MioHash: A Memory-Efficient and I/O-Optimized Hashing Index on Hybrid PMem-DARM Memories

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SH	ps/s) Thread=1	2 067467027	4 2 54120275	8 5 265225162	16 5 601201605	24 5 560427000
H	1.080309792 0.6927915	2.067467027 1.33181725	3.54139375 2.43652025	5.265225163 4.08677525	5.601201605 5.44514925	5.560437909 5.66926275
l	0.517253332	0.566679181	0.706762602	0.864436573	1.014259263	1.056101841
el 1	0.14161 0.438103	0.272089 0.83422125	0.504664 1.6048145	0.903298 2.4292295	1.399661 4.294831	1.716833 5.97354325
r	1.916868	3.51213	6.477029	9.194919	12.335607	13.04946
ash rm Positive Search Throug	2.523302 about (I Thread=1	4.3044485 2	7.770145 4	11.19255225 8	16.8236075 16	19.88255167 24
H	3.333146	5.646048	9.280315	13.539036	17.525591	18.408078
:H	2.145908	4.352373	9.02399	15.176016	19.615334	20.702171
el rel	1.050534 0.990972	1.738362 1.81147	3.092409 3.56415	4.906786 6.773919	6.404106 12.12053	7.143704 16.35713
sh	0.66246525	1.2985415	2.479261	3.4266955	6.18491075	9.49267075
er Hash	2.096916 3.134054	4.012847 6.22590625	8.116097 12.229869	12.593406 14.0550155	25.527122 26.7947485	37.48872 38.912764
orm Negative Search Throu		2	4	8	16	24
SH	3.33464	5.642306	9.312879	13.537437	17.621648	18.535994
EH ⁄el	0.715493 1.051344	1.414038 1.735256	2.708599 3.113679	4.740526 4.901411	7.459968 6.449082	7.946879 7.051144
vel	0.811196	1.542197	3.005827	5.733635	10.279313	13.616402
sh	0.92998575	1.8471755	3.605941	4.82533025	9.25337825	13.745963
er Hash	4.435612 3.62707425	8.763846 7.2290625	17.417176 14.08542675	21.866726 19.298319	42.342509 34.82591625	61.9225 47.20718225
form Delete Throughput (Mo		2	4	8	16	24
SH EH	1.898662 1.229131	3.598952 2.490614	5.935547 4.70361	8.094248 7.886595	7.910209 8.918177	8.000926 10.328562
rel	0.937153	1.531833	2.772285	4.398251	5.593817	5.666127
vel	0.299471	0.559957	1.03137	1.956335	3.418501	4.645158
sh er	0.39326175 1.85327	0.77641925 3.519253	1.513762 6.853577	2.283574725 10.342089	4.14544275 15.766681	6.05539775 17.652877
Hash	1.690429	3.293858125	6.254388	8.86109575	15.02798225	19.60113467
ian Insert Throughput (Mops	s/s) Thread=1 1.053913	2 2.036119	4	8	16	24 5.4589
SH EH	0.589479	1.18045	3.449268 2.285433	5.292045 4.021246	5.805819 5.582147	5.4589
/el	0.474362	0.757504	0.973837	1.374645	1.461386	1.382936
vel sh	0.137404 0.372362	0.261074 0.757704	0.491295 1.534042	0.887227 2.734872	1.380396 3.891831	1.717355 4.608914
er	1.918128	3.488715	6.433229	9.637801	12.175177	12.902454
Hash ian Positive Search Through	2.516055	4.243159 2	7.60807025 4	11.10811225 8	17.041096 16	20.1762295 24
nan Positive Search Through SH	3.336167	5.586168	9.299656	13.530452	17.573843	18.276381
EH	2.046681	4.19717	8.781548	15.505613	19.346186	20.01743
vel evel	1.032295 0.997262	1.740166 1.877826	3.093239 3.626865	4.901955 6.997729	6.396258 13.112314	7.103214 18.246416
sh	0.585573	1.188494	2.514597	4.270248	7.509008	9.457597
er Hach	2.102515 3.00255875	3.944174 5.9849455	8.176301 11.780668	12.950664 13.1106245	24.569926 23.660596	36.804304 34.29530725
oHash fian Negative Search Throug		5.9849455	11.780668	13.1106245	23.660596	34.29530725 24
SH	3.332858	5.648635	9.31015	13.563526	17.526157	18.38305
EH vel	0.713374 1.05248	1.405746 1.740997	2.7034 3.098963	4.67963 4.889724	7.465958 6.410645	7.823678 7.096786
evel	0.812245	1.534612	2.948581	5.728126	10.174163	12.411457
sh	0.796609	1.654961	3.517741	6.129173	10.566435	13.902013
oer oHash	4.47395 3.64170925	8.295752 7.18883175	17.129539 14.346825	22.372177 19.3584845	42.177021 34.70292175	60.593687 47.010148
fian Delete Throughput (Mop	ps/s) Thread=1	2	4	8	16	24
SH EH	1.607616 1.224438	3.240823 2.468547	5.494735 4.720928	7.556856 7.922391	7.241076 9.215614	7.64346 10.335044
vel	1.224438 0.809582	1.383746	2.516669	4.048322	5.082029	5.198309
evel	0.295755	0.55504	1.008447	2.030666	3.581514	4.975246
ush oer	0.337059 1.863955	0.711316 3.492423	1.453221 6.891585	2.597762 10.442913	3.946841 15.672394	4.739526 17.574828
periment 2 form YCSB-A Throughput (N	Mons/s) Thread=1	2				
CEH	1.941595	3.613314	4 6.282357	8 9.603273	16 10.940991	24 11.432127
evel	1.941595 0.215008	3.613314 0.419314	6.282357 0.809303	9.603273 1.53451	10.940991 2.702261	11.432127 3.576111
	1.941595	3.613314	6.282357	9.603273	10.940991	11.432127
evel ush per pHash	1.941595 0.215008 0.423265 1.780937 1.9295995	3.613314 0.419314 0.95656 3.28364 3.779359	6.282357 0.809303 1.878408 5.034586 7.358267	9.603273 1.53451 2.619554 5.644092 9.924119	10.940991 2.702261 5.083122 5.529003 18.3813365	11.432127 3.576111 7.476417 4.956198 25.373776
evel ish ier bHash form YCSB-B Throughput (N	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1	3.613314 0.419314 0.95656 3.28364 3.779359	6.282357 0.809303 1.878408 5.034586 7.358267	9.603273 1.53451 2.619554 5.644092 9.924119 8	10.940991 2.702261 5.083122 5.529003 18.3813365 16	11.432127 3.576111 7.476417 4.956198 25.373776 24
evel ish er obhash form YCSB-B Throughput (N EH ivel	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462	10,940991 2,702261 5,083122 5,529003 18,3813365 16 12,110555 4,435138	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593
vel sh er Hash form YCSB-B Throughput (N EH vel sh	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119
vel sh er Hash form YCSB-B Throughput (M EH vel sh er	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462	10,940991 2,702261 5,083122 5,529003 18,3813365 16 12,110555 4,435138	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593
vel sh er Hash form YCSB-B Throughput (N EH vel sh er Hash orm YCSB-D Throughput (N	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323
evel Issh eer Hash Gorm YCSB-B Throughput (M EH evel Issh eer Hash Gorm YCSB-D Throughput (M SH SH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043
vel sh er Hash form YCSB-B Throughput (N EH vel sh er oldash form YCSB-D Throughput (N SH EH EH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053
vel sh er Hash form YCSB-B Throughput (N EH vel sh er Hash form YCSB-D Throughput (N SH EH er Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072	3.613314 0.419314 0.96656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099
vel sh er Hash form YCSB-B Throughput (N EH vel sh er Hash orm YCSB-D Throughput (N SH EH eel	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053
vel sh er Hash form YCSB-B Throughput (M EH vel sh er HJash form YCSB-D Throughput (M SH EH vel sh er sel er vel sh er	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.43347667 5.3270765	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485
vel sh er Hash orm YCSB-B Throughput (N EH vel sh er Hash orm YCSB-D Throughput (N EH el el vel sh er Hash orm Throughput (N EH el er Hash orm YCSB-F Throughput (N EH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24
vel ssh er Hash form YCSB-B Throughput (N EH vel ssh er Hash form YCSB-D Throughput (N SH EH el vel ssh er Hash form YCSB-F Throughput (N SH EH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373	3.613314 0.419314 0.96656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.199723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.508485 24 7.086551 6.397954
vel sh er iHash form YCSB-B Throughput (N EH vel sh er iHash form YCSB-D Throughput (N SH EH el iHash form Throughput (N SH EH el iHash form YCSB-F Throughput (N SH EH HASH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.7732373 0.694532	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145
evel issh er iHash form YCSB-B Throughput (N EH evel issh er iHash form YCSB-D Throughput (N SH EH evel issh er iHash form YCSB-D Throughput (N SH EH evel issh form YCSB-F Throughput (N SH EH er iHash form YCSB-F Throughput (N SH EH evel issh	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909
evel sish sish ser JHash form YCSB-B Throughput (N EH evel sish ser JHash form YCSB-D Throughput (N SH EEH evel sish ser JHash form YCSB-F Throughput (N SH ESH evel sish ser JHash form YCSB-F Throughput (N SH EH evel sish	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.622560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel ssh er iHash form YCSB-B Throughput (N EH vel ssh er HHash form YCSB-D Throughput (N EH EH iHash form YCSB-F Throughput (N EH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909
vel sh er iHash forom YCSB-B Throughput (N EH vel sh er iHash forom YCSB-D Throughput (N SH EH er iHash forom YCSB-F Throughput (N SH EH er iHash sh er iHash sh er iHash iHash sh er iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.622560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel ssh er Hash form YCSB-B Throughput (N EH vel ssh er Hash form YCSB-D Throughput (N SH EH vel ssh er Hash form YCSB-F Throughput (N SH EH el vel ssh er Hash form YCSB-F Throughput (N SH EH el vel ssh er Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.622560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er Hash Form YCSB-B Throughput (MEH vel sh her my CSB-D Throughput (MSH hash form YCSB-D Throughput (MSH hash form YCSB-F Thr	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.366149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.2832 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh form YCSB-D Throughput (N SH EH vel sh form YCSB-D Throughput (N SH EH vel vel sh form YCSB-F Throughput (N SH EH iHash form YCSB-F Throughput (N SH EH vel vel sh form YCSB-F Throughput (N SH EH sh er iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.500925 1.1768816667	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh er iHash form YCSB-D Throughput (N SH EH evel sh er iHash form YCSB-F Throughput (N SH EH evel sh er iHash beriment 4 rage Latency (µs) SH EH evel	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.366149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.2832 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh sh err Hash orom YCSB-B Throughput (NEH sh) sh err Hash orom YCSB-D Throughput (NEH sh) err Hash orom YCSB-F Throughput (NEH sh) err Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556635	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176881667 1.077073333 1.263503333 1.154294	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel ssh er Hash form YCSB-B Throughput (N EH evel ssh er Hash form YCSB-D Throughput (N EH el el el el el er Hash FH EH el er Hash berer Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.500925 1.176861667 1.077073333 1.263503333 1.154294 0.327	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er Hash orom YCSB-B Throughput (NEH vel sh er Hash orom YCSB-D Throughput (NEH vel sh er Hash orom YCSB-F Throughput (NEH vel sh er Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556635	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176881667 1.077073333 1.263503333 1.154294	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er Hash form YCSB-B Throughput (N EH vel sh er Hash form YCSB-D Throughput (N SH EH vel sh er Hash sh er Hash sh er Hash sh er Hash SH EH	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er Hash form YCSB-B Throughput (N EH vel sh form YCSB-D Throughput (N SH EH vel vel sh form YCSB-D Throughput (N SH EH vel vel sh her r Hash form YCSB-F Throughput (N SH EH er vel sh sh er Hash Latency (µs) SH EH EH el vel sh Latency (µs) SH EH EH el vel sh	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.977523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.039588333 3.415083333 2.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh er sh er iHash form YCSB-D Throughput (N SH EH vel sh er iHash form YCSB-D Throughput (N SH EH vel sh er sh ar iHash form YCSB-F Throughput (N SH EH vel vel sh er sh er sh er sh er sh er sh bash form YCSB-F Throughput (N SH EH vel vel sh er sh er sh bash bash bash bash bash bash bash b	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh form YCSB-D Throughput (N SH EH vel vel sh form YCSB-D Throughput (N SH EH vel vel sh form YCSB-F Throughput (N SH EH vel sh bash Latency (µs) SH Latency (µs) SH Latency (µs) SH EH vel vel sh Latency (µs) SH EH vel vel sh	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 7.030871667 7.030871667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.243333333 3.057166667 9.195833333 248.0072	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.572166667 1.572166667 1.572166667 1.7761333333 2.7224	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835 Delete 0,718684667 0,728425333 1,03958833 3,415083333 2,629362 0,5745 0,6487288 Delete 1,379166667 1,322833333 1,833166667 4,414666667 261,3952	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh her iHash form YCSB-D Throughput (N SH EH vel sh er iHash form YCSB-F Throughput (N SH EH er iHash form YCSB-F Throughput (N SH EH er iHash form YCSB-F Throughput (N SH EH er iHash sh er iHash sh er iHash sh er iHash SH EH EH er iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.243333333 3.057166667 9.195833333 248.0072 41.24025	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.5721666667 1.5721666667 1.5721666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.5710333333 2.7224 2.37925	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.415083333 3.415083333 3.415083333 3.415083333 3.415083333 3.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.414666667 261.3952 4.1392	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel ssh er Hash orom YCSB-B Throughput (N EH evel ssh er Hash orm YCSB-D Throughput (N SH EH el el vel ssh er Hash orm YCSB-F Throughput (N SH EH el el vel ssh er Hash beriment 4 rage Latency (µs) SH EH el el vel ssh er Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 7.030871667 7.030871667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.243333333 3.057166667 9.195833333 248.0072	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.572166667 1.572166667 1.572166667 1.7761333333 2.7224	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835 Delete 0,718684667 0,728425333 1,03958833 3,415083333 2,629362 0,5745 0,6487288 Delete 1,379166667 1,322833333 1,833166667 4,414666667 261,3952	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh her Hash form YCSB-B Throughput (NEH vel sh her my CSB-D Throughput (NEH vel sh her my CSB-F Th	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.243333333 3.057166667 9.195833333 248.0072 41.24025	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.5721666667 1.5721666667 1.5721666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.5710333333 2.7224 2.37925	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.415083333 3.415083333 3.415083333 3.415083333 3.415083333 3.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.414666667 261.3952 4.1392	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
evel sish eer oldash form YCSB-B Throughput (M. EH evel sish eer olds eer o	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.140333333 3.0571666667 9.195833333 3.0571666667 9.195833333 3.0571666667 9.195833333 3.248.0072 41.24025 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535 Positive Search 0.373066833 0.386246 0.5450395 1.033883333 1.583204 0.328 0.5871938 Positive Search 0.924166667 1.098333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.446333333 1.4463333333	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.527166667 1.77033333 2.7224 2.37925 1.0794	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.039588333 3.415083333 2.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.414666667 4.414666667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667	10.940991 2.7702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.776346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743 15.8329955	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977 20.028024
vel sh er sh	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.140333333 3.0571666667 9.195833333 3.0571666667 9.195833333 3.0571666667 9.195833333 3.248.0072 41.24025 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.455495 0.89648 4.22807 3.5556535	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.5721666667 1.5721666667 1.5721666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.571666667 1.5710333333 2.7224 2.37925	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.415083333 3.415083333 3.415083333 3.415083333 3.415083333 3.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.414666667 261.3952 4.1392	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977
vel sh er iHash form YCSB-B Throughput (N EH vel sh form YCSB-D Throughput (N SH EH iHash form YCSB-D Throughput (N SH EH iHash form YCSB-F Throughput (N SH EH iHash form YCSB-F Throughput (N SH EH iHash form YCSB-F Throughput (N SH EH iHash beriment 4 rage Latency (µs) SH EH iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 7.030871667 7.030871667 7.030871667 7.030871667 7.030871667 7.030871667 7.042224 Insert 1.835166667 9.19583333 3.057166667 9.19583333 3.48.0072 41.24025 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535 Positive Search 0.373066833 0.386246 0.5450395 1.033883333 1.583204 0.328 0.5871938 Positive Search 0.924166667 1.098333333 1.4463333333 1.4463333333 1.436333333	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.977523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.527166667 1.527166667 1.527166667 1.527166667 1.527166667 1.527166667 1.527166667 1.527166667 1.527166667	9,603273 1,53451 2,619554 5,644092 9,924119 8 10,17395 3,493462 3,13946 5,592824 12,136581 8 10,655705 9,841329 3,644325 4,137716 4,880244 21,772137 20,5088805 8 7,28332 4,836576 3,537363 1,651285 2,413629 10,98181 9,6083835 Delete 0,718684667 0,728425333 1,039588333 3,415083333 2,629362 0,5745 0,6487288 Delete 1,379166667 1,322833333 1,833166667 4,414666667 261,3952 4,132 1,452	10.940991 2.7702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743 15.8329955	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977 20.028024
vel sh er Hash form YCSB-B Throughput (N EH vel sh er Hash form YCSB-D Throughput (N SH EH vel sh er Hash form YCSB-F Throughput (N SH EH el vel sh er Hash SH EH EH EH el vel sh beriment 4 rarge Latency (µs) SH EH EH EH er Hash beriment 5 beraller vel sh ber er Hash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.24333333 3.057166667 2.24333333 3.057166667 2.24333333 3.057166667 2.24333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.243333333 3.057166667 2.241729 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.43347667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535 Positive Search 0.373066833 0.386246 0.5450395 1.033883333 1.583204 0.328 0.5871938 Positive Search 0.924166667 1.098333333 1.446333333	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667 1.572166667	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.508805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.039588333 3.415083333 2.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.414666667 261.3952 4.132 1.452 8 8 5.265225163 4.08677525 0.864436573	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.363183 6.132695 4.236918 2.836115 4.704921 11.3979743 15.8329955	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.92088 6.940909 10.901977 20.028024
vel sh er iHash form YCSB-B Throughput (N EH vel sh er iHash form YCSB-D Throughput (N SH EH vel sh er iHash form YCSB-F Throughput (N SH EH vel vel sh her iHash form YCSB-F Throughput (N SH EH vel vel sh er iHash beriment 4 rage Latency (µs) SH EH vel vel sh her er iHash Latency (µs) SH EH rel vel sh her er iHash Latency (µs) SH EH rel vel sh her er iHash beriment 5 herality Throughput (Mops/s) SH EH rel vel sh her er iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.570881667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.24333333 3.057166667 9.195833333 248.0072 41.24025 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535 Positive Search 0.37306833 0.365246 0.5450395 1.033883333 1.583204 0.328 0.5871938 Positive Search 0.924166667 1.098333333 1.4463333333 1.4463333333 1.4463333333 1.44633333333 1.44633333333 1.44633333333 1.446333333	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.57166667 1.57166667 1.57166667 1.57166667 1.57166667 1.57166667 1.57166667 1.710333333 2.724 2.37925 1.0794	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.039588333 3.415083333 2.629362 0.5745 0.6487288 Delete 1.379166667 4.414666667 261.3952 4.132 1.452	10.940991 2.702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.716346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4.704921 11.3979743 15.8329955	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.29053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.92088 6.940909 10.901977 20.028024
vel sh er iHash form YCSB-B Throughput (N EH vel sh er sh er iHash form YCSB-D Throughput (N SH EH rel vel sh er iHash form YCSB-F Throughput (N SH EH rel vel sh er iHash form YCSB-F Throughput (N SH EH rel vel sh er iHash beriment 4 rer sp er iHash Latency (µs) SH EH er rel vel sh er iHash Latency (µs) SH EH er iHash	1.941595 0.215008 0.423265 1.780937 1.9295995 Mops/s) Thread=1 1.553614 0.547787 0.62971 1.778103 2.622453 Mops/s) Thread=1 2.547534 1.519133 0.872114 0.575072 1.16033 3.625560333 5.043314 Mops/s) Thread=1 1.361149 0.732373 0.694532 0.237316 0.446808 1.959922 1.8972135 Insert 1.044361667 1.524968333 1.57081667 7.030871667 2.420722 0.62575 0.442224 Insert 1.835166667 2.24333333 3.057166667 2.124333333 3.057166667 2.124025 6.6324	3.613314 0.419314 0.95656 3.28364 3.779359 2 3.214115 1.032996 1.225157 3.250971 5.198723 2 4.556558 3.087774 1.425969 1.102422 1.20241 7.433447667 5.3270765 2 2.770951 1.389933 1.239523 0.453495 0.89648 4.22807 3.5556535 Positive Search 0.373066833 0.386246 0.5450395 1.033883333 1.583204 0.332 0.45395 0.924166667 1.098333333 1.583204 0.328 0.5871938 Positive Search 0.924166667 1.098333333 1.446333333 2.0745 3.3296 2.37875 1.2416	6.282357 0.809303 1.878408 5.034586 7.358267 4 6.395054 1.977721 2.422948 4.995168 10.266235 4 7.806189 6.070746 1.972523 2.145923 2.2662 14.772049 10.502546 4 4.811631 2.745591 2.192028 0.884652 1.7672565 8.227409 6.6841395 Negative Search 0.5000925 1.176861667 1.077073333 1.263503333 1.154294 0.327 0.348968 Negative Search 0.814833333 1.776166667 1.577166667 1.577166667 1.577166667 1.7703333 2.7224 2.37925 1.0794	9.603273 1.53451 2.619554 5.644092 9.924119 8 10.17395 3.493462 3.13946 5.592824 12.136581 8 10.655705 9.841329 3.644325 4.137716 4.880244 21.772137 20.5088805 8 7.28332 4.836576 3.537363 1.651285 2.413629 10.98181 9.6083835 Delete 0.718684667 0.728425333 1.03958833 3.415083333 2.629362 0.5745 0.6487288 Delete 1.379166667 1.322833333 1.833166667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667 4.41466667	10.940991 2.7702261 5.083122 5.529003 18.3813365 16 12.110555 4.435138 6.263437 5.477951 23.401413 16 9.969395 11.607526 4.776346 7.2416 6.240233 25.086287 24.746811 16 7.353183 6.132695 4.236918 2.836115 4,704921 11.3979743 15.8329955	11.432127 3.576111 7.476417 4.956198 25.373776 24 13.752623 5.079593 9.295119 5.06256 33.741323 24 9.275043 12.588382 5.236053 9.988099 9.361369 25.97748067 36.5088485 24 7.086551 6.397954 4.501145 3.920888 6.940909 10.901977 20.028024

periment 6 prage Traffic	Write Traffic (GB)	Read Traffic (GB)				
ASH CEH	35.11431432 21.9854815	33.44651294 128.2352502				
vel evel	27.12402272 41.02325344	74.41524744 102.6981823				
ish er	12.37470412 7.8515625	7.149165392 0.803710938				
Hash	6.346679688	3.326171875				
periment 7 ace(GB)	Number of inserted items=10	M 20M	30M	40M	50M	60M
sh-DRAM sh-PM	0.249999746 0.249999839	0.262560851 4.249999495	0.250000104 4.250000493	0.249999771 4.249998931	0.249999632 4.25000808	0.250000264 4.250006269
er-DRAM	0.396240234	0.794219971	1.047981263 0.452316284	1.587265016 0.603103638	2.0145607 0.753890991	2.093997956 0.904655457
er-PM Hash-DRAM	0.150764466 0.066098828	0.301551819 0.132199512	0.183785938	0.264400391	0.264400391	0.367154297
Hash-PM ce(GB)	0.291180664 Number of inserted items=70	0.575436523 M 80M	0.802583984 90M	1.155664063 100M	1.153710938 110M	1.586894531 120M
sh-DRAM sh-PM	0.250000051 4.250008685	0.250000017 4.250005096	0.249999711 4.249994726	0.250000352 4.250002624	0.249970499 4.250003643	0.249999636 4.25000454
er-DRAM	2.375648499	3.173919678	3.845325471	4.030708313	4.082023621	4.193206787
er-PM Hash-DRAM	1.055442811 0.528804688	1.206207275 0.528803711	1.356994629 0.528803711	1.507781982 0.529323242	1.658546448 0.533805664	1.809333802 0.739245117
Hash-PM	2.282929688 Number of inserted items=13	2.296601563	2.296601563	2.298916016	2.333466797	3.203115234
ce(GB) sh-DRAM	0.250000085	0M 140M 0.250000074	150M 0.249999896	160M 0.249999777	170M 0.24999799	180M 0.249999666
sh-PM er-DRAM	4.249996225 4.428947449	4.250001735 4.85838318	4.249998959 5.520629883	4.250003048 6.344173432	4.249998202 7.139011384	4.250003074 7.690620423
er-PM	1.960116893	2.11088562	2.261672974	2.412437439	2.563224793	2.714005627
Hash-DRAM Hash-PM	0.739245117 3.203115234	1.057611328 4.553066406	1.057610352 4.601894531	1.057610352 4.595058594	1.057609375 4.595058594	1.057608398 4.597988281
ice(GB) sh-DRAM	Number of inserted items=19 0.250000195	0M 200M 0.250000172	210M 0.24999976	220M 0.250000245	230M 0.249999726	240M 0.250000213
sh-PM	4.250001257	4.250002091	68.2499742	68.24978246	68.24991443	68.24981132
er-DRAM er-PM	7.961681366 2.864776611	8.058933259 3.015563965	8.105636598 3.16632843	8.168132782 3.317115784	8.254638672 3.467903137	8.382823944 3.618667603
Hash-DRAM Hash-PM	1.057608398 4.593105469	1.058648438 4.591884766	1.059292969 4.595302734	1.068192383 4.645605469	1.145938477 5.025908203	1.476976563 6.390634766
ce(GB)	Number of inserted items=25	DM 260M	270M	280M	290M	300M
sh-DRAM sh-PM	0.249999631 68.25001036	0.249999887 68.25005041	0.249999807 68.25025806	0.249999916 68.24994929	0.250000147 68.250072	0.250000207 68.25005004
er-DRAM	8.573005677	8.845458984	9.217933655	9.708759309	10.31484985	11.03757095
er-PM Hash-DRAM	3.769481659 1.974335938	3.920246124 2.112382813	4.071033478 2.115224609	4.221820831 2.115224609	4.372585297 2.115224609	4.52337265 2.115224609
Hash-PM	8.364619141	8.966396484	9.056240234	9.113857422	9.167568359	9.184169922
periment 8						
able Size Throughput (Mo		32B	64B	128B	256B	
SH vel	4.761206 1.75256215	4.370462 1.7737998	4.012544 1.7562037	3.648672 1.771669775	2.531003 1.741172375	
sh er	4.0494265 12.55229975	3.61212125 12.30331375	3.46075975 9.808057	3.36415675 7.12537625	3.05871875 4.50371775	
ei Hash	14.092812	12.9155135	10.503505	7.34719125	4.3792125	
eriment 9 d Factor (%)	Number of inserted items=10		30M	40M	50M	60M
SH EH	66.0554 59.5719	66.0554 59.5737	53.2927 47.6062	66.0554 59.5728	82.4597 69.9493	53.3501 47.5765
el vel	90.8261 79.4729	90.8261 34.0598	68.1196 59.6046	90.8261 79.4729	56.7663 49.6705	68.1196 59.6046
sh	59.6046	7.01231	10.5185	14.0246	17.308	21.0369
er Hash	37.7066 56.0727	37.668 56.0856	42.8273 61.5157	37.7237 56.092	37.1483 70.1151	42.9255 61.5264
d Factor (%)	Number of inserted items=70	M 80M	90M	100M	110M	120M
SH EH	57.7984 52.1537	66.0554 59.5742	74.3123 66.6419	82.434 70.1075	79.1072 59.5115	53.3446 47.6101
/el	79.4729	90.8261	51.0897	56.7663	62.443	68.1196
vel sh	69.5388 24.5431	34.0598 28.0492	44.7035 31.5554	49.6705 35.0616	54.6376 38.5677	59.6046 42.0739
er Hash	43.2452 49.0834	37.7426 56.953	35.0398 63.1072	37.1422 70.1191	40.3423 76.5192	42.8817 61.3701
d Factor (%)	Number of inserted items=13	DM 140M	150M	160M	170M	180M
SH EH	53.6829 48.4817	57.7984 52.1525	61.9269 55.8725	66.0554 59.5756	70.1838 63.2159	74.3117 66.6449
/el	73.7962	79.4729	85.1495	90.8261	48.2514	51.0897
vel sh	64.5717 45.58	69.5388 49.0862	74.5058 52.5923	34.0598 56.0985	42.22 59.6046	44.7035 63.1108
er Hash	43.9789 45.6442	43.1678 49.0848	40.6975 52.5908	37.7694 56.0969	35.6577 59.6029	35.0449 63.109
d Factor (%)	Number of inserted items=19	OM 200M	210M	220M	230M	240M
SH EH	78.4342 69.3263	82.4434 70.0462	84.9072 66.8545	79.1159 59.503	63.3772 51.8082	53.3364 47.5918
el	53.928	56.7663	59.6046	62.443	65.2813	68.1196
vel sh	47.187 66.617	49.6705 70.1231	52.1541 4.58497	54.6376 4.8033	57.1211 5.02164	59.6046 5.23997
er Hash	35.7313 66.615	37.1574 70.1168	38.7904 73.6002	40.3647 76.5144	41.7568 74.8935	42.9049 61.2596
14311	00.013	70.1100	13.0002	7 U.U 1444	74.0533	01.2090
eriment 10						
overy Time (s) ead-1	Number of inserted items=10 0.560193	M 20M 1.089347	30M 1.614449	40M 2.549051	50M 2.559382	60M 3.447411
ead-2	0.331689	0.644957	0.923353	1.445274	1.507391	1.922619
ead-4 ead-8	0.235937 0.159552	0.416497 0.301159	0.614051 0.420544	0.916964 0.64551	0.923644 0.640922	1.172099 0.864405
ead-16	0.154403 0.122917	0.233623 0.216846	0.332565 0.310919	0.494526 0.471374	0.502285 0.4684	0.743899 0.642067
ead-24 overy Time (s)	Number of inserted items=70	M 80M	90M	100M	U.4064	U.04ZU0/
ead-1 ead-2	4.971479 2.75402	5.305649 2.958968	5.405138 2.966657	5.512479 3.025063	_	
ead-4	1.704711	1.787486	1.785323	1.811582		
ead-8 ead-16	1.248624 0.968667	1.263118 1.017342	1.254723 1.034704	1.289331 1.021178		
ead-24	0.881894	0.923817	0.944532	0.945199		
eriment 11						
ecting Table Throughput (2	4 7 127902	8	16	24
CT=4 CT=8	2.533653 2.545541	4.293149 4.268679	7.137802 7.45585	8.904839 10.502003	10.007422 13.94874	8.26563 14.238366
CT=16	2.526699	4.32143	7.621123	10.50557	15.644961	17.940957
CT=64 CT=256	2.529887 2.536601	4.301137 4.338474	7.665617 7.88022	10.878732 11.090656	16.60617 16.991854	19.671948 20.213206
CT=1024	2.551242	4.373844	7.852751	11.811766	17.486818	20.370545
periment 12						
able D-Bucket Size Throu		Positive Search				
oucket=32B oucket=64B	1.85281225 2.16642825	2.94434275 2.9541595				
ucket=128B	2.42965825	2.9828735				
ucket=256B ucket=512B	2.54010175 2.50579775	2.980101 3.006221				
iable P-Bucket Size Throu	ughput (M Insert	Positive Search				
ucket=1KB ucket=2KB	2.23251575 2.410912	3.08697575 3.06805275				
ucket=4KB	2.54756875	2.97051575				
ucket=8KB	2.6717505	2.77006725				