

Results of Original Secure Yannakakis

1. TPC-H Query 3

(1) 1MB

| row_num | o_orderkey | o_orderdate | o_shippriority | annotation |
|---------|------------|-------------|----------------|------------|
| 276 | 1092 | 1995-03-04 | 0 | 8006 |
| 462 | 1830 | 1995-02-23 | 0 | 7164 |
| 517 | 2053 | 1995-02-07 | 0 | 12143 |
| 782 | 3110 | 1994-12-17 | 0 | 2937 |
| 958 | 3814 | 1995-02-22 | 0 | 12594 |
| 1038 | 4134 | 1995-01-12 | 0 | 12116 |
| 1059 | 4227 | 1995-02-24 | 0 | 8724 |
| 1142 | 4550 | 1994-12-29 | 0 | 898 |
| 1179 | 4707 | 1995-02-27 | 0 | 5718 |
| 1240 | 4960 | 1995-02-26 | 0 | 11275 |
| 1328 | 5312 | 1995-02-24 | 0 | 6176 |

Running time: 2505ms

Communication cost: 15.9736 MB

(2) 3MB

| row_num | o_orderkey | o_orderdate | o_shippriority | annotation |
|---------|------------|-------------|----------------|------------|
| 232 | 928 | 1995-03-02 | 0 | 255523 |
| 254 | 998 | 1994-11-26 | 0 | 14171 |
| 321 | 1281 | 1994-12-11 | 0 | 84846 |
| 355 | 1411 | 1994-12-21 | 0 | 109442 |
| 530 | 2114 | 1995-01-16 | 0 | 37113 |
| 782 | 3110 | 1994-12-17 | 0 | 32844 |
| 866 | 3458 | 1994-12-22 | 0 | 105892 |
| 964 | 3844 | 1994-12-29 | 0 | 5428 |
| 1038 | 4134 | 1995-01-12 | 0 | 147788 |
| 1074 | 4290 | 1995-01-15 | 0 | 31619 |
| 1457 | 5825 | 1995-02-21 | 0 | 28472 |
| 1555 | 6211 | 1994-11-24 | 0 | 37573 |
| 1881 | 7521 | 1995-02-28 | 0 | 93833 |
| 1887 | 7527 | 1994-12-12 | 0 | 11782 |
| 2071 | 8263 | 1995-01-27 | 0 | 105110 |
| 2309 | 9221 | 1995-01-04 | 0 | 170096 |
| 2456 | 9824 | 1995-01-23 | 0 | 32909 |
| 2489 | 9953 | 1995-02-28 | 0 | 2622 |
| 2610 | 10434 | 1994-12-24 | 0 | 39754 |
| 2612 | 10436 | 1995-01-03 | 0 | 35555 |
| 2783 | 11111 | 1995-01-18 | 0 | 41397 |
| 3050 | 12194 | 1995-03-02 | 0 | 45471 |
| 3546 | 14178 | 1995-01-01 | 0 | 11417 |
| 3631 | 14503 | 1995-02-06 | 0 | 154148 |
| 3828 | 15300 | 1995-02-09 | 0 | 94061 |
| 4120 | 16480 | 1994-12-07 | 0 | 40762 |
| 4121 | 16481 | 1995-02-19 | 0 | 51719 |
| 4266 | 17058 | 1995-01-02 | 0 | 45132 |
| 4360 | 17440 | 1995-01-24 | 0 | 143161 |

Running time: 3163ms

Communication cost: 51.5879 MB

(3) 10MB

| row_num | o_orderkey | o_orderdate | o_shippriority | annotation |
|---------|------------|--------------|----------------|------------|
| 95 | 359 | 1994-12-19 0 | 6159 | |
| 462 | 1830 | 1995-02-23 0 | 9900 | |
| 530 | 2114 | 1995-01-16 0 | 4466 | |
| 782 | 3110 | 1994-12-17 0 | 4498 | |
| 941 | 3749 | 1995-02-24 0 | 12958 | |
| 958 | 3814 | 1995-02-22 0 | 18494 | |
| 1111 | 4423 | 1995-02-17 0 | 406 | |
| 1240 | 4960 | 1995-02-26 0 | 15620 | |
| 1303 | 5191 | 1994-12-11 0 | 7391 | |
| 1505 | 6017 | 1995-01-31 0 | 9542 | |
| 1555 | 6211 | 1994-11-24 0 | 4744 | |
| 1965 | 7845 | 1994-12-14 0 | 7290 | |
| 2051 | 8195 | 1995-01-07 0 | 9929 | |
| 2074 | 8290 | 1994-12-10 0 | 6209 | |
| 2120 | 8480 | 1995-01-30 0 | 11436 | |
| 2199 | 8775 | 1995-02-04 0 | 5991 | |
| 2202 | 8802 | 1995-02-01 0 | 8929 | |
| 2536 | 10144 | 1995-01-03 0 | 4210 | |
| 2565 | 10245 | 1995-02-14 0 | 22226 | |
| 2763 | 11043 | 1995-02-20 0 | 7731 | |
| 2806 | 11206 | 1994-12-29 0 | 7894 | |
| 2905 | 11617 | 1994-12-11 0 | 13124 | |
| 3159 | 12615 | 1995-03-06 0 | 1987 | |
| 3622 | 14470 | 1995-01-25 0 | 7609 | |
| 3829 | 15301 | 1994-12-27 0 | 5743 | |
| 3972 | 15876 | 1995-01-25 0 | 6209 | |
| 4121 | 16481 | 1995-02-19 0 | 7223 | |
| 4511 | 18023 | 1995-02-25 0 | 5652 | |
| 4564 | 18244 | 1995-02-12 0 | 9247 | |
| 4672 | 18688 | 1995-03-06 0 | 19994 | |
| 4708 | 18820 | 1995-02-12 0 | 15953 | |
| 4918 | 19654 | 1995-01-10 0 | 8686 | |
| 5020 | 20068 | 1995-03-01 0 | 8013 | |
| 5070 | 20262 | 1994-12-27 0 | 14400 | |
| 5126 | 20486 | 1995-03-06 0 | 20322 | |
| 5340 | 21348 | 1995-03-11 0 | 2244 | |
| 5342 | 21350 | 1995-02-25 0 | 2725 | |
| 5347 | 21379 | 1995-01-15 0 | 8298 | |
| 5411 | 21635 | 1994-12-03 0 | 1655 | |
| 5456 | 21824 | 1995-02-08 0 | 2833 | |
| 5474 | 21890 | 1995-01-25 0 | 3561 | |
| 5692 | 22756 | 1994-12-25 0 | 8418 | |
| 5984 | 23936 | 1994-12-18 0 | 10760 | |
| 6040 | 24160 | 1995-02-02 0 | 5622 | |
| 6181 | 24709 | 1995-01-16 0 | 1380 | |
| 6238 | 24934 | 1995-01-31 0 | 1112 | |
| 6240 | 24960 | 1995-01-28 0 | 26780 | |
| 6279 | 25095 | 1995-01-26 0 | 16005 | |
| 6296 | 25184 | 1995-02-28 0 | 8181 | |
| 6361 | 25441 | 1995-01-10 0 | 2815 | |
| 6513 | 26049 | 1995-03-01 0 | 4909 | |

| | | | | |
|-------|-------|------------|---|-------|
| 6653 | 26597 | 1995-01-14 | 0 | 9195 |
| 6777 | 27105 | 1995-02-17 | 0 | 1972 |
| 6862 | 27430 | 1995-02-01 | 0 | 5270 |
| 6955 | 27811 | 1995-03-05 | 0 | 9661 |
| 6999 | 27975 | 1995-02-13 | 0 | 8319 |
| 7279 | 29095 | 1995-03-09 | 0 | 27652 |
| 7766 | 31046 | 1995-02-08 | 0 | 19499 |
| 7967 | 31847 | 1994-12-19 | 0 | 8752 |
| 8146 | 32578 | 1995-02-06 | 0 | 6025 |
| 8272 | 33088 | 1994-12-24 | 0 | 14705 |
| 8275 | 33091 | 1995-01-26 | 0 | 5213 |
| 8592 | 34368 | 1995-01-08 | 0 | 2187 |
| 8648 | 34592 | 1995-02-28 | 0 | 4836 |
| 8721 | 34881 | 1995-02-08 | 0 | 17279 |
| 8746 | 34978 | 1995-02-05 | 0 | 15038 |
| 8891 | 35555 | 1995-03-05 | 0 | 13321 |
| 8964 | 35844 | 1994-12-07 | 0 | 5912 |
| 9053 | 36197 | 1995-01-25 | 0 | 22620 |
| 9240 | 36960 | 1995-03-09 | 0 | 1601 |
| 9379 | 37507 | 1994-12-09 | 0 | 4329 |
| 9487 | 37927 | 1995-01-26 | 0 | 7775 |
| 9772 | 39076 | 1994-12-12 | 0 | 769 |
| 10092 | 40356 | 1994-12-20 | 0 | 9416 |
| 10125 | 40485 | 1994-12-28 | 0 | 11834 |
| 10848 | 43392 | 1995-01-01 | 0 | 10513 |
| 10958 | 43814 | 1995-01-10 | 0 | 15042 |
| 11154 | 44610 | 1995-03-11 | 0 | 15781 |
| 11242 | 44962 | 1994-12-29 | 0 | 436 |
| 11267 | 45059 | 1995-02-04 | 0 | 21847 |
| 11342 | 45350 | 1995-01-04 | 0 | 3056 |
| 11362 | 45442 | 1995-02-07 | 0 | 6111 |
| 11531 | 46115 | 1995-03-03 | 0 | 26891 |
| 11532 | 46116 | 1995-01-08 | 0 | 8102 |
| 11691 | 46755 | 1995-02-07 | 0 | 20615 |
| 11803 | 47203 | 1994-12-19 | 0 | 3757 |
| 12227 | 48899 | 1995-01-19 | 0 | 1327 |
| 12400 | 49600 | 1995-03-08 | 0 | 12017 |
| 12441 | 49761 | 1995-01-25 | 0 | 23611 |
| 12481 | 49921 | 1995-02-18 | 0 | 18522 |
| 12572 | 50276 | 1995-02-15 | 0 | 7765 |
| 12617 | 50465 | 1995-03-12 | 0 | 16332 |
| 12891 | 51555 | 1994-12-13 | 0 | 6565 |
| 13022 | 52070 | 1994-12-02 | 0 | 715 |
| 13126 | 52486 | 1995-01-05 | 0 | 15324 |
| 13146 | 52578 | 1995-03-08 | 0 | 12131 |
| 13350 | 53382 | 1994-12-28 | 0 | 9662 |
| 13722 | 54882 | 1995-02-07 | 0 | 8123 |
| 13768 | 55072 | 1995-01-05 | 0 | 181 |
| 13771 | 55075 | 1995-02-02 | 0 | 14220 |

Running time: 5288ms

Communication cost: 185.305 MB

2. TPC-H Query 10

(1) 1MB

| row_num | c_custkey | c_name | c_nationkey | annotation |
|---------|-----------|----------|-------------|------------|
| 1 | 1 | 00000001 | 15 | 399 |
| 4 | 4 | 00000004 | 4 | 8136 |
| 13 | 13 | 00000013 | 3 | 8217 |
| 19 | 19 | 00000019 | 18 | 4504 |
| 37 | 37 | 00000037 | 8 | 360 |
| 41 | 41 | 00000041 | 10 | 4502 |
| 44 | 44 | 00000044 | 16 | 5933 |
| 49 | 49 | 00000049 | 10 | 473 |
| 52 | 52 | 00000052 | 11 | 7552 |
| 56 | 56 | 00000056 | 10 | 4117 |
| 61 | 61 | 00000061 | 17 | 14357 |
| 64 | 64 | 00000064 | 3 | 4444 |
| 67 | 67 | 00000067 | 9 | 3485 |
| 70 | 70 | 00000070 | 22 | 2390 |
| 76 | 76 | 00000076 | 0 | 7192 |
| 79 | 79 | 00000079 | 15 | 7318 |
| 80 | 80 | 00000080 | 0 | 1550 |
| 82 | 82 | 00000082 | 18 | 3905 |
| 92 | 92 | 00000092 | 2 | 4622 |
| 97 | 97 | 00000097 | 17 | 13144 |
| 101 | 101 | 00000101 | 2 | 870 |
| 103 | 103 | 00000103 | 9 | 9731 |
| 104 | 104 | 00000104 | 10 | 5606 |
| 109 | 109 | 00000109 | 16 | 2912 |
| 115 | 115 | 00000115 | 8 | 9309 |
| 118 | 118 | 00000118 | 18 | 7209 |
| 121 | 121 | 00000121 | 17 | 22072 |
| 122 | 122 | 00000122 | 3 | 1490 |
| 124 | 124 | 00000124 | 18 | 10799 |
| 125 | 125 | 00000125 | 19 | 8481 |
| 133 | 133 | 00000133 | 17 | 21930 |
| 142 | 142 | 00000142 | 9 | 10003 |
| 143 | 143 | 00000143 | 16 | 9558 |

Running time: 2122ms

Communication cost: 12.3652 MB

(2) 3MB

| row_num | c_custkey | c_name | c_nationkey | annotation |
|---------|-----------|----------|-------------|------------|
| 1 | 1 | 00000001 | 15 | 109225 |
| 4 | 4 | 00000004 | 4 | 5334 |
| 7 | 7 | 00000007 | 18 | 65151 |
| 10 | 10 | 00000010 | 5 | 7525 |
| 13 | 13 | 00000013 | 3 | 126906 |
| 19 | 19 | 00000019 | 18 | 36731 |
| 25 | 25 | 00000025 | 12 | 14962 |
| 34 | 34 | 00000034 | 15 | 233755 |
| 35 | 35 | 00000035 | 17 | 9948 |
| 37 | 37 | 00000037 | 8 | 30587 |
| 38 | 38 | 00000038 | 12 | 115734 |
| 40 | 40 | 00000040 | 3 | 98360 |

| | | | | |
|-----|-----|----------|----|--------|
| 46 | 46 | 00000046 | 6 | 42593 |
| 49 | 49 | 00000049 | 10 | 162143 |
| 52 | 52 | 00000052 | 11 | 58101 |
| 55 | 55 | 00000055 | 10 | 12889 |
| 58 | 58 | 00000058 | 13 | 133771 |
| 67 | 67 | 00000067 | 9 | 148960 |
| 76 | 76 | 00000076 | 0 | 97224 |
| 95 | 95 | 00000095 | 15 | 32122 |
| 97 | 97 | 00000097 | 17 | 76425 |
| 100 | 100 | 00000100 | 20 | 172657 |
| 103 | 103 | 00000103 | 9 | 42823 |
| 104 | 104 | 00000104 | 10 | 18148 |
| 106 | 106 | 00000106 | 1 | 4093 |
| 112 | 112 | 00000112 | 19 | 86165 |
| 121 | 121 | 00000121 | 17 | 132809 |
| 122 | 122 | 00000122 | 3 | 68682 |
| 130 | 130 | 00000130 | 9 | 282352 |
| 131 | 131 | 00000131 | 11 | 101382 |
| 136 | 136 | 00000136 | 7 | 27712 |
| 139 | 139 | 00000139 | 9 | 27948 |
| 142 | 142 | 00000142 | 9 | 132439 |
| 143 | 143 | 00000143 | 16 | 5932 |
| 145 | 145 | 00000145 | 13 | 53784 |
| 148 | 148 | 00000148 | 11 | 53408 |
| 154 | 154 | 00000154 | 19 | 32006 |
| 157 | 157 | 00000157 | 15 | 51922 |
| 164 | 164 | 00000164 | 4 | 70463 |
| 166 | 166 | 00000166 | 10 | 163119 |
| 169 | 169 | 00000169 | 18 | 13528 |
| 172 | 172 | 00000172 | 22 | 28661 |
| 181 | 181 | 00000181 | 9 | 106114 |
| 182 | 182 | 00000182 | 3 | 66216 |
| 187 | 187 | 00000187 | 4 | 35366 |
| 193 | 193 | 00000193 | 23 | 237315 |
| 202 | 202 | 00000202 | 7 | 223094 |
| 203 | 203 | 00000203 | 1 | 92363 |
| 205 | 205 | 00000205 | 12 | 67498 |
| 208 | 208 | 00000208 | 19 | 121013 |
| 214 | 214 | 00000214 | 8 | 53338 |
| 217 | 217 | 00000217 | 23 | 31867 |
| 220 | 220 | 00000220 | 16 | 96384 |
| 224 | 224 | 00000224 | 15 | 151050 |
| 226 | 226 | 00000226 | 3 | 68888 |
| 232 | 232 | 00000232 | 22 | 36097 |
| 233 | 233 | 00000233 | 3 | 95290 |
| 238 | 238 | 00000238 | 16 | 93062 |
| 242 | 242 | 00000242 | 3 | 47040 |
| 251 | 251 | 00000251 | 13 | 39567 |
| 256 | 256 | 00000256 | 10 | 172681 |
| 259 | 259 | 00000259 | 5 | 33166 |
| 260 | 260 | 00000260 | 1 | 21747 |
| 262 | 262 | 00000262 | 4 | 66911 |
| 269 | 269 | 00000269 | 14 | 45085 |
| 274 | 274 | 00000274 | 19 | 57532 |
| 277 | 277 | 00000277 | 23 | 172443 |

| | | | | |
|-----|-----|----------|----|--------|
| 283 | 283 | 00000283 | 7 | 94450 |
| 286 | 286 | 00000286 | 22 | 37481 |
| 292 | 292 | 00000292 | 11 | 155232 |
| 298 | 298 | 00000298 | 21 | 192081 |
| 302 | 302 | 00000302 | 4 | 11829 |
| 307 | 307 | 00000307 | 13 | 90384 |
| 308 | 308 | 00000308 | 9 | 114463 |
| 313 | 313 | 00000313 | 0 | 65828 |
| 316 | 316 | 00000316 | 8 | 39858 |
| 325 | 325 | 00000325 | 15 | 116520 |
| 338 | 338 | 00000338 | 23 | 200527 |
| 340 | 340 | 00000340 | 2 | 137643 |
| 343 | 343 | 00000343 | 3 | 50091 |
| 344 | 344 | 00000344 | 2 | 7567 |
| 346 | 346 | 00000346 | 2 | 113975 |
| 350 | 350 | 00000350 | 15 | 46215 |
| 352 | 352 | 00000352 | 9 | 118354 |
| 353 | 353 | 00000353 | 10 | 91159 |
| 358 | 358 | 00000358 | 5 | 326676 |
| 359 | 359 | 00000359 | 14 | 54510 |
| 362 | 362 | 00000362 | 17 | 71096 |
| 364 | 364 | 00000364 | 23 | 135621 |
| 365 | 365 | 00000365 | 24 | 92398 |
| 367 | 367 | 00000367 | 13 | 17943 |
| 368 | 368 | 00000368 | 22 | 27429 |
| 370 | 370 | 00000370 | 12 | 119861 |
| 373 | 373 | 00000373 | 20 | 118398 |
| 374 | 374 | 00000374 | 22 | 26568 |
| 376 | 376 | 00000376 | 16 | 193117 |
| 389 | 389 | 00000389 | 9 | 128930 |
| 392 | 392 | 00000392 | 17 | 87708 |
| 394 | 394 | 00000394 | 23 | 132110 |
| 397 | 397 | 00000397 | 7 | 150506 |

Running time: 3362ms

Communication cost: 39.7549 MB

(3) 10MB

| row_num | c_custkey | c_name | c_nationkey | annotation |
|---------|-----------|----------|-------------|------------|
| 1 | 1 | 00000001 | 15 | 1955 |
| 2 | 2 | 00000002 | 13 | 9872 |
| 7 | 7 | 00000007 | 18 | 8085 |
| 10 | 10 | 00000010 | 5 | 637 |
| 11 | 11 | 00000011 | 23 | 8249 |
| 22 | 22 | 00000022 | 3 | 3908 |
| 23 | 23 | 00000023 | 3 | 19336 |
| 28 | 28 | 00000028 | 8 | 6525 |
| 35 | 35 | 00000035 | 17 | 22998 |
| 40 | 40 | 00000040 | 3 | 12540 |
| 41 | 41 | 00000041 | 10 | 6891 |
| 43 | 43 | 00000043 | 19 | 34853 |
| 58 | 58 | 00000058 | 13 | 7630 |
| 59 | 59 | 00000059 | 1 | 5355 |
| 64 | 64 | 00000064 | 3 | 13306 |

| | | | | |
|-----|-----|----------|----|-------|
| 71 | 71 | 00000071 | 7 | 3856 |
| 79 | 79 | 00000079 | 15 | 7601 |
| 86 | 86 | 00000086 | 0 | 14811 |
| 88 | 88 | 00000088 | 16 | 11863 |
| 94 | 94 | 00000094 | 9 | 175 |
| 97 | 97 | 00000097 | 17 | 11608 |
| 106 | 106 | 00000106 | 1 | 15747 |
| 107 | 107 | 00000107 | 15 | 2006 |
| 109 | 109 | 00000109 | 16 | 29422 |
| 110 | 110 | 00000110 | 10 | 2682 |
| 113 | 113 | 00000113 | 12 | 10488 |
| 116 | 116 | 00000116 | 16 | 1167 |
| 118 | 118 | 00000118 | 18 | 3797 |
| 121 | 121 | 00000121 | 17 | 18013 |
| 124 | 124 | 00000124 | 18 | 14668 |
| 130 | 130 | 00000130 | 9 | 10373 |
| 133 | 133 | 00000133 | 17 | 14988 |
| 136 | 136 | 00000136 | 7 | 5920 |
| 137 | 137 | 00000137 | 16 | 9518 |
| 143 | 143 | 00000143 | 16 | 2714 |
| 148 | 148 | 00000148 | 11 | 5221 |
| 149 | 149 | 00000149 | 19 | 25245 |
| 154 | 154 | 00000154 | 19 | 19736 |
| 155 | 155 | 00000155 | 0 | 2246 |
| 158 | 158 | 00000158 | 10 | 18587 |
| 163 | 163 | 00000163 | 21 | 8226 |
| 172 | 172 | 00000172 | 22 | 6105 |
| 175 | 175 | 00000175 | 10 | 4779 |
| 178 | 178 | 00000178 | 21 | 3837 |
| 179 | 179 | 00000179 | 4 | 1710 |
| 184 | 184 | 00000184 | 21 | 16716 |
| 188 | 188 | 00000188 | 5 | 12571 |
| 190 | 190 | 00000190 | 11 | 2325 |
| 193 | 193 | 00000193 | 23 | 5853 |
| 202 | 202 | 00000202 | 7 | 14456 |
| 205 | 205 | 00000205 | 12 | 798 |
| 215 | 215 | 00000215 | 9 | 1526 |
| 223 | 223 | 00000223 | 20 | 15968 |
| 226 | 226 | 00000226 | 3 | 14595 |
| 238 | 238 | 00000238 | 16 | 14926 |
| 244 | 244 | 00000244 | 15 | 8166 |
| 247 | 247 | 00000247 | 20 | 5482 |
| 248 | 248 | 00000248 | 10 | 12037 |
| 250 | 250 | 00000250 | 16 | 16810 |
| 251 | 251 | 00000251 | 13 | 5817 |
| 253 | 253 | 00000253 | 15 | 11913 |
| 254 | 254 | 00000254 | 1 | 3772 |
| 256 | 256 | 00000256 | 10 | 8579 |
| 262 | 262 | 00000262 | 4 | 4343 |
| 265 | 265 | 00000265 | 17 | 5757 |
| 272 | 272 | 00000272 | 2 | 1526 |
| 275 | 275 | 00000275 | 22 | 10942 |
| 277 | 277 | 00000277 | 23 | 4421 |
| 278 | 278 | 00000278 | 20 | 7130 |
| 283 | 283 | 00000283 | 7 | 16531 |

| | | | | |
|-----|-----|----------|----|-------|
| 289 | 289 | 00000289 | 10 | 10212 |
| 299 | 299 | 00000299 | 4 | 467 |
| 302 | 302 | 00000302 | 4 | 11834 |
| 304 | 304 | 00000304 | 0 | 6252 |
| 313 | 313 | 00000313 | 0 | 8718 |
| 316 | 316 | 00000316 | 8 | 11675 |
| 319 | 319 | 00000319 | 6 | 6023 |
| 323 | 323 | 00000323 | 18 | 2822 |
| 325 | 325 | 00000325 | 15 | 8409 |
| 328 | 328 | 00000328 | 5 | 11808 |
| 332 | 332 | 00000332 | 22 | 11376 |
| 334 | 334 | 00000334 | 4 | 24629 |
| 337 | 337 | 00000337 | 0 | 4065 |
| 340 | 340 | 00000340 | 2 | 25186 |
| 341 | 341 | 00000341 | 9 | 13008 |
| 346 | 346 | 00000346 | 2 | 1555 |
| 352 | 352 | 00000352 | 9 | 16595 |
| 355 | 355 | 00000355 | 14 | 20416 |
| 364 | 364 | 00000364 | 23 | 1142 |
| 374 | 374 | 00000374 | 22 | 10668 |
| 379 | 379 | 00000379 | 7 | 27300 |
| 382 | 382 | 00000382 | 8 | 9649 |
| 386 | 386 | 00000386 | 24 | 15872 |
| 388 | 388 | 00000388 | 7 | 2248 |
| 389 | 389 | 00000389 | 9 | 5668 |
| 391 | 391 | 00000391 | 11 | 10134 |
| 394 | 394 | 00000394 | 23 | 10882 |
| 398 | 398 | 00000398 | 15 | 345 |
| 401 | 401 | 00000401 | 19 | 8002 |
| 403 | 403 | 00000403 | 14 | 5822 |

Running time: 4898ms

Communication cost: 142.878 MB

3. The extension query

(1) 1MB

row_num o_custkey o_orderkey c_name l_returnflag annotation
Empty Relation!

Running time: 8747ms

Communication cost: 223.354 MB

(2) 3MB

| row_num | | o_custkey | o_orderkey | c_name | l_returnflag | annotation |
|---------|----|---------------|------------|--------|--------------|------------|
| 1 | 4 | 164 | 00000004 | R | | 17062 |
| 2 | 5 | 896 | 00000005 | A | | 3872 |
| 3 | 7 | 7621 | 00000007 | N | | 1408 |
| 4 | 10 | 1389000000010 | N | | | 633 |
| 5 | 11 | 1696 | 00000011 | N | | 11229 |
| 6 | 16 | 7399 | 00000016 | N | | 2816 |
| 7 | 16 | 1392600000016 | N | | | 817 |

| | | | | |
|----|-----|---------------|---|-------|
| 8 | 16 | 1568700000016 | R | 5729 |
| 9 | 20 | 7105 00000020 | R | 8448 |
| 10 | 55 | 1066100000055 | R | 5632 |
| 11 | 85 | 8195 00000085 | R | 16282 |
| 12 | 91 | 2720 00000091 | A | 17248 |
| 13 | 100 | 7874 00000100 | N | 1634 |
| 14 | 100 | 8706 00000100 | N | 16164 |
| 15 | 101 | 6278 00000101 | R | 7385 |
| 16 | 101 | 9735 00000101 | N | 4381 |
| 17 | 103 | 3552 00000103 | N | 12132 |
| 18 | 110 | 5346 00000110 | A | 2464 |
| 19 | 112 | 1 00000112 | N | 4200 |
| 20 | 112 | 2662 00000112 | N | 3546 |
| 21 | 119 | 6402 00000119 | N | 5697 |
| 22 | 134 | 4871 00000134 | N | 5729 |
| 23 | 139 | 1059800000139 | R | 13072 |
| 24 | 149 | 1360300000149 | N | 7744 |
| 25 | 160 | 1613400000160 | R | 4652 |
| 26 | 160 | 1626200000160 | A | 3033 |
| 27 | 163 | 1408 00000163 | N | 48846 |
| 28 | 169 | 1954 00000169 | N | 10339 |
| 29 | 175 | 1056600000175 | N | 7353 |
| 30 | 176 | 4545 00000176 | A | 2816 |
| 31 | 182 | 7524 00000182 | R | 5388 |
| 32 | 187 | 6084 00000187 | N | 1971 |
| 33 | 188 | 8645 00000188 | N | 7751 |
| 34 | 196 | 5312 00000196 | A | 25413 |
| 35 | 196 | 1062900000196 | A | 3376 |
| 36 | 199 | 8582 00000199 | A | 9304 |
| 37 | 205 | 4004 00000205 | A | 8980 |
| 38 | 220 | 3746 00000220 | R | 7227 |
| 39 | 220 | 1414700000220 | A | 4044 |
| 40 | 220 | 1689600000220 | N | 19771 |
| 41 | 223 | 6343 00000223 | N | 29075 |
| 42 | 223 | 1472200000223 | N | 28595 |
| 43 | 230 | 2656 00000230 | R | 11229 |
| 44 | 238 | 993 00000238 | N | 4200 |
| 45 | 244 | 1587500000244 | N | 5697 |
| 46 | 244 | 1603600000244 | R | 58150 |
| 47 | 247 | 1175000000247 | N | 352 |
| 48 | 253 | 2630 00000253 | R | 37582 |
| 49 | 253 | 3108 00000253 | A | 13024 |
| 50 | 253 | 1356900000253 | R | 12806 |
| 51 | 257 | 1232200000257 | R | 1056 |
| 52 | 260 | 1289900000260 | N | 1477 |
| 53 | 262 | 8805 00000262 | N | 2464 |
| 54 | 265 | 7618 00000265 | R | 27912 |
| 55 | 265 | 1235800000265 | N | 3489 |
| 56 | 266 | 1184 00000266 | N | 1347 |
| 57 | 274 | 1050100000274 | N | 25586 |
| 58 | 283 | 1666 00000283 | N | 36053 |
| 59 | 284 | 1776000000284 | A | 1055 |
| 60 | 286 | 418 00000286 | N | 591 |
| 61 | 299 | 9987 00000299 | N | 38379 |
| 62 | 304 | 9955 00000304 | N | 12255 |

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|----|-----|-------|----------|---|-------|
| 63 | 307 | 2432 | 00000307 | N | 4576 |
| 64 | 307 | 3492 | 00000307 | R | 3143 |
| 65 | 311 | 868 | 00000311 | R | 10621 |
| 66 | 319 | 16391 | 00000319 | N | 6752 |
| 67 | 332 | 5254 | 00000332 | A | 18791 |
| 68 | 332 | 5570 | 00000332 | N | 12469 |
| 69 | 341 | 9159 | 00000341 | N | 20094 |
| 70 | 346 | 5478 | 00000346 | N | 27777 |
| 71 | 370 | 4803 | 00000370 | N | 4009 |
| 72 | 383 | 15685 | 00000383 | N | 633 |
| 73 | 385 | 17473 | 00000385 | N | 17157 |
| 74 | 406 | 7138 | 00000406 | N | 8448 |
| 75 | 418 | 8134 | 00000418 | N | 10327 |
| 76 | 422 | 2370 | 00000422 | A | 14184 |
| 77 | 448 | 15396 | 00000448 | N | 15119 |

Running time: 10538ms

Communication cost: 715.562 MB

(3) 10MB

| row_num | o_custkey | o_orderkey | c_name | l_returnflag | annotation |
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| 1 | 23 | 4086400000023 | N | 228 | |
| 2 | 34 | 4883600000034 | A | 119 | |
| 3 | 37 | 1031 00000037 | R | 525 | |
| 4 | 41 | 5488000000041 | N | 48 | |
| 5 | 50 | 1129900000050 | R | 765 | |
| 6 | 65 | 7105 00000065 | A | 620 | |
| 7 | 65 | 1882200000065 | A | 1395 | |
| 8 | 83 | 2150400000083 | N | 150 | |
| 9 | 85 | 2477100000085 | N | 1221 | |
| 10 | 89 | 1415000000089 | A | 2178 | |
| 11 | 89 | 1949000000089 | N | 682 | |
| 12 | 100 | 2899600000100 | N | 667 | |
| 13 | 104 | 5363900000104 | N | 798 | |
| 14 | 118 | 6499 00000118 | N | 240 | |
| 15 | 121 | 4195500000121 | N | 1015 | |
| 16 | 131 | 3318600000131 | R | 840 | |
| 17 | 131 | 5501300000131 | N | 900 | |
| 18 | 136 | 2588800000136 | N | 1050 | |
| 19 | 154 | 1235700000154 | N | 444 | |
| 20 | 169 | 5075300000169 | N | 3300 | |
| 21 | 179 | 5491700000179 | A | 1125 | |
| 22 | 181 | 2723400000181 | N | 170 | |
| 23 | 188 | 1587200000188 | A | 2550 | |
| 24 | 196 | 2179700000196 | N | 646 | |
| 25 | 200 | 3225600000200 | N | 700 | |
| 26 | 211 | 4326600000211 | N | 760 | |
| 27 | 220 | 2227600000220 | R | 943 | |
| 28 | 226 | 1222800000226 | A | 414 | |
| 29 | 227 | 5260900000227 | N | 675 | |
| 30 | 230 | 5959 00000230 | A | 1261 | |
| 31 | 233 | 3133500000233 | N | 190 | |
| 32 | 233 | 3779400000233 | R | 370 | |

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|----|-----|---------------|---|------|
| 33 | 235 | 3107300000235 | R | 1075 |
| 34 | 239 | 4864200000239 | A | 80 |
| 35 | 242 | 3222700000242 | N | 2268 |
| 36 | 244 | 5321700000244 | N | 40 |
| 37 | 247 | 2627400000247 | A | 660 |
| 38 | 248 | 2960500000248 | A | 25 |
| 39 | 259 | 3277400000259 | A | 119 |
| 40 | 259 | 4224600000259 | R | 825 |
| 41 | 268 | 5213500000268 | A | 120 |
| 42 | 280 | 5079000000280 | N | 1452 |
| 43 | 281 | 5958900000281 | A | 930 |
| 44 | 295 | 4199000000295 | N | 320 |
| 45 | 304 | 3469400000304 | N | 215 |
| 46 | 307 | 3232700000307 | R | 280 |
| 47 | 314 | 1828 00000314 | R | 726 |
| 48 | 337 | 9382 00000337 | N | 264 |
| 49 | 355 | 1312500000355 | R | 38 |
| 50 | 355 | 4544700000355 | R | 629 |
| 51 | 388 | 3649 00000388 | A | 57 |
| 52 | 388 | 1130300000388 | R | 1472 |
| 53 | 388 | 3968600000388 | A | 208 |
| 54 | 392 | 323 00000392 | A | 4000 |
| 55 | 395 | 5130000000395 | N | 80 |
| 56 | 400 | 3462600000400 | A | 275 |
| 57 | 400 | 4205300000400 | N | 10 |
| 58 | 400 | 5453200000400 | N | 460 |
| 59 | 403 | 8098 00000403 | N | 399 |
| 60 | 409 | 2016600000409 | A | 200 |
| 61 | 409 | 3360500000409 | R | 190 |
| 62 | 409 | 4518700000409 | R | 390 |
| 63 | 410 | 5911000000410 | N | 609 |
| 64 | 440 | 1101000000440 | N | 2024 |
| 65 | 455 | 2176000000455 | R | 32 |
| 66 | 458 | 1270600000458 | A | 2214 |
| 67 | 458 | 2524800000458 | N | 1350 |
| 68 | 463 | 2778300000463 | N | 475 |
| 69 | 469 | 1619400000469 | R | 2070 |
| 70 | 472 | 1792 00000472 | R | 675 |
| 71 | 473 | 3587700000473 | A | 510 |
| 72 | 478 | 3312100000478 | N | 368 |
| 73 | 488 | 8199 00000488 | N | 1377 |
| 74 | 490 | 2969700000490 | N | 29 |
| 75 | 496 | 3623000000496 | R | 152 |
| 76 | 497 | 2486500000497 | R | 1110 |
| 77 | 497 | 4256700000497 | A | 570 |
| 78 | 505 | 5168400000505 | R | 3588 |
| 79 | 506 | 3712200000506 | N | 459 |
| 80 | 508 | 4880100000508 | A | 630 |
| 81 | 509 | 3898000000509 | A | 510 |
| 82 | 526 | 2803200000526 | N | 2720 |
| 83 | 529 | 1699500000529 | R | 1406 |
| 84 | 548 | 5056600000548 | N | 1715 |
| 85 | 577 | 6663 00000577 | R | 200 |
| 86 | 580 | 3738000000580 | A | 1716 |
| 87 | 583 | 1785900000583 | A | 58 |

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| 88 | 584 | 3603300000584 | R | 1875 |
| 89 | 593 | 4506000000593 | R | 476 |
| 90 | 595 | 4768600000595 | R | 1518 |
| 91 | 602 | 2400500000602 | A | 493 |
| 92 | 607 | 8997 00000607 | A | 2178 |
| 93 | 611 | 3303100000611 | R | 270 |
| 94 | 623 | 4269000000623 | A | 370 |
| 95 | 625 | 2259700000625 | N | 87 |
| 96 | 632 | 2796800000632 | N | 2666 |
| 97 | 637 | 4329800000637 | N | 300 |
| 98 | 655 | 8518 00000655 | N | 992 |
| 99 | 661 | 1123200000661 | N | 750 |
| 100 | 667 | 2925500000667 | N | 1575 |
| 101 | 685 | 2006600000685 | A | 40 |
| 102 | 685 | 4192400000685 | N | 155 |
| 103 | 689 | 4726700000689 | R | 970 |
| 104 | 691 | 8576 00000691 | A | 140 |
| 105 | 715 | 5210200000715 | A | 1806 |
| 106 | 731 | 3746 00000731 | R | 644 |
| 107 | 734 | 3664600000734 | R | 630 |
| 108 | 737 | 4787700000737 | A | 2046 |
| 109 | 745 | 5350 00000745 | R | 361 |
| 110 | 746 | 3395300000746 | R | 1406 |
| 111 | 751 | 2243600000751 | N | 210 |
| 112 | 760 | 5654700000760 | A | 760 |
| 113 | 778 | 5491600000778 | N | 30 |
| 114 | 785 | 2960600000785 | N | 464 |
| 115 | 788 | 2813300000788 | N | 756 |
| 116 | 794 | 2279 00000794 | A | 162 |
| 117 | 805 | 1318500000805 | N | 1400 |
| 118 | 811 | 4634100000811 | R | 920 |
| 119 | 818 | 1174900000818 | N | 3024 |
| 120 | 820 | 4003200000820 | A | 114 |
| 121 | 830 | 4163900000830 | N | 164 |
| 122 | 839 | 2640000000839 | N | 1998 |
| 123 | 883 | 2144500000883 | R | 3300 |
| 124 | 892 | 2209 00000892 | A | 35 |
| 125 | 901 | 4701500000901 | A | 1260 |
| 126 | 908 | 3553 00000908 | R | 252 |
| 127 | 908 | 5529900000908 | A | 2904 |
| 128 | 910 | 5901200000910 | A | 68 |
| 129 | 913 | 4889600000913 | A | 528 |
| 130 | 943 | 3773400000943 | A | 2064 |
| 131 | 946 | 5501400000946 | A | 713 |
| 132 | 949 | 1164800000949 | N | 874 |
| 133 | 949 | 3981000000949 | N | 2268 |
| 134 | 952 | 2451900000952 | N | 841 |
| 135 | 965 | 3750 00000965 | R | 1786 |
| 136 | 967 | 4514 00000967 | R | 2160 |
| 137 | 971 | 768 00000971 | N | 2574 |
| 138 | 973 | 4381200000973 | N | 841 |
| 139 | 986 | 2336700000986 | N | 836 |
| 140 | 994 | 2089900000994 | R | 1938 |
| 141 | 1010 | 5193700001010 | R | 1554 |
| 142 | 1015 | 2620900001015 | N | 666 |

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|-----|------|---------------|---|------|
| 143 | 1021 | 1223100001021 | N | 1008 |
| 144 | 1025 | 4631000001025 | A | 450 |
| 145 | 1027 | 390 00001027 | N | 130 |
| 146 | 1027 | 1571 00001027 | A | 180 |
| 147 | 1028 | 6789 00001028 | N | 209 |
| 148 | 1033 | 2259500001033 | N | 559 |
| 149 | 1040 | 3926400001040 | N | 1650 |
| 150 | 1042 | 5254500001042 | N | 2400 |
| 151 | 1045 | 1856 00001045 | R | 4324 |
| 152 | 1045 | 2839000001045 | R | 1075 |
| 153 | 1060 | 1485200001060 | N | 1122 |
| 154 | 1061 | 4384600001061 | R | 3520 |
| 155 | 1079 | 5088000001079 | A | 3600 |
| 156 | 1084 | 2256000001084 | N | 215 |
| 157 | 1093 | 4102800001093 | N | 2625 |
| 158 | 1096 | 3286400001096 | N | 874 |
| 159 | 1099 | 2922300001099 | A | 770 |
| 160 | 1102 | 3952000001102 | N | 990 |
| 161 | 1102 | 5385800001102 | N | 180 |
| 162 | 1106 | 7047 00001106 | N | 2025 |
| 163 | 1117 | 5299600001117 | N | 232 |
| 164 | 1124 | 5933300001124 | N | 2046 |
| 165 | 1142 | 3578100001142 | A | 1710 |
| 166 | 1148 | 1491700001148 | N | 1000 |
| 167 | 1157 | 8261 00001157 | R | 825 |
| 168 | 1163 | 4358800001163 | A | 3168 |
| 169 | 1171 | 3548800001171 | N | 1512 |
| 170 | 1174 | 2032200001174 | A | 650 |
| 171 | 1178 | 801 00001178 | A | 726 |
| 172 | 1184 | 4778000001184 | R | 1292 |
| 173 | 1189 | 3891800001189 | N | 100 |
| 174 | 1192 | 2329900001192 | A | 40 |
| 175 | 1198 | 7140 00001198 | A | 207 |
| 176 | 1207 | 2988900001207 | R | 112 |
| 177 | 1207 | 4125500001207 | R | 140 |
| 178 | 1213 | 5632300001213 | N | 165 |
| 179 | 1214 | 1136500001214 | N | 1922 |
| 180 | 1222 | 3109 00001222 | A | 2150 |
| 181 | 1223 | 1885100001223 | R | 370 |
| 182 | 1226 | 3667300001226 | A | 225 |
| 183 | 1234 | 5104400001234 | R | 532 |
| 184 | 1246 | 7589 00001246 | N | 1400 |
| 185 | 1252 | 482 00001252 | N | 528 |
| 186 | 1255 | 1997500001255 | A | 2052 |
| 187 | 1255 | 2729900001255 | A | 483 |
| 188 | 1255 | 3926800001255 | R | 736 |
| 189 | 1256 | 4489600001256 | N | 2775 |
| 190 | 1261 | 8001 00001261 | R | 20 |
| 191 | 1261 | 1213000001261 | N | 726 |
| 192 | 1264 | 4179600001264 | N | 525 |
| 193 | 1270 | 2906300001270 | A | 175 |
| 194 | 1276 | 3449800001276 | A | 560 |
| 195 | 1277 | 2547400001277 | A | 52 |
| 196 | 1282 | 1827200001282 | N | 285 |
| 197 | 1285 | 3357000001285 | R | 32 |

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|-----|------|---------------|---|------|
| 198 | 1291 | 1367100001291 | N | 516 |
| 199 | 1300 | 1888000001300 | R | 1800 |
| 200 | 1300 | 5066200001300 | N | 1122 |
| 201 | 1321 | 3453000001321 | R | 2356 |
| 202 | 1333 | 1398600001333 | N | 1725 |
| 203 | 1340 | 1284 00001340 | N | 245 |
| 204 | 1348 | 1485000001348 | N | 1160 |
| 205 | 1358 | 5552400001358 | N | 70 |
| 206 | 1360 | 4838700001360 | R | 1584 |
| 207 | 1378 | 4096 00001378 | R | 200 |
| 208 | 1385 | 4940900001385 | N | 2400 |
| 209 | 1397 | 3233 00001397 | A | 625 |
| 210 | 1403 | 3175100001403 | N | 333 |
| 211 | 1406 | 3145900001406 | N | 1334 |
| 212 | 1418 | 7750 00001418 | R | 150 |
| 213 | 1451 | 5443500001451 | N | 475 |
| 214 | 1453 | 5555300001453 | R | 220 |
| 215 | 1468 | 3069300001468 | N | 2442 |
| 216 | 1481 | 9602 00001481 | A | 1296 |
| 217 | 1496 | 4515700001496 | N | 1500 |
| 218 | 1499 | 3514300001499 | N | 836 |

Running time: 37706ms

Communication cost: 2562.21 MB