5\%\dagger}$	$0.3178^{+13.2\%}$	$0.2342^{-9.6\%\dagger}$
7z	$0.9000^{+114.3\%\dagger}$	$0.7962^{+74.3\%\dagger}$	$0.7804^{+56.5\%\dagger}$	$0.9151^{+12.7\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.7434^{+149.7\%\dagger}$	$0.6469^{+132.9\%\dagger}$	$0.3363^{+29.9\%\dagger}$
DConvert	$0.8733^{+101.5\%\dagger}$	$0.7594^{+60.3\%\dagger}$	$0.7078^{+39.4\%\dagger}$	$0.9157^{+12.2\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.7394^{+162.4\%\dagger}$	$0.5724^{+117.4\%\dagger}$	$0.3576^{+40.6\%\dagger}$
DeepArch	$0.3800^{-10.2\%}$	$0.3653^{-26.7\%\dagger}$	$0.4566^{-12.9\%\dagger}$	$0.8022^{-2.4\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0271^{-91.5\%\dagger}$	$0.1098^{-61.5\%\dagger}$	$0.2410^{-7.8\%\star}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.4556^{-2.8\%}$	$0.6270^{+23.5\%\dagger}$	$0.8483^{+4.3\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.3439^{+12.3\%}$	$0.4551^{+59.4\%\dagger}$	$0.3050^{+17.8\%\dagger}$
Hadoop	$0.9000^{+76.5\%\dagger}$	$0.8155^{+68.1\%\dagger}$	$0.8636^{+69.9\%\dagger}$	$0.9353^{+14.3\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.9267^{+246.5\%\dagger}$	$0.4124^{+61.9\%\dagger}$
MariaDB	$0.5167^{-2.5\%}$	$0.5777^{+12.9\%\star}$	$0.5960^{+11.2\%\star}$	$0.8517^{+2.7\%\star}$	$0.8667^{+36.8\%\star}$	$0.4661^{+28.4\%\star}$	$0.3528^{+12.4\%\star}$	$0.2926^{+8.7\%\dagger}$
MongoDB	$0.9933^{+89.8\%\dagger}$	$0.9292^{+87.1\%\dagger}$	$0.8768^{+71.1\%\dagger}$	$0.9596^{+16.7\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9293^{+179.2\%\dagger}$	$0.8275^{+193.5\%\dagger}$	$0.4013^{+54.0\%\dagger}$
PostgreSQL	$0.5067^{+24.6\%\star}$	$0.5566^{+18.4\%\star}$	$0.5791^{+10.5\%\dagger}$	$0.8335^{+1.8\%}$	$1.0000^{+130.8\%\dagger}$	$0.4593^{+55.4\%\dagger}$	$0.3973^{+40.4\%\dagger}$	$0.2782^{+5.8\%\star}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8747^{+72.7\%\dagger}$	$0.8147^{+54.7\%\dagger}$	$0.9281^{+12.5\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8400^{+155.6\%\dagger}$	$0.6236^{+114.9\%\dagger}$	$0.3168^{+20.6\%\dagger}$
Spark	$0.8833^{+124.6\%\dagger}$	$0.5904^{+19.5\%\star}$	$0.6155^{+16.1\%\star}$	$0.8615^{+4.8\%\dagger}$	$0.9667^{+107.1\%\dagger}$	$0.2902^{-15.4\%}$	$0.2725^{-13.1\%}$	$0.2629^{-2.4\%}$
Storm	$0.7200^{+84.6\%\dagger}$	$0.7014^{+49.2\%\dagger}$	$0.7158^{+38.3\%\dagger}$	$0.8897^{+8.9\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.6625^{+128.8\%\dagger}$	$0.5707^{+105.3\%\dagger}$	$0.3361^{+29.6\%\dagger}$
HSMGP	$0.4200^{-18.7\%}$	$0.5212^{-1.2\%}$	$0.6060^{+12.2\%\dagger}$	$0.8435^{+1.5\%}$	$0.7333^{+29.4\%}$	$0.3546^{-4.0\%}$	$0.3646^{+16.5\%}$	$0.2892^{+8.1\%\star}$
XGBoost	$0.4000^{+16.5\%}$	$0.3850^{-19.3\%\dagger}$	$0.4644^{-11.1\%\dagger}$	$0.7965^{-2.6\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0113^{-96.2\%\dagger}$	$0.0500^{-82.9\%\dagger}$	$0.1942^{-26.6\%\dagger}$
HIPAcc	$0.8967^{+90.8\%\dagger}$	$0.9224^{+97.4\%\dagger}$	$0.8208^{+62.6\%\dagger}$	$0.9472^{+16.1\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.8926^{+212.9\%\dagger}$	$0.6229^{+138.2\%\dagger}$	$0.3755^{+46.9\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.8220^{+79.1\%\dagger}$	$0.7048^{+38.6\%\dagger}$	$0.8957^{+10.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.6780^{+146.7\%\dagger}$	$0.4438^{+67.7\%\dagger}$	$0.2899^{+13.0\%\dagger}$
JavaGC	$0.6600^{+36.6\%}$	$0.6285^{+29.9\%\dagger}$	$0.5957^{+15.0\%\dagger}$	$0.8618^{+5.0\%\dagger}$	$0.9000^{+68.8\%\star}$	$0.5283^{+92.4\%\dagger}$	$0.4048^{+58.4\%\dagger}$	$0.2977^{+17.0\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.8264^{+73.7\%\dagger}$	$0.7912^{+53.1\%\dagger}$	$0.9332^{+14.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7053^{+148.9\%\dagger}$	$0.5793^{+116.3\%\dagger}$	$0.3482^{+34.3\%\dagger}$
Average	$\mathbf{0.7239}^{+62.9\%\dagger}$	$\mathbf{0.6678}^{+38.0\%\dagger}$	$\mathbf{0.6719}^{+29.7\%\dagger}$	$\mathbf{0.8784}^{+7.2\%\dagger}$	$\mathbf{0.8556}^{+78.4\%\dagger}$	$\mathbf{0.5614}^{+82.0\%\dagger}$	$\mathbf{0.4744}^{+68.2\%\dagger}$	$\mathbf{0.3094}^{+18.8\%\dagger}$

Table 14: Performance comparison for feature combination Ske+MIE on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.2400^{-48.6\%\dagger}$	$0.5231^{+7.0\%}$	$0.4608^{-11.2\%\star}$	$0.7916^{-3.5\%\dagger}$	$0.1000^{-81.2\%\dagger}$	$0.5064^{+67.1\%\dagger}$	$0.3068^{+9.3\%}$	$0.2359^{-8.9\%\dagger}$
7z	$0.9000^{+114.3\%\dagger}$	$0.8584^{+87.9\%\dagger}$	$0.7845^{+57.3\%\dagger}$	$0.9218^{+13.5\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.8242^{+176.9\%\dagger}$	$0.6559^{+136.2\%\dagger}$	$0.3316^{+28.1\%\dagger}$
DConvert	$0.5083^{+17.3\%}$	$0.6133^{+29.5\%\dagger}$	$0.6620^{+30.4\%\dagger}$	$0.8716^{+6.8\%\dagger}$	$0.5667^{+13.3\%}$	$0.5106^{+81.2\%\dagger}$	$0.5165^{+96.2\%\dagger}$	$0.3345^{+31.5\%\dagger}$
DeepArch	$0.1600^{-62.2\%\star}$	$0.3878^{-22.2\%\dagger}$	$0.4810^{-8.2\%\star}$	$0.8004^{-2.6\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0461^{-85.6\%\dagger}$	$0.1385^{-51.4\%\dagger}$	$0.2411^{-7.8\%\star}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.5422^{+15.7\%\star}$	$0.6567^{+29.4\%\dagger}$	$0.8673^{+6.7\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.4233^{+38.2\%\star}$	$0.5181^{+81.5\%\dagger}$	$0.3333^{+28.7\%\dagger}$
Hadoop	$0.9000^{+76.5\%\dagger}$	$0.8593^{+77.1\%\dagger}$	$0.8382^{+64.9\%\dagger}$	$0.9401^{+14.9\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+225.6\%\dagger}$	$0.8526^{+218.8\%\dagger}$	$0.4070^{+59.8\%\dagger}$
MariaDB	$0.3733^{-29.6\%\star}$	$0.5331^{+4.2\%}$	$0.5597^{+4.5\%\star}$	$0.8416^{+1.5\%}$	$0.6000^{-5.3\%}$	$0.3460^{-4.7\%}$	$0.3015^{-3.9\%}$	$0.2913^{+8.3\%\dagger}$
MongoDB	$0.8667^{+65.6\%\dagger}$	$0.9594^{+93.2\%\dagger}$	$0.9008^{+75.8\%\dagger}$	$0.9601^{+16.8\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$1.0000^{+200.4\%\dagger}$	$0.9104^{+222.9\%\dagger}$	$0.4215^{+61.8\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.4818^{+2.5\%}$	$0.5314^{+1.4\%}$	$0.8126^{-0.8\%}$	$1.0000^{+130.8\%\dagger}$	$0.4339^{+46.7\%\dagger}$	$0.3842^{+35.8\%\dagger}$	$0.2706^{+2.8\%}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8711^{+72.0\%\dagger}$	$0.8535^{+62.1\%\dagger}$	$0.9368^{+13.5\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.8352^{+154.1\%\dagger}$	$0.6875^{+136.9\%\dagger}$	$0.3347^{+27.4\%\dagger}$
Spark	$0.7483^{+90.3\%\dagger}$	$0.6311^{+27.8\%\dagger}$	$0.6014^{+13.4\%\dagger}$	$0.8576^{+4.3\%\dagger}$	$0.7333^{+57.1\%\star}$	$0.3629^{+5.8\%}$	$0.2896^{-7.7\%}$	$0.2566^{-4.7\%}$
Storm	$0.8600^{+120.5\%\dagger}$	$0.7304^{+55.3\%\dagger}$	$0.7221^{+39.5\%\dagger}$	$0.9001^{+10.1\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.6682^{+130.8\%\dagger}$	$0.5282^{+90.1\%\dagger}$	$0.3296^{+27.1\%\dagger}$
HSMGP	$0.3333^{-35.5\%\star}$	$0.4825^{-8.5\%\star}$	$0.5835^{+8.0\%\star}$	$0.8430^{+1.5\%}$	$0.4333^{-23.5\%}$	$0.2984^{-19.2\%\star}$	$0.3362^{+7.4\%}$	$0.3030^{+13.2\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.3942^{-17.3\%\dagger}$	$0.4393^{-15.9\%\dagger}$	$0.7936^{-2.9\%\dagger}$	$0.0000^{-100.0\%\dagger}$	$0.0045^{-98.5\%\dagger}$	$0.0284^{-90.3\%\dagger}$	$0.1899^{-28.2\%\dagger}$
HIPAcc	$0.5933^{+26.2\%}$	$0.7200^{+54.1\%\dagger}$	$0.7598^{+50.5\%\dagger}$	$0.9050^{+11.0\%\dagger}$	$0.7000^{+31.2\%}$	$0.6774^{+137.4\%\dagger}$	$0.6502^{+148.6\%\dagger}$	$0.3749^{+46.7\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.6461^{+40.8\%\dagger}$	$0.6696^{+31.7\%\dagger}$	$0.8737^{+7.3\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.4419^{+60.8\%\dagger}$	$0.4193^{+58.5\%\dagger}$	$0.2896^{+12.9\%\dagger}$
JavaGC	$0.6872^{+42.2\%\star}$	$0.5122^{+5.9\%}$	$0.5911^{+14.1\%\dagger}$	$0.8468^{+3.2\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.3636^{+32.4\%\star}$	$0.4080^{+59.7\%\dagger}$	$0.2967^{+16.6\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.8371^{+75.9\%\dagger}$	$0.7739^{+49.7\%\dagger}$	$0.9281^{+13.4\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.7195^{+154.0\%\dagger}$	$0.5407^{+101.9\%\dagger}$	$0.3340^{+28.9\%\dagger}$
Average	$\mathbf{0.6428}^{+44.7\%\dagger}$	$\mathbf{0.6435}^{+33.0\%\dagger}$	$\mathbf{0.6594}^{+27.3\%\dagger}$	$\mathbf{0.8718}^{+6.4\%\dagger}$	$\mathbf{0.7296}^{+52.1\%\dagger}$	$\mathbf{0.5257}^{+70.4\%\dagger}$	$\mathbf{0.4707}^{+66.9\%\dagger}$	$\mathbf{0.3098}^{+18.9\%\dagger}$

Table 15: Performance comparison for feature combination Ske+NBC on batch data

System	NDCG@1	NDCG@10	NDCG@20	NDCG(all)	AP@1	AP@10	AP@20	MAP(all)
Apache	$0.4000^{-14.3\%}$	$0.4347^{-11.1\%}$	$0.4013^{-22.7\%\dagger}$	$0.7772^{-5.3\%\dagger}$	$0.6667^{+25.0\%}$	$0.2959^{-2.4\%}$	$0.1882^{-33.0\%\dagger}$	$0.2142^{-17.3\%\dagger}$
7z	$0.9000^{+114.3\%\dagger}$	$0.7427^{+62.6\%\dagger}$	$0.7566^{+51.8\%\dagger}$	$0.9037^{+11.3\%\dagger}$	$1.0000^{+114.3\%\dagger}$	$0.6422^{+115.8\%\dagger}$	$0.5577^{+100.8\%\dagger}$	$0.3073^{+18.7\%\dagger}$
DConvert	$0.8767^{+102.3\%\dagger}$	$0.6128^{+29.4\%\dagger}$	$0.6292^{+23.9\%\dagger}$	$0.8698^{+6.6\%\dagger}$	$0.9333^{+86.7\%\dagger}$	$0.4967^{+76.3\%\dagger}$	$0.4358^{+65.5\%\dagger}$	$0.3021^{+18.8\%\dagger}$
DeepArch	$0.3800^{-10.2\%}$	$0.4307^{-13.6\%\star}$	$0.4816^{-8.1\%\star}$	$0.8147^{-0.9\%}$	$0.0667^{-81.8\%\star}$	$0.1500^{-53.1\%\dagger}$	$0.1624^{-43.0\%\dagger}$	$0.2496^{-4.6\%}$
ExaStencils	$0.7000^{+84.2\%\dagger}$	$0.5020^{+7.1\%}$	$0.6742^{+32.8\%\dagger}$	$0.8726^{+7.3\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.4072^{+33.0\%\star}$	$0.5267^{+84.5\%\dagger}$	$0.3304^{+27.6\%\dagger}$
Hadoop	$0.9533^{+86.9\%\dagger}$	$0.8753^{+80.5\%\dagger}$	$0.9009^{+77.2\%\dagger}$	$0.9521^{+16.4\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9366^{+205.0\%\dagger}$	$0.9119^{+241.0\%\dagger}$	$0.4114^{+61.5\%\dagger}$
MariaDB	$0.5000^{-5.7\%}$	$0.5230^{+2.2\%}$	$0.5499^{+2.6\%}$	$0.8327^{+0.4\%}$	$1.0000^{+57.9\%\dagger}$	$0.3381^{-6.9\%}$	$0.2831^{-9.8\%}$	$0.2658^{-1.2\%}$
MongoDB	$1.0000^{+91.1\%\dagger}$	$0.9650^{+94.3\%\dagger}$	$0.8948^{+74.7\%\dagger}$	$0.9626^{+17.1\%\dagger}$	$1.0000^{+66.7\%\dagger}$	$0.9857^{+196.1\%\dagger}$	$0.8461^{+200.1\%\dagger}$	$0.4105^{+57.6\%\dagger}$
PostgreSQL	$0.5000^{+23.0\%}$	$0.5839^{+24.2\%\dagger}$	$0.5801^{+10.7\%\star}$	$0.8355^{+2.0\%\star}$	$1.0000^{+130.8\%\dagger}$	$0.6799^{+130.0\%\dagger}$	$0.5299^{+87.2\%\dagger}$	$0.2996^{+13.9\%\dagger}$
Redis	$0.9000^{+86.2\%\dagger}$	$0.8532^{+68.5\%\dagger}$	$0.8506^{+61.5\%\dagger}$	$0.9373^{+13.6\%\dagger}$	$1.0000^{+100.0\%\dagger}$	$0.7930^{+141.3\%\dagger}$	$0.6891^{+137.5\%\dagger}$	$0.3352^{+27.6\%\dagger}$
Spark	$0.6633^{+68.6\%\dagger}$	$0.5447^{+10.3\%}$	$0.5895^{+11.2\%\star}$	$0.8435^{+2.6\%\star}$	$0.6333^{+35.7\%}$	$0.2687^{-21.7\%}$	$0.2797^{-10.9\%}$	$0.2518^{-6.5\%}$
Storm	$0.5633^{+44.4\%\star}$	$0.6238^{+32.7\%\dagger}$	$0.6346^{+22.6\%\dagger}$	$0.8601^{+5.2\%\dagger}$	$1.0000^{+172.7\%\dagger}$	$0.5301^{+83.1\%\dagger}$	$0.4491^{+61.6\%\dagger}$	$0.3042^{+17.3\%\dagger}$
HSMGP	$0.4600^{-11.0\%}$	$0.5412^{+2.6\%}$	$0.6523^{+20.8\%\dagger}$	$0.8602^{+3.5\%\dagger}$	$0.8000^{+41.2\%}$	$0.4235^{+14.6\%}$	$0.4986^{+59.3\%\dagger}$	$0.3319^{+24.0\%\dagger}$
XGBoost	$0.4000^{+16.5\%}$	$0.3867^{-18.9\%\dagger}$	$0.4636^{-11.2\%\dagger}$	$0.7986^{-2.3\%\star}$	$0.0000^{-100.0\%\dagger}$	$0.0041^{-98.6\%\dagger}$	$0.0537^{-81.7\%\dagger}$	$0.1985^{-25.0\%\dagger}$
HIPAcc	$0.8233^{+75.2\%\dagger}$	$0.9003^{+92.7\%\dagger}$	$0.8547^{+69.3\%\dagger}$	$0.9478^{+16.2\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.9057^{+217.5\%\dagger}$	$0.7438^{+184.4\%\dagger}$	$0.4018^{+57.2\%\dagger}$
SQL	$0.9000^{+119.5\%\dagger}$	$0.9502^{+107.0\%\dagger}$	$0.7295^{+43.5\%\dagger}$	$0.9073^{+11.4\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.9446^{+243.7\%\dagger}$	$0.5135^{+94.1\%\dagger}$	$0.3051^{+18.9\%\dagger}$
JavaGC	$0.9000^{+86.2\%\dagger}$	$0.7052^{+45.7\%\dagger}$	$0.6490^{+25.3\%\dagger}$	$0.8871^{+8.1\%\dagger}$	$1.0000^{+87.5\%\dagger}$	$0.6097^{+122.0\%\dagger}$	$0.4509^{+76.5\%\dagger}$	$0.3038^{+19.4\%\dagger}$
Polly	$1.0000^{+141.9\%\dagger}$	$0.9212^{+93.6\%\dagger}$	$0.8433^{+63.2\%\dagger}$	$0.9498^{+16.0\%\dagger}$	$1.0000^{+150.0\%\dagger}$	$0.8921^{+214.9\%\dagger}$	$0.7095^{+164.9\%\dagger}$	$0.3706^{+43.0\%\dagger}$
Average	$\mathbf{0.7122}^{+60.3\%\dagger}$	$\mathbf{0.6720}^{+38.9\%\dagger}$	$\mathbf{0.6742}^{+30.2\%\dagger}$	$\mathbf{0.8785}^{+7.2\%\dagger}$	$\mathbf{0.8389}^{+74.9\%\dagger}$	$\mathbf{0.5724}^{+85.6\%\dagger}$	$\mathbf{0.4905}^{+74.0\%\dagger}$	$\mathbf{0.3108}^{+19.3\%\dagger}$

Table 16: Performance comparison for feature combination Ske+PLO on batch data