Q1-D. Write a 500-word (maximum) explanation of how you developed your hybrid sorting algorithm. What combinations of the algorithms/approaches you tried, what different parameters you chose, and how much of a difference these changes made to the efficiency of your algorithm, including the run time complexity.

Create a single report .pdf file containing the following:

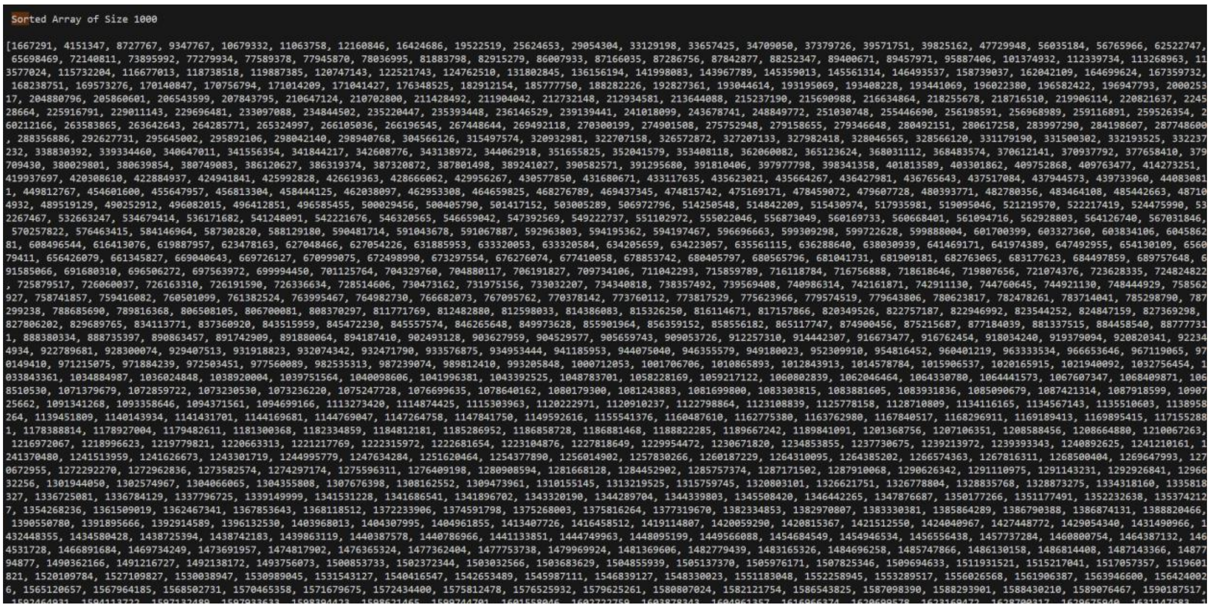
When starting the project, I first reviewed the sorts I would need. I used the PowerPoint provided in weeks prior to remind me of the sorts. In the quicksort document, there was pseudocode for quicksort. I took inspiration from this to help write my quicksort. This helped me gather further understanding on how I would go about coding, as well as the overall structure of my quicksort. Quicksort uses pivots to split code and sort it before merging recursively. I chose to put my pivot in the middle as I thought this would be most efficient, however I could have benefited form making my pivot randomised. I then spent the next few hours fleshing out and experimenting with quicksort. This was difficult at times as my java is not as strong as my python, this meant I spent a lot of time researching and working out how to code quicksort.

After developing it, I tested it. This included timing the program and taking the average over 10 runs, as well as running the sorts with sorted, random, and opposite sorted. I did this for all values from 1000 to 500, 000. This helped me visualise how fast the sort was as well as test all values. This took a little while to work out, however I had experience with timing sorts from previous exercises. The reverse, sorted and random arrays took the longest as I struggled to get my head around the problem. In terms of items, I chose to use only positive values as I thought that made sense for item ID's in a company.

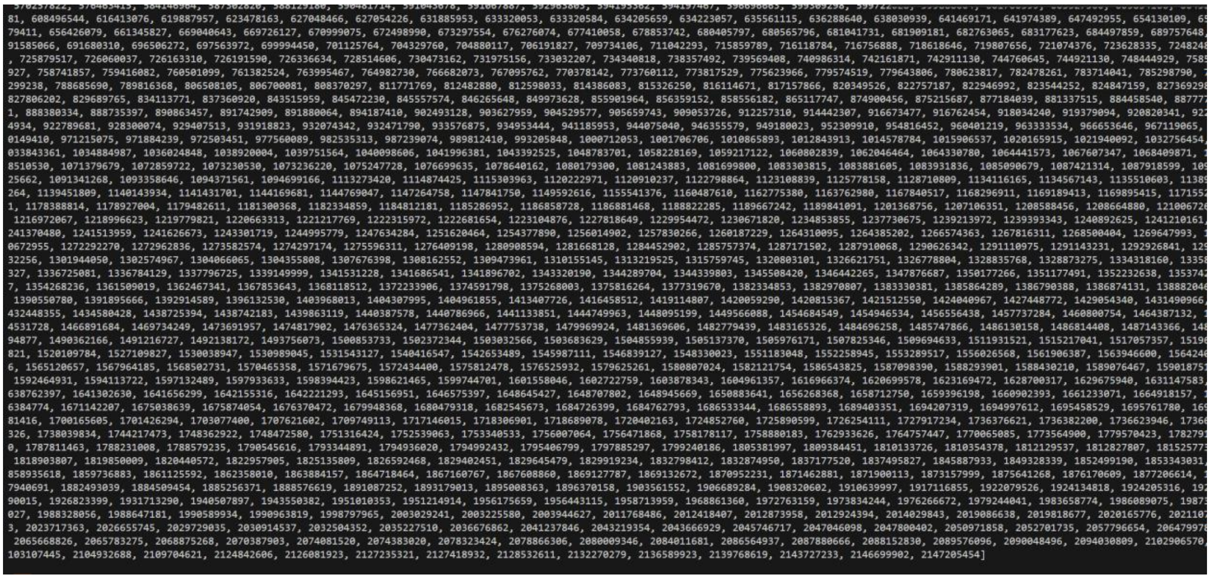
After that, I started developing my hybrid sort. I started by creating a selection sort to mix with quick sort as it was the easiest and efficient for small sizes. I once again reviewed the PowerPoints provided to help my understanding. Coding selection sort was quick as is it is a simpler search, and I had experience with it from A-Level. Following its creation, I had to decide on a cutoff point. This works by switching from quicksort to selection sort once there are only n values left. I tested a few cutoff sizes ranging from 5 to 100, but I found 10 worked best on average. I also tried insertion sort, this was harder to make, but I had experience with it from A-Level which helped. I tested these two sorts; I found the selection sort hybrid had similar timing. After this, I chose insertion sort as it seemed more efficient overall. I also tested various cutoff points for insertion and found around 500 to be the best. Choosing a percentage would have probably been better in hindsight. In conclusion, I found the hybrid sort was on average faster than the quick sort. This was more apparent on smaller arrays. It worked well on sorted, random and reverse arrays also.

1A

```
Def quicksort(array):
If array length = 1 or less then it is sorted
End (return the array) #basecase

Left_of_pivot = []
right_of_pivot = []
middle_of_array = []

  Pivot = length of array // 2  #middle of array
  For Item in array:
    If item < pivot:
      Add to Left_of_pivot
    If item > pivot:
      Move right_of_pivot
If item = to pivot:
      Move to middle_of_array

Return  quicksort(Array) + Left_of_pivot + middle_of_array + right_of_pivot
```

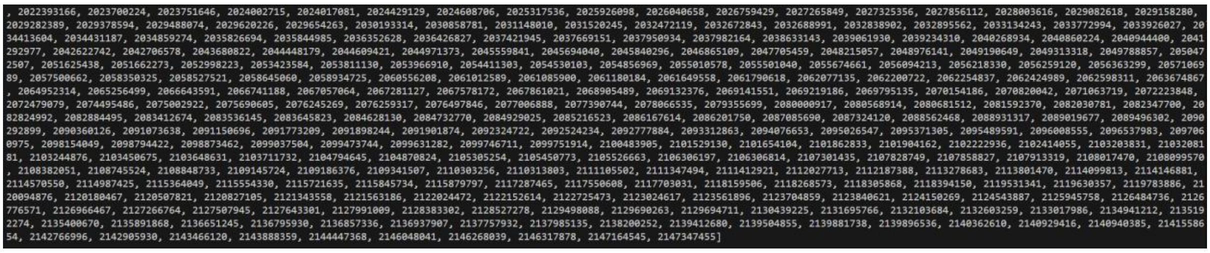


```
Sorted Array of Size 1000

[1667291, 4151347, 8727767, 9347767, 10679332, 11063758, 12160846, 16424686, 19522519, 25624653, 29054304, 33129198, 33657425, 34709050, 37379726, 39571751, 39825162, 47729948, 56035184, 56765966, 62522747,
 65698469, 72140811, 73895992, 77279934, 77589378, 77945870, 78036995, 81883798, 82915279, 86007933, 87166035, 87286756, 87842877, 88252347, 89400671, 89457971, 95887406, 101374932, 112339734, 113268963, 11
3577024, 115732204, 116677013, 118738518, 119887385, 120747143, 122521743, 124762510, 131802845, 136156194, 141998083, 143967789, 145359013, 145561314, 146493537, 158739037, 162042109, 164699624, 167359732,
 168238751, 169573276, 170140847, 170756794, 171014209, 171041427, 176348525, 182912154, 185777750, 188282226, 192827361, 193044614, 193195069, 193408228, 193441069, 196022380, 196582422, 196947793, 2000253
17, 204880796, 205860601, 206543599, 207843795, 210647124, 210702800, 211428492, 211904042, 212732148, 212934581, 213644088, 215237190, 215690988, 216634864, 218255678, 218716510, 219906114, 220821637, 2245
28664, 225916791, 229011143, 229696481, 233097088, 234844502, 235220447, 235393448, 236146529, 239139441, 241018099, 243678741, 248849772, 251030748, 255446690, 256198591, 256968989, 259116891, 259526354, 2
60212166, 263583865, 263642643, 264285771, 265324997, 266105036, 266196545, 267448644, 269492118, 270300199, 274901508, 275752948, 279158655, 279346648, 280492151, 280617258, 283997290, 284198607, 287748600
, 288356886, 292627731, 295645002, 295892106, 298042140, 298940768, 304566126, 315497574, 320932981, 322707158, 326572872, 327207133, 327982418, 328046565, 328566120, 331179190, 331500302, 332193525, 332237
232, 338830392, 339334460, 340647011, 341556354, 341844217, 342608776, 343138972, 344062918, 351655825, 352041579, 353408118, 362060082, 365123624, 368031112, 368483574, 370612141, 370937792, 377658410, 379
709430, 380029801, 380639854, 380749083, 386120627, 386319374, 387320872, 387801498, 389241027, 390582571, 391295680, 391810406, 397977798, 398341358, 401813589, 403301862, 409752868, 409763477, 414273251,
419937697, 420308610, 422884937, 424941841, 425992828, 426619363, 428666062, 429956267, 430577850, 431680671, 433117635, 435623021, 435664267, 436427981, 436765643, 437517084, 437944573, 439733960, 44083081
1, 449812767, 454601600, 455647957, 456813304, 458444125, 462038097, 462953308, 464659825, 468276789, 469437345, 474815742, 475169171, 478459072, 479607728, 480393771, 482780356, 483464108, 485442663, 48710
4932, 489519129, 490252912, 496082015, 496412851, 496585455, 500029456, 500405790, 501417152, 503005289, 506972796, 514250548, 514842209, 515430974, 517935981, 519095046, 521219570, 522217419, 524475990, 53
2267467, 532663247, 534679414, 536171682, 541248091, 542221676, 546320565, 546659042, 547392569, 549222737, 551102972, 555022046, 556873049, 560169733, 560668401, 561094716, 562928803, 564126740, 567031846,
 570257822, 576463415, 584146964, 587302820, 588129180, 590481714, 591043678, 591067887, 592963803, 594195362, 594197467, 596696663, 599309298, 599722628, 599888004, 601700399, 603327360, 603834106, 6045862
81, 608496544, 616413076, 619887957, 623478163, 627048466, 627054226, 631885953, 633320053, 633320584, 634205659, 634223057, 635561115, 636288640, 638030939, 641469171, 641974389, 647492955, 654130109, 6560
79411, 656426079, 661345827, 669040643, 669726127, 670999075, 672498990, 673297554, 676276074, 677410058, 678853742, 680405797, 680565796, 681041731, 681909181, 682763065, 683177623, 684497859, 689757648, 6
91585066, 691680310, 696506272, 697563972, 699994450, 701125764, 704329760, 704880117, 706191827, 709734106, 711042293, 715859789, 716118784, 716756888, 718618646, 719807656, 721074376, 723628335, 724824822
, 725879517, 726060037, 726163310, 726191590, 726336634, 728514606, 730473162, 731975156, 733032207, 734340818, 738357492, 739569408, 740986314, 742161871, 742911130, 744760645, 744921130, 748444929, 758562
927, 758741857, 759416082, 760501099, 761382524, 763995467, 764982730, 766682073, 767095762, 770378142, 773760112, 773817529, 775623966, 779574519, 779643806, 780623817, 782478261, 783714041, 785298790, 787
299238, 788685690, 789816368, 806508105, 806700081, 808370297, 811771769, 812482880, 812598033, 814386083, 815326250, 816114671, 817157866, 820349526, 822757187, 822946992, 823544252, 824847159, 827369298,
827806202, 829689765, 834113771, 837360920, 843515959, 845472230, 845557574, 846265648, 849973628, 855901964, 856359152, 858556182, 865117747, 874900456, 875215687, 877184039, 881337515, 884458540, 88777731
1, 888380334, 888735397, 890863457, 891742909, 891880064, 894187410, 902493128, 903627959, 904529577, 905659743, 909053726, 912257310, 914442307, 916673477, 916762454, 918034240, 919379094, 920820341, 92234
4934, 922789681, 928300074, 929407513, 931918823, 932074342, 932471790, 933576875, 934953444, 941185953, 944075040, 946355579, 949180023, 952309910, 954816452, 960401219, 963333534, 966653646, 967119065, 97
0149410, 971215075, 971884239, 972503451, 977560089, 982535313, 987239074, 989812410, 993205848, 1000712053, 1001706706, 1010865893, 1012843913, 1014578784, 1015906537, 1020165915, 1021940092, 1032756454, 1
033843361, 1034884987, 1036024848, 1038920004, 1039751564, 1040098606, 1041996381, 1043392525, 1048783701, 1058228169, 1059217122, 1060802839, 1062046464, 1064330780, 1064441573, 1067607347, 1068409871, 106
8510530, 1071379679, 1072859722, 1073230530, 1073236220, 1075247728, 1076699635, 1078640162, 1080179300, 1081243883, 1081699800, 1083303815, 1083881605, 1083931836, 1085090679, 1087421314, 1087918599, 10907
25662, 1091341268, 1093358646, 1094371561, 1094699166, 1113273420, 1114874425, 1115303963, 1120222971, 1120910237, 1122798864, 1123108839, 1125778158, 1128710809, 1134116165, 1134567143, 1135510603, 1138958
264, 1139451809, 1140143934, 1141431701, 1144169681, 1144769047, 1147264758, 1147841750, 1149592616, 1155541376, 1160487610, 1162775380, 1163762980, 1167840517, 1168296911, 1169189413, 1169895415, 117155288
1, 1178388814, 1178927004, 1179482611, 1181300368, 1182334859, 1184812181, 1185286952, 1186858728, 1186881468, 1188822285, 1189667242, 1189841091, 1201368756, 1207106351, 1208588456, 1208664880, 1210067263,
 1216972067, 1218996623, 1219779821, 1220663313, 1221217769, 1222315972, 1222681654, 1223104876, 1227818649, 1229954472, 1230671820, 1234853855, 1237730675, 1239213972, 1239393343, 1240892625, 1241210161, 1
241370480, 1241513959, 1241626673, 1243301719, 1244995779, 1247634284, 1251620464, 1254377890, 1256014902, 1257830266, 1260187229, 1264310095, 1264385202, 1266574363, 1267816311, 1268500404, 1269647993, 127
0672955, 1272292270, 1272962836, 1273582574, 1274297174, 1275596311, 1276409198, 1280908594, 1281668128, 1284452902, 1285757374, 1287171502, 1287910068, 1290626342, 1291110975, 1291143231, 1292926841, 12966
32256, 1301944050, 1302574967, 1304066065, 1304355808, 1307676398, 1308162552, 1309473961, 1310155145, 1313219525, 1315759745, 1320803101, 1326621751, 1326778804, 1328835768, 1328873275, 1334318160, 1335818
327, 1336725081, 1336784129, 1337796725, 1339149999, 1341531228, 1341686541, 1341896702, 1343320190, 1344289704, 1344339803, 1345508420, 1346442265, 1347876687, 1350177266, 1351177491, 1352232638, 135374212
7, 1354268236, 1361509019, 1362467341, 1367853643, 1368118512, 1372233906, 1374591798, 1375268003, 1375816264, 1377319670, 1382334853, 1382970807, 1383330381, 1385864289, 1386790388, 1386874131, 1388820466,
 1390550780, 1391895666, 1392914589, 1396132530, 1403968013, 1404307995, 1404961855, 1413407726, 1416458512, 1419114807, 1420059290, 1420815367, 1421512550, 1424040967, 1427448772, 1429054340, 1431490966, 1
432448355, 1434580428, 1438725394, 1438742183, 1439863119, 1440387578, 1440786966, 1441133851, 1444749963, 1448095199, 1449566088, 1454684549, 1454946534, 1456556438, 1457737284, 1460800754, 1464387132, 146
4531728, 1466891684, 1469734249, 1473691957, 1474817902, 1476365324, 1477362404, 1477753738, 1479969924, 1481369606, 1482779439, 1483165326, 1484696258, 1485747866, 1486130158, 1486814408, 1487143366, 14877
94877, 1490362166, 1491216727, 1492138172, 1493756073, 1500853733, 1502372344, 1503032566, 1503683629, 1504855939, 1505137370, 1505976171, 1507825346, 1509694633, 1511931521, 1515217041, 1517057357, 1519601
821, 1520109784, 1527109827, 1530038947, 1530989045, 1531543127, 1540416547, 1542653489, 1545987111, 1546839127, 1548330023, 1551183048, 1552258945, 1553289517, 1556026568, 1561906387, 1563946600, 156424002
6, 1565120657, 1567964185, 1568502731, 1570465358, 1571679675, 1572434400, 1575812478, 1576525932, 1579625261, 1580807024, 1582121754, 1586543825, 1587098390, 1588293901, 1588430210, 1589076467, 1590187517,
```

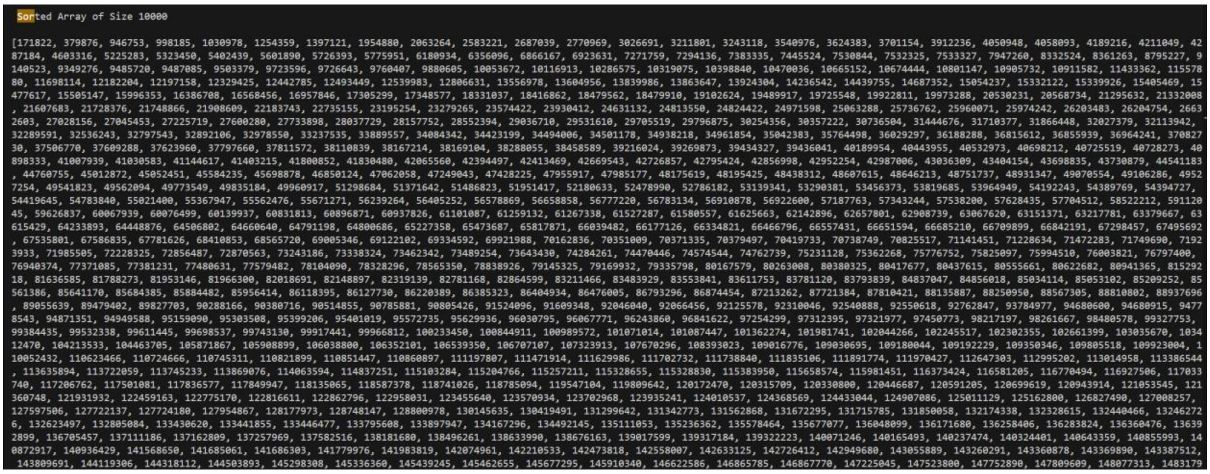


```
81, 608496544, 616413076, 619887957, 623478163, 627048466, 627054226, 631885953, 633320053, 633320584, 634205659, 634223057, 635561115, 636288640, 638030939, 641469171, 641974389, 647492955, 654130109, 65
79411, 656426079, 661345827, 669040643, 669726127, 670999075, 672498990, 673297554, 676276074, 677410058, 678853742, 680405797, 680565796, 681041731, 681909181, 682763065, 683177623, 684497859, 689757648,
91585066, 691680310, 696506272, 697563972, 699994450, 701125764, 704329760, 704880117, 706191827, 709734106, 711042293, 715859789, 716118784, 716756888, 718618646, 719807656, 721074376, 723628335, 7248248
, 725879517, 726060037, 726163310, 726191590, 726336634, 728514606, 730473162, 731975156, 733032207, 734340818, 738357492, 739569408, 740986314, 742161871, 742911130, 744760645, 744921130, 748444929, 7585
927, 758741857, 759416082, 760501099, 761382524, 763995467, 764982730, 766682073, 767095762, 770378142, 773760112, 773817529, 775623966, 779574519, 779643806, 780623817, 782478261, 783714041, 785298790, 7
299238, 788685690, 789816368, 806508105, 806700081, 808370297, 811771769, 812482880, 812598033, 814386083, 815326250, 816114671, 817157866, 820349526, 822757187, 822946992, 823544252, 824847159, 827369298
827806202, 829689765, 834113771, 837360920, 843515959, 845472230, 845557574, 846265648, 849973628, 855901964, 856359152, 858556182, 865117747, 874900456, 875215687, 877184039, 881337515, 884458540, 887777
1, 888380334, 888735397, 890863457, 891742909, 891880064, 894187410, 902493128, 903627959, 904529577, 905659743, 909053726, 912257310, 914442307, 916673477, 916762454, 918034240, 919379094, 920820341, 922
4934, 922789681, 928300074, 929407513, 931918823, 932074342, 932471790, 933576875, 934953444, 941185953, 944075040, 946355579, 949180023, 952309910, 954816452, 960401219, 963333534, 966653646, 967119065,
0149410, 971215075, 971884239, 972503451, 977560089, 982535313, 987239074, 989812410, 993205848, 1000712053, 1001706706, 1010865893, 1012843913, 1014578784, 1015906537, 1020165915, 1021940092, 1032756454,
033843361, 1034884987, 1036024848, 1038920004, 1039751564, 1040098606, 1041996381, 1043392525, 1048783701, 1058228169, 1059217122, 1060802839, 1062046464, 1064330780, 1064441573, 1067607347, 1068409871,
8510530, 1071379679, 1072859722, 1073230530, 1073236220, 1075247728, 1076699635, 1078640162, 1080179300, 1081243883, 1081699800, 1083303815, 1083881605, 1083931836, 1085090679, 1087421314, 1087918599, 109
25662, 1091341268, 1093358646, 1094371561, 1094699166, 1113273420, 1114874425, 1115303963, 1120222971, 1120910237, 1122798864, 1123108839, 1125778158, 1128710809, 1134116165, 1134567143, 1135510603, 11389
264, 1139451809, 1140143934, 1141431701, 1144169681, 1144769047, 1147264758, 1147841750, 1149592616, 1155541376, 1160487610, 1162775380, 1163762980, 1167840517, 1168296911, 1169189413, 1169895415, 1171552
1, 1178388814, 1178927004, 1179482611, 1181300368, 1182334859, 1184812181, 1185286952, 1186858728, 1186881468, 1188822285, 1189667242, 1189841091, 1201368756, 1207106351, 1208588456, 1208664880, 121006726
 1216972067, 1218996623, 1219779821, 1220663313, 1221217769, 1222315972, 1222681654, 1223104876, 1227818649, 1229954472, 1230671820, 1234853855, 1237730675, 1239213972, 1239393343, 1240892625, 1241210161,
241370480, 1241513959, 1241626673, 1243301719, 1244995779, 1247634284, 1251620464, 1254377890, 1256014902, 1257830266, 1260187229, 1264310095, 1264385202, 1266574363, 1267816311, 1268500404, 1269647993,
0672955, 1272292270, 1272962836, 1273582574, 1274297174, 1275596311, 1276409198, 1280908594, 1281668128, 1284452902, 1285757374, 1287171502, 1287910068, 1290626342, 1291110975, 1291143231, 1292926841, 129
32256, 1301944050, 1302574967, 1304066065, 1304355808, 1307676398, 1308162552, 1309473961, 1310155145, 1313219525, 1315759745, 1320803101, 1326621751, 1326778804, 1328835768, 1328873275, 1334318160, 13358
327, 1336725081, 1336784129, 1337796725, 1339149999, 1341531228, 1341686541, 1341896702, 1343320190, 1344289704, 1344339803, 1345508420, 1346442265, 1347876687, 1350177266, 1351177491, 1352232638, 1353742
7, 1354268236, 1361509019, 1362467341, 1367853643, 1368118512, 1372233906, 1374591798, 1375268003, 1375816264, 1377319670, 1382334853, 1382970807, 1383330381, 1385864289, 1386790388, 1386874131, 138882046
 1390550780, 1391895666, 1392914589, 1396132530, 1403968013, 1404307995, 1404961855, 1413407726, 1416458512, 1419114807, 1420059290, 1420815367, 1421512550, 1424040967, 1427448772, 1429054340, 1431490966,
432448355, 1434580428, 1438725394, 1438742183, 1439863119, 1440387578, 1440786966, 1441133851, 1444749963, 1448095199, 1449566088, 1454684549, 1454946534, 1456556438, 1457737284, 1460800754, 1464387132,
4531728, 1466891684, 1469734249, 1473691957, 1474817902, 1476365324, 1477362404, 1477753738, 1479969924, 1481369606, 1482779439, 1483165326, 1484696258, 1485747866, 1486130158, 1486814408, 1487143366, 148
94877, 1490362166, 1491216727, 1492138172, 1493756073, 1500853733, 1502372344, 1503032566, 1503683629, 1504855939, 1505137370, 1505976171, 1507825346, 1509694633, 1511931521, 1515217041, 1517057357, 15196
821, 1520109784, 1527109827, 1530038947, 1530989045, 1531543127, 1540416547, 1542653489, 1545987111, 1546839127, 1548330023, 1551183048, 1552258945, 1553289517, 1556026568, 1561906387, 1563946600, 1564240
6, 1565120657, 1567964185, 1568502731, 1570465358, 1571679675, 1572434400, 1575812478, 1576525932, 1579625261, 1580807024, 1582121754, 1586543825, 1587098390, 1588293901, 1588430210, 1589076467, 159018751
 1592464931, 1594113722, 1597132489, 1597933633, 1598394423, 1598621465, 1599744701, 1601558046, 1602722759, 1603878343, 1604961357, 1616966374, 1620699578, 1623169472, 1628700317, 1629675940, 1631147583,
638762397, 1641302630, 1641656299, 1642155316, 1642221293, 1645156951, 1646575397, 1648645427, 1648707802, 1648945669, 1650883641, 1656268368, 1658712750, 1659396198, 1660902393, 1661233071, 1664918157,
6384774, 1671142207, 1675038639, 1675874054, 1676370472, 1679948368, 1680479318, 1682545673, 1684726399, 1684762793, 1686533344, 1686558893, 1689403351, 1694207319, 1694997612, 1695458529, 1695761780, 169
81416, 1700165605, 1701426294, 1703077400, 1707621602, 1709749113, 1717146015, 1718306901, 1718689078, 1720402163, 1724852760, 1725890599, 1726254111, 1727917234, 1736376621, 1736382200, 1736623946, 17366
326, 1738039834, 1744217473, 1748362922, 1748472580, 1751316424, 1752539063, 1753340533, 1756007064, 1756471868, 1758178117, 1758880183, 1762933626, 1764757447, 1770065085, 1773564900, 1779570423, 1782791
0, 1787811463, 1788231008, 1788579235, 1790545616, 1793344891, 1794936020, 1794992432, 1795406799, 1797885297, 1799240186, 1805381997, 1809384451, 1810133726, 1810354378, 1812129537, 1812827807, 181525773
 1818903807, 1819850009, 1820440572, 1822957905, 1825135809, 1826592468, 1829402451, 1829645479, 1829919234, 1832798412, 1832874950, 1837177520, 1837495827, 1845887933, 1849328339, 1852499190, 1853343031,
858935618, 1859736883, 1861125592, 1862358010, 1863884157, 1864718464, 1867160767, 1867608860, 1869127787, 1869132672, 1870952231, 1871462881, 1871900113, 1873157999, 1875641268, 1876170609, 1877206614,
7940691, 1882493039, 1884509454, 1885256371, 1888576619, 1891087252, 1893179013, 1895008363, 1896370158, 1903561552, 1906689284, 1908320602, 1910639997, 1917116855, 1922079526, 1924134818, 1924205316, 192
90015, 1926823399, 1931713290, 1940507897, 1943550382, 1951010353, 1951214914, 1956175659, 1956443115, 1958713959, 1968861360, 1972763159, 1973834244, 1976266672, 1979244041, 1983658774, 1986089075, 19873
027, 1988328056, 1988647181, 1990589934, 1990963819, 1998797965, 2003029241, 2003225580, 2003944627, 2011768486, 2012418407, 2012873958, 2012924394, 2014029843, 2019086638, 2019818677, 2020165776, 2021107
3, 2023717363, 2026655745, 2029729035, 2030914537, 2032504352, 2035227510, 2036676862, 2041237846, 2043219354, 2043666929, 2045746717, 2047046098, 2047800402, 2050971858, 2052701735, 2057796654, 206479978
 2065668826, 2065783275, 2068875268, 2070387903, 2074081520, 2074383020, 2078323424, 2078866306, 2080009346, 2084011681, 2086564937, 2087880666, 2088152830, 2089576096, 2090048496, 2094030809, 2102906570,
103107445, 2104932688, 2109704621, 2124842606, 2126081923, 2127235321, 2127418932, 2128532611, 2132270279, 2136589923, 2139768619, 2143727233, 2146699902, 2147205454]
```

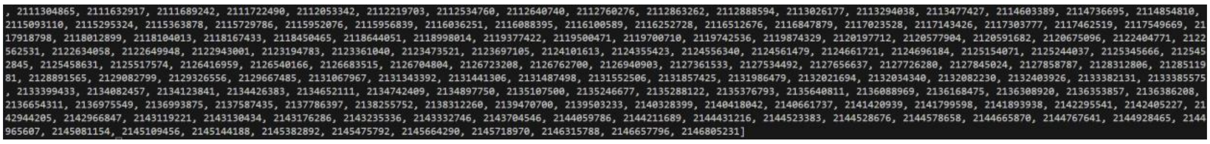
```
Sorted Array of Size 5000

[366719, 459160, 936000, 1284634, 1502414, 2024888, 2284098, 3214827, 3742902, 3802644, 4036987, 4354722, 4541642, 4842189, 5370537, 5942063, 6506170, 6676884, 7418896, 9406785, 9632335, 9766206, 10040706,
10228162, 10758384, 11012820, 11266013, 12070364, 12181071, 12258458, 12918468, 13014950, 13692287, 14434448, 14838498, 16027125, 17466688, 18523724, 18766320, 18970166, 18991110, 19155044, 19469530, 196724
44, 19984349, 20144669, 21109037, 21574184, 21586421, 21955498, 22719441, 24216871, 24223279, 24262631, 24874235, 25535990, 25594846, 25706620, 25771248, 26049076, 27520092, 27579935, 27669988, 27965868, 28
474926, 28592480, 28760725, 28944168, 30030823, 32190924, 33920069, 35093728, 35652656, 35766135, 35935563, 36314081, 36494471, 36958621, 37009918, 37301202, 37636995, 38017262, 38066227, 38409610, 38623960
, 39205626, 39390682, 39818938, 40117398, 40121568, 40295518, 40621268, 41342223, 41567233, 41686438, 41964597, 42587063, 42848157, 43117672, 43812351, 43840426, 45675345, 46314645, 46380162, 46518531, 4658
7609, 47017181, 47488982, 47584622, 47614433, 47726747, 49180181, 49307798, 50225245, 50395505, 51044665, 51184714, 51808488, 52838048, 53110538, 53731702, 54157982, 54189971, 54497189, 54704467, 54882609,
54887599, 55047055, 55563186, 55929197, 56100290, 56482914, 57279710, 57420170, 57538363, 57609354, 57778537, 57912896, 58434173, 58691038, 59525939, 59559247, 59733386, 60170534, 60645232, 62247681, 628322
05, 63107086, 64491800, 64727319, 64836949, 65305986, 65631555, 66307691, 66635615, 66767818, 66854599, 67133960, 68626470, 68723453, 68732327, 68907466, 69012522, 69438000, 70110546, 70744954, 73172012, 73
264571, 73374624, 73816886, 74173136, 74491763, 75109620, 75137073, 75324078, 75704203, 76028835, 76141934, 76257597, 78363336, 78745909, 78839735, 79840850, 79966747, 80527285, 80668500, 80977771, 81230921
, 81657522, 82394176, 82817942, 82856487, 83299147, 84082522, 84831784, 84878908, 84947810, 84971713, 85055084, 85332633, 85499900, 86044778, 86104593, 86226764, 87538914, 88413135, 88439381, 89048567, 9019
1738, 90219881, 90422715, 92032400, 92352391, 92495276, 92868677, 92961235, 94396740, 94469363, 94767469, 94825045, 94850429, 94914661, 94938404, 94975645, 95980877, 96539803, 96638153, 96956826, 97791741,
97815937, 97884610, 98258328, 98296904, 98847203, 98911001, 98989047, 99059577, 99476074, 100007335, 101451572, 101678347, 102881685, 103142895, 103715022, 104355264, 104361415, 104412008, 104536707, 104726
748, 105442746, 106769781, 106981818, 106989077, 108410364, 108983116, 109454411, 109902918, 110186399, 110288838, 110333519, 110454550, 110597224, 110742749, 111497791, 111590599, 111664347, 111887050, 111
926224, 111960788, 112418305, 112949349, 113603705, 113888994, 114520193, 114523699, 115542982, 116392572, 116738262, 118423766, 118570726, 118750799, 118810664, 119101284, 119794065, 119833462, 120181781,
120254686, 122344436, 122377351, 123310734, 124294648, 124418104, 125317265, 125579044, 126762112, 126928032, 127299622, 127685176, 128251746, 128481775, 129093922, 129212331, 129574122, 129698064, 13007268
5, 130251155, 130309868, 130461344, 130721387, 131018597, 131554040, 131827043, 131882392, 132142319, 133982834, 134067767, 134140692, 134539815, 134589271, 134749105, 135400169, 135412868, 135582616, 13572
2741, 135771518, 135857419, 135950546, 136229625, 136366711, 137599492, 137880452, 138014572, 138673752, 139187071, 139300822, 139391287, 139432151, 140402990, 140867122, 141200111, 141364713, 141635602, 14
1774487, 142345948, 142905916, 143348761, 143858064, 143879886, 144384846, 144456650, 144491278, 144890682, 145092635, 145366288, 145636281, 146174750, 146820095, 147617807, 148388645, 148771418, 148941010,
 149356197, 149386187, 150040577, 150335026, 150380601, 150474357, 151978165, 152069335, 152300606, 152582293, 152640335, 152804399, 152883409, 153316094, 154117876, 154738749, 154778720, 154821570, 1549040
04, 155150437, 155476540, 155976277, 156827471, 156874540, 156937515, 157179286, 157419999, 157797415, 157822627, 158366060, 158452738, 158484134, 158629503, 159639150, 160231405, 160308857, 160741476, 1607
56618, 160919691, 161133254, 161874070, 161884672, 161919633, 162285739, 162621331, 162716371, 162821700, 164313505, 164317859, 164635369, 164871410, 164879436, 165659632, 165969271, 166814793, 167385293, 1
67528517, 167882116, 168560848, 168778793, 169582204, 170572868, 171691949, 173004830, 173143297, 173778639, 174188002, 174370618, 175226332, 175604420, 176031525, 176146995, 177281113, 177670806, 178068516
, 178486593, 178849230, 179450545, 179720047, 179771358, 179832067, 180999402, 181737960, 181892018, 182040873, 182263176, 182503069, 182935860, 184075858, 184370555, 185023429, 185377521, 185460097, 186420
473, 186801651, 187071894, 187396847, 187950195, 188138293, 188512872, 188812099, 190312807, 190448465, 190845496, 191185689, 191219731, 191564825, 191972013, 192464787, 192469771, 192742797, 193982745, 194
285315, 194630292, 194774296, 194824878, 195477746, 196107501, 196136514, 196306999, 196390288, 196858858, 197501555, 198410674, 199336354, 199383133, 199395163, 199487474, 199607488, 199711728, 199816173,
200483572, 200952698, 201064723, 201822647, 202232961, 202368597, 203148194, 203318636, 203380785, 203853043, 204856521, 205255513, 206128993, 206938815, 207067113, 207193693, 207231823, 208331037, 20867486
2, 208780992, 209065406, 209429983, 209759400, 211485236, 212127987, 212628362, 212822698, 212912391, 213273183, 213335575, 213821263, 214522471, 214814752, 214867229, 215041176, 215858262, 216290376, 21698
9059, 217264862, 217840030, 217890638, 218503389, 219608462, 220715179, 221075148, 221076783, 221653160, 222163588, 222469694, 222640788, 222668091, 223213085, 223220371, 223440193, 223484962, 224713781, 22
4835227, 224851448, 225252350, 226806710, 227248453, 227568758, 227927379, 229148443, 230073514, 230302987, 231052319, 231276963, 231753176, 232098358, 232103502, 232131066, 232610676, 232881306, 233164776,
 233726317, 233756744, 233815477, 235055092, 235237129, 235408686, 235479224, 235933000, 236118231, 237567590, 237578923, 238290374, 239873772, 239947608, 240050202, 240383468, 240902517, 240987831, 2410354
14, 241667111, 241784073, 242408038, 242870617, 242964075, 243298278, 244064630, 244240060, 245144517, 245178237, 245884550, 246121980, 247108356, 247458058, 247683937, 248188522, 248359061, 248629175, 2489
49195, 249205240, 249786706, 250237426, 250353554, 250693375, 251110896, 252718096, 253072466, 253117013, 253634533, 254024005, 254653782, 255628164, 256293789, 256808404, 257591932, 257596795, 257899999, 2
57923442, 257926840, 258174202, 258398627, 259708908, 260109657, 260279650, 260800498, 260843436, 261239329, 261998727, 262011900, 262921373, 263505386, 263982258, 264434531, 264475990, 264735165, 265042365
, 265627904, 266052676, 266889879, 267926662, 268371162, 269076093, 269472662, 269727690, 270837246, 271885928, 272350384, 272745572, 272982474, 273299227, 274158936, 274239656, 274625832, 276309786, 277078
390, 277607698, 277770844, 278476068, 279181963, 279311623, 279452280, 279974925, 280006883, 280092147, 280106709, 280138158, 280366846, 280620343, 280961222, 281666301, 282390302, 282802751, 283074089, 283
356715, 285026116, 285180336, 285240580, 285841745, 286992115, 287351435, 287364463, 287396903, 287412880, 288919616, 289042474, 289705039, 289714565, 290287615, 290773429, 291063020, 292783866, 292827417,
293156575, 293710013, 295409263, 295412009, 295579180, 295933119, 297214700, 298224985, 298735706, 298836853, 299258261, 299696341, 300223223, 300661446, 301722263, 302343437, 302676673, 302711194, 30362953
```



```
, 2022393166, 2023700224, 2023751646, 2024002715, 2024017081, 2024429129, 2024608706, 2025317536, 2025926098, 2026040658, 2026759429, 2027265849, 2027325356, 2027856112, 2028003616, 2029082618, 2029158280,
2029282389, 2029378594, 2029488074, 2029620226, 2029654263, 2030193314, 2030858781, 2031148010, 2031520245, 2032472119, 2032672843, 2032688991, 2032838902, 2032895562, 2033134243, 2033772994, 2033926027, 20
34413604, 2034431187, 2034859274, 2035826694, 2035844985, 2036352628, 2036426827, 2037421945, 2037669151, 2037950934, 2037982164, 2038633143, 2039061930, 2039234310, 2040268934, 2040860224, 2040944400, 2041
292977, 2042622742, 2042706578, 2043680822, 2044448179, 2044609421, 2044971373, 2045559841, 2045694040, 2045840296, 2046865109, 2047705459, 2048215057, 2048976141, 2049190649, 2049313318, 2049788857, 205047
2507, 2051625438, 2051662273, 2052998223, 2053423584, 2053811130, 2053966910, 2054411303, 2054530103, 2054856969, 2055010578, 2055501040, 2055674661, 2056094213, 2056218330, 2056259120, 2056363299, 20571069
89, 2057500662, 2058350325, 2058527521, 2058645060, 2058934725, 2060556208, 2061012589, 2061085900, 2061180184, 2061649558, 2061790618, 2062077135, 2062200722, 2062254837, 2062424989, 2062598311, 2063674867
, 2064952314, 2065256499, 2066643591, 2066741188, 2067057064, 2067281127, 2067578172, 2067861021, 2068905489, 2069132376, 2069141551, 2069219186, 2069795135, 2070154186, 2070820042, 2071063719, 2072223848,
2072479079, 2074495486, 2075002922, 2075690605, 2076245269, 2076259317, 2076497846, 2077006888, 2077390744, 2078066535, 2079355699, 2080000917, 2080568914, 2080681512, 2081592370, 2082030781, 2082347700, 20
82824992, 2082884495, 2083412674, 2083536145, 2083645823, 2084628130, 2084732770, 2084929025, 2085216523, 2086167614, 2086201750, 2087085690, 2087324120, 2088562468, 2088931317, 2089019677, 2089496302, 2090
292899, 2090360126, 2091073638, 2091150696, 2091773209, 2091898244, 2091901874, 2092324722, 2092524234, 2092777884, 2093312863, 2094076653, 2095026547, 2095371305, 2095489591, 2096008555, 2096537983, 209706
0975, 2098154049, 2098794422, 2098873462, 2099037504, 2099473744, 2099631282, 2099746711, 2099751914, 2100483905, 2101529130, 2101654104, 2101862833, 2101904162, 2102222936, 2102414055, 2103203831, 21032081
81, 2103244876, 2103450675, 2103648631, 2103711732, 2104794645, 2104870824, 2105305254, 2105450773, 2105526663, 2106306197, 2106306814, 2107301435, 2107828749, 2107858827, 2107913319, 2108017470, 2108099570
, 2108382051, 2108745524, 2108848733, 2109145724, 2109186376, 2109341507, 2110303256, 2110313803, 2111105502, 2111347494, 2111412921, 2112027713, 2112187388, 2113278683, 2113801470, 2114099813, 2114146881,
2114570550, 2114987425, 2115364049, 2115554330, 2115721635, 2115845734, 2115879797, 2117287465, 2117550608, 2117703031, 2118159506, 2118268573, 2118305868, 2118394150, 2119531341, 2119630357, 2119783886, 21
20094876, 2120180467, 2120507821, 2120827105, 2121343558, 2121563186, 2122024472, 2122152614, 2122725473, 2123024617, 2123561896, 2123704859, 2123840621, 2124150269, 2124543887, 2125945758, 2126484736, 2126
776571, 2126966467, 2127266764, 2127507945, 2127643301, 2127991009, 2128383302, 2128527278, 2129498088, 2129690263, 2129694711, 2130439225, 2131695766, 2132103684, 2132603259, 2133017986, 2134941212, 213519
2274, 2135400670, 2135891868, 2136651245, 2136795930, 2136857336, 2136937907, 2137757932, 2137985135, 2138200252, 2139412680, 2139504855, 2139881738, 2139896536, 2140362610, 2140929416, 2140940385, 21415586
54, 2142766996, 2142905930, 2143466120, 2143888359, 2144447368, 2146048041, 2146268039, 2146317878, 2147164545, 2147347455]
```

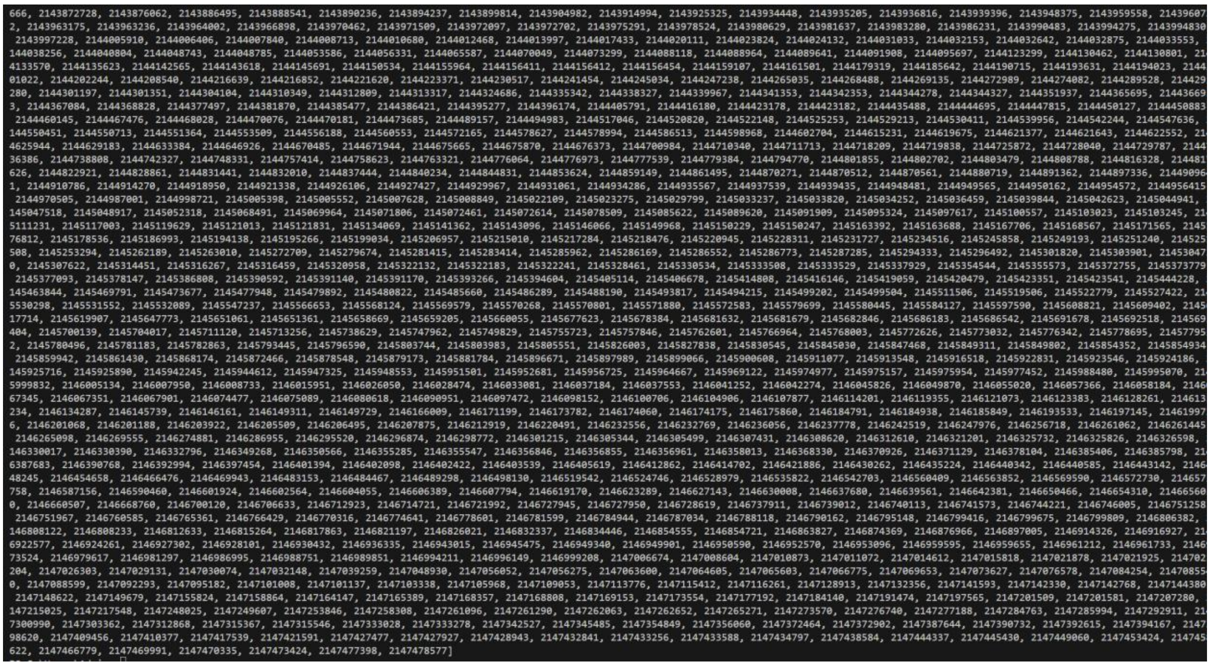


```
Sorted Array of Size 10000

[171822, 379876, 946753, 998185, 1030978, 1254359, 1397121, 1954880, 2063264, 2583221, 2687039, 2770969, 3026691, 3211801, 3243118, 3540976, 3624383, 3701154, 3912236, 4050948, 4058093, 4189216, 4211049, 42
87184, 4603316, 5225283, 5323450, 5402439, 5601890, 5726393, 5775951, 6180934, 6356096, 6866167, 6923631, 7271759, 7294136, 7383335, 7445524, 7530844, 7532325, 7533327, 7947260, 8332524, 8361263, 8795227, 9
140523, 9349276, 9485720, 9487085, 9503379, 9723596, 9726643, 9760407, 9880605, 10053672, 10116913, 10286575, 10319075, 10398840, 10470036, 10665152, 10674444, 10801147, 10905732, 10911582, 11433362, 115578
80, 11698114, 12182204, 12197158, 12329425, 12442785, 12493449, 12539983, 12806631, 13556978, 13604956, 13839986, 13863647, 13924304, 14236542, 14439755, 14687352, 15054237, 15332122, 15339926, 15405469, 15
477617, 15505147, 15996353, 16386708, 16568456, 16957846, 17305299, 17348577, 18331037, 18416862, 18479562, 18479910, 19102624, 19489917, 19725548, 19922811, 19973288, 20530231, 20568734, 21295632, 21332008
, 21607683, 21728376, 21748866, 21908609, 22183743, 22735155, 23195254, 23279265, 23574422, 23930412, 24631132, 24813550, 24824422, 24971598, 25063288, 25736762, 25960071, 25974242, 26203483, 26204754, 2663
2603, 27028156, 27045453, 27225719, 27600280, 27733898, 28037729, 28157752, 28552394, 29036710, 29531610, 29705519, 29796875, 30254356, 30357222, 30736504, 31444676, 31710377, 31866448, 32027379, 32113942,
32289591, 32536243, 32797543, 32892106, 32978550, 33237535, 33889557, 34084342, 34423199, 34494006, 34501178, 34938218, 34961854, 35042383, 35764498, 36029297, 36188288, 36815612, 36855939, 36964241, 370827
30, 37506770, 37609288, 37623960, 37797660, 37811572, 38110839, 38167214, 38169104, 38288055, 38458589, 39216024, 39269873, 39434327, 39436041, 40189954, 40443955, 40532973, 40698212, 40725519, 40728273, 40
898333, 41007939, 41030583, 41144617, 41403215, 41800852, 41830480, 42065560, 42394497, 42413469, 42669543, 42726857, 42795424, 42856998, 42952254, 42987006, 43036309, 43404154, 43698835, 43730879, 44541183
, 44760755, 45012872, 45052451, 45584235, 45698878, 46850124, 47062058, 47249043, 47428225, 47955917, 47985177, 48175619, 48195425, 48438312, 48607615, 48646213, 48751737, 48931347, 49070554, 49106286, 4952
7254, 49541823, 49562094, 49773549, 49835184, 49960917, 51298684, 51371642, 51486823, 51951417, 52180633, 52478990, 52786182, 53139341, 53290381, 53456373, 53819685, 53964949, 54192243, 54389769, 54394727,
54419645, 54783840, 55021400, 55367947, 55562476, 55671271, 56239264, 56405252, 56578869, 56658858, 56777220, 56783134, 56910878, 56922600, 57187763, 57343244, 57538200, 57628435, 57704512, 58522212, 591120
45, 59626837, 60067939, 60076499, 60139937, 60831813, 60896871, 60937826, 61101087, 61259132, 61267338, 61527287, 61580557, 61625663, 62142896, 62657801, 62908739, 63067620, 63151371, 63217781, 63379667, 63
615429, 64233893, 64448876, 64506802, 64660640, 64791198, 64800686, 65227358, 65473687, 65817871, 66039482, 66177126, 66334821, 66466796, 66557431, 66651594, 66685210, 66709899, 66842191, 67298457, 67495692
, 67535801, 67586835, 67781626, 68410853, 68565720, 69005346, 69122102, 69334592, 69921988, 70162836, 70351009, 70371335, 70379497, 70419733, 70738749, 70825517, 71141451, 71228634, 71472283, 71749690, 7192
3933, 71985505, 72228325, 72856487, 72870563, 73243186, 73338324, 73462342, 73489254, 73643430, 74284261, 74470446, 74574544, 74762739, 75231128, 75362268, 75776752, 75825097, 75994510, 76003821, 76797400,
76940374, 77371085, 77381231, 77480631, 77579482, 78104090, 78328296, 78565350, 78838926, 79145325, 79169932, 79335798, 80167579, 80263008, 80380325, 80417677, 80437615, 80555661, 80622682, 80941365, 815292
18, 81636585, 81788273, 81953146, 81966300, 82018691, 82148897, 82319139, 82781168, 82864599, 83211466, 83483929, 83553841, 83611753, 83781120, 83793839, 84837047, 84856018, 85034114, 85053102, 85209252, 85
561386, 85641170, 85684385, 85884482, 85956414, 86118395, 86127730, 86220389, 86385323, 86404934, 86476005, 86793296, 86874454, 87213262, 87721384, 87810421, 88135887, 88250950, 88567305, 88810802, 88937696
, 89055639, 89479402, 89827703, 90288166, 90380716, 90514855, 90785881, 90805426, 91524096, 91609348, 92046040, 92066456, 92125578, 92310046, 92540888, 92550618, 92762847, 93784977, 94680600, 94680915, 9477
8543, 94871351, 94949588, 95159090, 95303508, 95399206, 95401019, 95572735, 95629936, 96030795, 96067771, 96243860, 96841622, 97254299, 97312395, 97321977, 97450773, 98217197, 98261667, 98480578, 99327753,
99384435, 99532338, 99611445, 99698537, 99743130, 99917441, 99966812, 100233450, 100844911, 100989572, 101071014, 101087447, 101362274, 101981741, 102044266, 102245517, 102302355, 102661399, 103035670, 1034
12470, 104213533, 104463705, 105871867, 105908899, 106038800, 106352101, 106539350, 106707107, 107323913, 107670296, 108393023, 109016776, 109030695, 109180044, 109192229, 109350346, 109805518, 109923004, 1
10052432, 110623466, 110724666, 110745311, 110821899, 110851447, 110860897, 111197807, 111471914, 111629986, 111702732, 111738840, 111835106, 111891774, 111970427, 112647303, 112995202, 113014958, 113386544
, 113635894, 113722059, 113745233, 113869076, 114063594, 114837251, 115103284, 115204766, 115257211, 115328655, 115328830, 115383950, 115658574, 115981451, 116373424, 116581205, 116770494, 116927506, 117033
740, 117206762, 117501081, 117836577, 117849947, 118135065, 118587378, 118741026, 118785094, 119547104, 119809642, 120172470, 120315709, 120330800, 120446687, 120591205, 120699619, 120943914, 121053545, 121
360748, 121931932, 122459163, 122775170, 122816611, 122862796, 122958031, 123455640, 123570934, 123702968, 123935241, 124010537, 124368569, 124433044, 124907086, 125011129, 125162800, 126827490, 127008257,
127597506, 127722137, 127724180, 127954867, 128177973, 128748147, 128800978, 130145635, 130419491, 131299642, 131342773, 131562868, 131672295, 131715785, 131850058, 132174338, 132328615, 132440466, 13246272
6, 132623497, 132805084, 133430620, 133441855, 133446477, 133795608, 133897947, 134167296, 134492145, 135111053, 135236362, 135578464, 135677077, 136048099, 136171680, 136258406, 136283824, 136360476, 13639
2899, 136705457, 137111186, 137162809, 137257969, 137582516, 138181680, 138496261, 138633990, 138676163, 139017599, 139317184, 139322223, 140071246, 140165493, 140237474, 140324401, 140643359, 140855993, 14
0872917, 140936429, 141568650, 141685061, 141686303, 141779976, 141983819, 142074961, 142210533, 142473818, 142558007, 142633125, 142726412, 142949680, 143055889, 143260291, 143360878, 143369890, 143387512,
 143809691, 144119306, 144318112, 144503893, 145298308, 145336360, 145439245, 145462655, 145677295, 145910340, 146622586, 146865785, 146867770, 147225045, 147523800, 147752890, 147809609, 148077313, 1483179
```



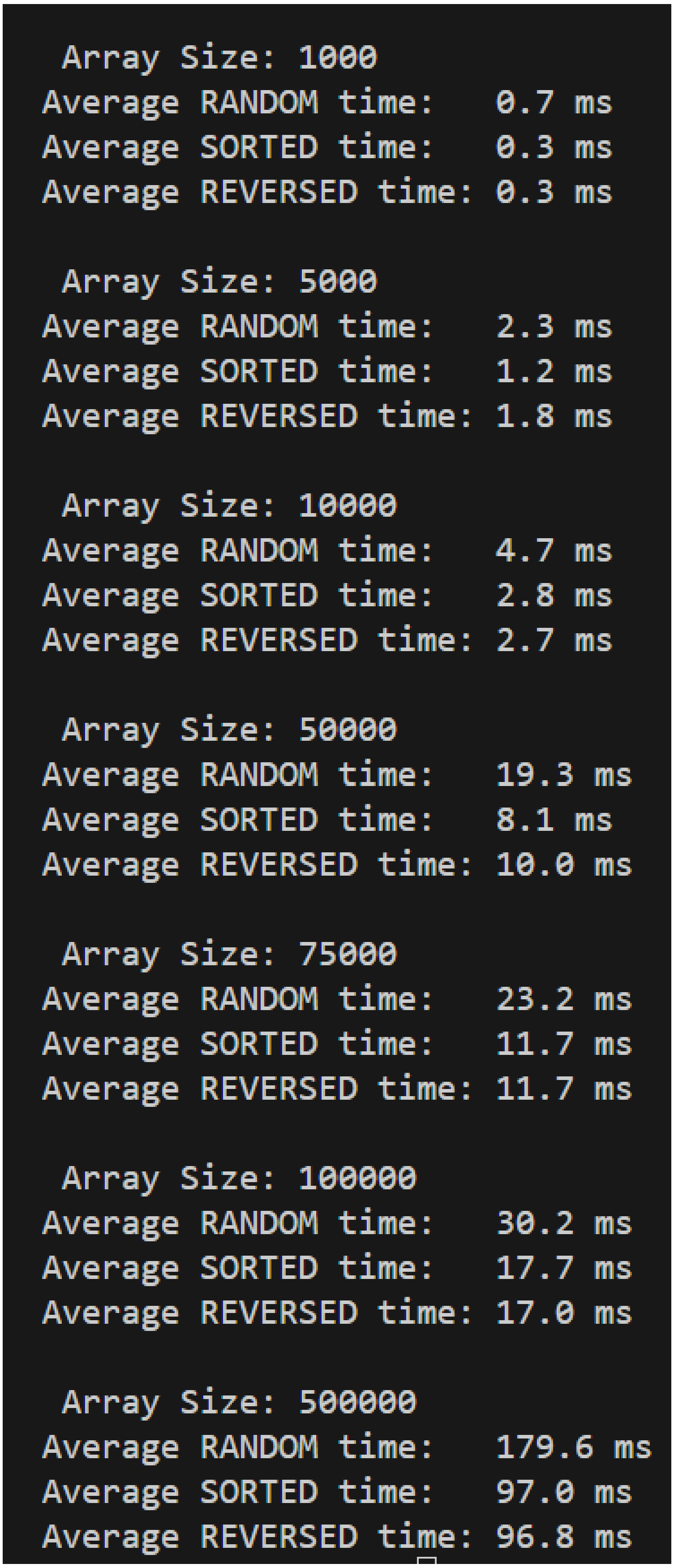
```
, 2111304865, 2111632917, 2111689242, 2111722490, 2112053342, 2112219703, 2112534760, 2112640740, 2112760276, 2112863262, 2112888594, 2113026177, 2113294038, 2113477427, 2114603389, 2114736695, 2114854810,
2115093110, 2115295324, 2115363878, 2115729786, 2115952076, 2115956839, 2116036251, 2116088395, 2116100589, 2116252728, 2116512676, 2116847879, 2117023528, 2117143426, 2117303777, 2117462519, 2117549669, 21
17918798, 2118012899, 2118104013, 2118167433, 2118450465, 2118644051, 2118998014, 2119377422, 2119500471, 2119700710, 2119742536, 2119874329, 2120197712, 2120577904, 2120591682, 2120675096, 2122404771, 2122
562531, 2122634058, 2122649948, 2122943001, 2123194783, 2123361040, 2123473521, 2123697105, 2124101613, 2124355423, 2124556340, 2124561479, 2124661721, 2124696184, 2125154071, 2125244037, 2125345666, 212545
2845, 2125458631, 2125517574, 2126416959, 2126540166, 2126683515, 2126704804, 2126723208, 2126762700, 2126940903, 2127361533, 2127534492, 2127656637, 2127726280, 2127845024, 2127858787, 2128312806, 21285119
81, 2128891565, 2129082799, 2129326556, 2129667485, 2131067967, 2131343392, 2131441306, 2131487498, 2131552506, 2131857425, 2131986479, 2132021694, 2132034340, 2132082230, 2132403926, 2133382131, 2133385575
, 2133399433, 2134082457, 2134123841, 2134426383, 2134652111, 2134742409, 2134897750, 2135107500, 2135246677, 2135288122, 2135376793, 2135640811, 2136088969, 2136168475, 2136308920, 2136353857, 2136386208,
2136654311, 2136975549, 2136993875, 2137587435, 2137786397, 2138255752, 2138312260, 2139470700, 2139503233, 2140328399, 2140418042, 2140661737, 2141420939, 2141799598, 2141893938, 2142295541, 2142405227, 21
42944205, 2142966847, 2143119221, 2143130434, 2143176286, 2143235336, 2143332746, 2143704546, 2144059786, 2144211689, 2144431216, 2144523383, 2144528676, 2144578658, 2144665870, 2144767641, 2144928465, 2144
965607, 2145081154, 2145109456, 2145144188, 2145382892, 2145475792, 2145664290, 2145718970, 2146315788, 2146657796, 2146805231]
```

The others do not fit on a screen:



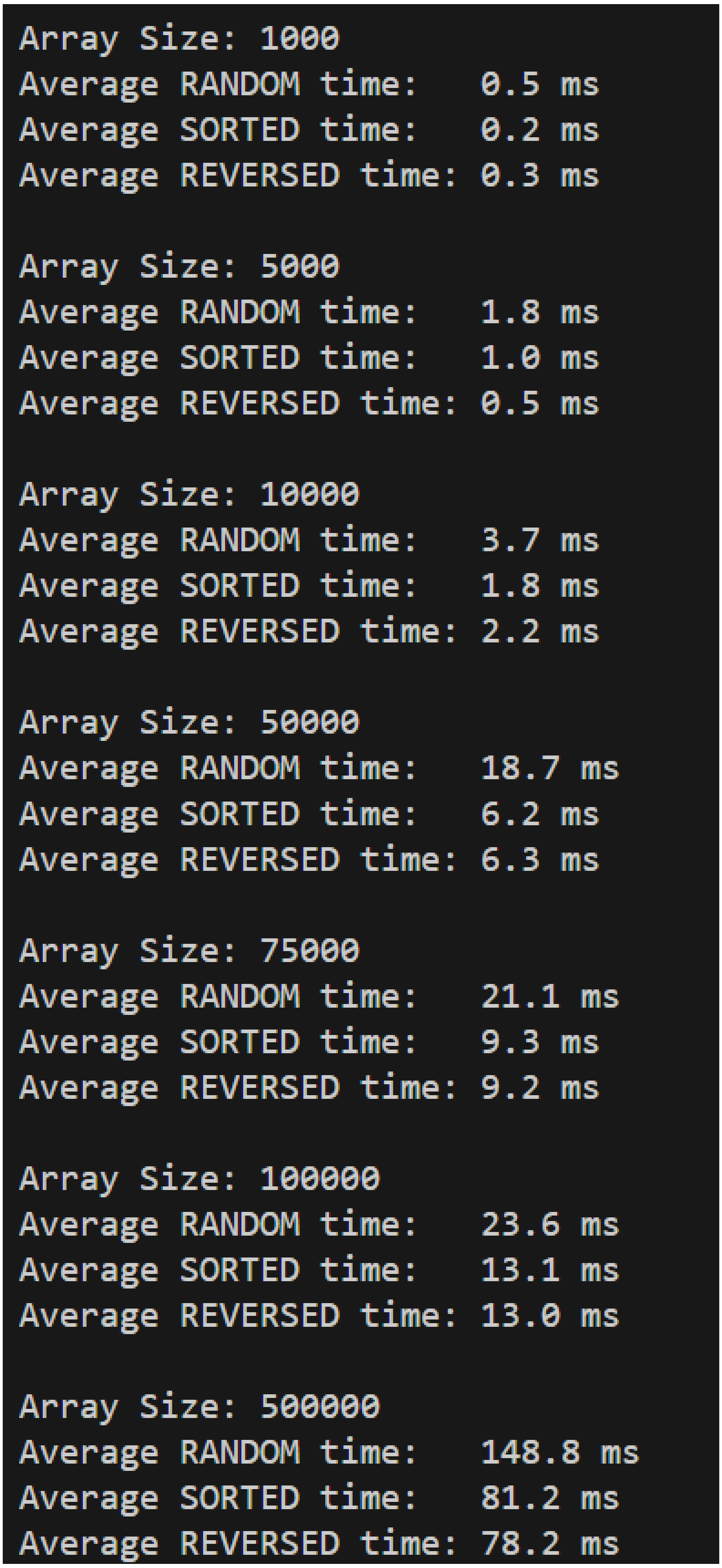
```
666, 2143872728, 2143876062, 2143886495, 2143888541, 2143890236, 2143894237, 2143899814, 2143904982, 2143914994, 2143925325, 2143934448, 2143935205, 2143936816, 2143939396, 2143948375, 2143959558, 21439607
2, 2143963175, 2143963236, 2143964002, 2143966898, 2143970462, 2143971509, 2143972097, 2143972702, 2143975291, 2143978524, 2143980629, 2143981637, 2143983280, 2143986231, 2143990483, 2143994275, 2143994830
 2143997228, 2144005910, 2144006406, 2144007840, 2144008713, 2144010680, 2144012468, 2144013997, 2144017433, 2144020111, 2144023824, 2144024132, 2144031033, 2144032153, 2144032642, 2144032875, 2144033553,
144038256, 2144040804, 2144048743, 2144048785, 2144053586, 2144056331, 2144065587, 2144070049, 2144073299, 2144088118, 2144088964, 2144089641, 2144091908, 2144095697, 2144123299, 2144130462, 2144130801, 21
4133570, 2144135623, 2144142565, 2144143618, 2144145691, 2144150534, 2144155964, 2144156411, 2144156412, 2144156454, 2144159107, 2144161501, 2144179319, 2144185642, 2144190715, 2144193631, 2144194023, 2144
01022, 2144202244, 2144208540, 2144216639, 2144216852, 2144221620, 2144223371, 2144230517, 2144241454, 2144245034, 2144247238, 2144265035, 2144268488, 2144269135, 2144272989, 2144274082, 2144289528, 214429
280, 2144301197, 2144301351, 2144304104, 2144310349, 2144312809, 2144313317, 2144324686, 2144335342, 2144338327, 2144339967, 2144341353, 2144342353, 2144344278, 2144344327, 2144351937, 2144365695, 21443669
3, 2144367084, 2144368828, 2144377497, 2144381870, 2144385477, 2144386421, 2144395277, 2144396174, 2144405791, 2144416180, 2144423178, 2144423182, 2144435488, 2144444695, 2144447815, 2144450127, 2144450883
 2144460145, 2144467476, 2144468028, 2144470076, 2144470181, 2144473685, 2144489157, 2144494983, 2144517046, 2144520820, 2144522148, 2144525253, 2144529213, 2144530411, 2144539956, 2144542244, 2144547636,
144550451, 2144550713, 2144551364, 2144553509, 2144556188, 2144560553, 2144572165, 2144578627, 2144578994, 2144586513, 2144598968, 2144602704, 2144615231, 2144619675, 2144621377, 2144621643, 2144622552, 21
4625944, 2144629183, 2144633384, 2144646926, 2144670485, 2144671944, 2144675665, 2144675870, 2144676373, 2144700984, 2144710340, 2144711713, 2144718209, 2144719838, 2144725872, 2144728040, 2144729787, 2144
36386, 2144738808, 2144742327, 2144748331, 2144757414, 2144758623, 2144763321, 2144776064, 2144776973, 2144777539, 2144779384, 2144794770, 2144801855, 2144802702, 2144803479, 2144808788, 2144816328, 214481
626, 2144822921, 2144828861, 2144831441, 2144832010, 2144837444, 2144840234, 2144844831, 2144853624, 2144859149, 2144861495, 2144870271, 2144870512, 2144870561, 2144880719, 2144891362, 2144897336, 21449096
1, 2144910786, 2144914270, 2144918950, 2144921338, 2144926106, 2144927427, 2144929967, 2144931061, 2144934286, 2144935567, 2144937539, 2144939435, 2144948481, 2144949565, 2144950162, 2144954572, 2144956415
 2144970505, 2144987001, 2144998721, 2145005398, 2145005552, 2145007628, 2145008849, 2145022109, 2145023275, 2145029799, 2145033237, 2145033820, 2145034252, 2145036459, 2145039844, 2145042623, 2145044941,
145047518, 2145048917, 2145052318, 2145068491, 2145069964, 2145071806, 2145072461, 2145072614, 2145078509, 2145085622, 2145089620, 2145091909, 2145095324, 2145097617, 2145100557, 2145103023, 2145103245, 21
5111231, 2145117003, 2145119629, 2145121013, 2145121831, 2145134069, 2145141362, 2145143096, 2145146066, 2145149968, 2145150229, 2145150247, 2145163392, 2145163688, 2145167706, 2145168567, 2145171565, 2145
76812, 2145178536, 2145186993, 2145194138, 2145195266, 2145199034, 2145206957, 2145215010, 2145217284, 2145218476, 2145220945, 2145228311, 2145231727, 2145234516, 2145245858, 2145249193, 2145251240, 214525
508, 2145253294, 2145262189, 2145263010, 2145272709, 2145279674, 2145281415, 2145283414, 2145285962, 2145286169, 2145286552, 2145286773, 2145287285, 2145294333, 2145296492, 2145301820, 2145303901, 21453047
0, 2145307622, 2145314451, 2145316267, 2145316459, 2145320958, 2145322132, 2145322183, 2145322241, 2145328461, 2145330534, 2145333508, 2145333529, 2145337929, 2145354544, 2145355573, 2145372755, 2145373779
 2145377093, 2145378147, 2145386808, 2145390592, 2145391140, 2145391170, 2145393266, 2145394604, 2145405114, 2145406678, 2145414808, 2145416146, 2145419059, 2145420479, 2145423351, 2145423541, 2145444228,
145463844, 2145469791, 2145473677, 2145477948, 2145479892, 2145480822, 2145485660, 2145486289, 2145488190, 2145493817, 2145494215, 2145499202, 2145499504, 2145511506, 2145519506, 2145522779, 2145527422, 21
5530298, 2145531552, 2145532089, 2145547237, 2145566653, 2145568124, 2145569579, 2145570268, 2145570801, 2145571880, 2145572583, 2145579699, 2145580445, 2145584127, 2145597590, 2145608821, 2145609402, 2145
17714, 2145619907, 2145647773, 2145651061, 2145651361, 2145658669, 2145659205, 2145660055, 2145677623, 2145678384, 2145681632, 2145681679, 2145682846, 2145686183, 2145686542, 2145691678, 2145692518, 214569
404, 2145700139, 2145704017, 2145711120, 2145713256, 2145738629, 2145747962, 2145749829, 2145755723, 2145757846, 2145762601, 2145766964, 2145768003, 2145772626, 2145773032, 2145776342, 2145778695, 21457795
2, 2145780496, 2145781183, 2145782863, 2145793445, 2145796590, 2145803744, 2145803983, 2145805551, 2145826003, 2145827838, 2145830545, 2145845030, 2145847468, 2145849311, 2145849802, 2145854352, 2145854934
 2145859942, 2145861430, 2145868174, 2145872466, 2145878548, 2145879173, 2145881784, 2145896671, 2145897989, 2145899066, 2145900608, 2145911077, 2145913548, 2145916518, 2145922831, 2145923546, 2145924186,
145925716, 2145925890, 2145942245, 2145944612, 2145947325, 2145948553, 2145951501, 2145952681, 2145956725, 2145964667, 2145969122, 2145974977, 2145975157, 2145975954, 2145977452, 2145988480, 2145995070, 21
5999832, 2146005134, 2146007950, 2146008733, 2146015951, 2146026050, 2146028474, 2146033081, 2146037184, 2146037553, 2146041252, 2146042274, 2146045826, 2146049870, 2146055020, 2146057366, 2146058184, 2146
67345, 2146067351, 2146067901, 2146074477, 2146075089, 2146080618, 2146090951, 2146097472, 2146098152, 2146100706, 2146104906, 2146107877, 2146114201, 2146119355, 2146121073, 2146123383, 2146128261, 214613
234, 2146134287, 2146145739, 2146146161, 2146149311, 2146149729, 2146166009, 2146171199, 2146173782, 2146174060, 2146174175, 2146175860, 2146184791, 2146184938, 2146185849, 2146193533, 2146197145, 21461997
6, 2146201068, 2146201188, 2146203922, 2146205509, 2146206495, 2146207875, 2146212919, 2146220491, 2146232556, 2146232769, 2146236056, 2146237778, 2146242519, 2146247976, 2146256718, 2146261062, 2146261445
 2146265098, 2146269555, 2146274881, 2146286955, 2146295520, 2146296874, 2146298772, 2146301215, 2146305344, 2146305499, 2146307431, 2146308620, 2146312610, 2146321201, 2146325732, 2146325826, 2146326598,
146330017, 2146330390, 2146332796, 2146349268, 2146350566, 2146355285, 2146355547, 2146356846, 2146356855, 2146356961, 2146358013, 2146368330, 2146370926, 2146371129, 2146378104, 2146385406, 2146385798, 21
6387683, 2146390768, 2146392994, 2146397454, 2146401394, 2146402098, 2146402422, 2146403539, 2146405619, 2146412862, 2146414702, 2146421886, 2146430262, 2146435224, 2146440342, 2146440585, 2146443142, 2146
48245, 2146454658, 2146466476, 2146469943, 2146483153, 2146484467, 2146489298, 2146498130, 2146519542, 2146524746, 2146528979, 2146535822, 2146542703, 2146560409, 2146563852, 2146569590, 2146572730, 214657
758, 2146587156, 2146590460, 2146601924, 2146602564, 2146604055, 2146606389, 2146607794, 2146619170, 2146623289, 2146627143, 2146630008, 2146637680, 2146639561, 2146642381, 2146650466, 2146654310, 21466560
0, 2146660507, 2146668760, 2146700120, 2146706633, 2146712923, 2146714721, 2146721992, 2146727945, 2146727950, 2146728619, 2146737911, 2146739012, 2146740113, 2146741573, 2146744221, 2146746005, 2146751258
 2146751967, 2146760585, 2146765361, 2146766429, 2146770316, 2146774641, 2146778601, 2146781599, 2146784944, 2146787034, 2146788118, 2146790162, 2146795148, 2146799416, 2146799675, 2146799809, 2146806382,
146808122, 2146808233, 2146812633, 2146815264, 2146817863, 2146821197, 2146826021, 2146832337, 2146834446, 2146854555, 2146854721, 2146863827, 2146874369, 2146876966, 2146897005, 2146914326, 2146916927, 21
6922577, 2146924261, 2146927302, 2146928101, 2146930432, 2146936335, 2146943015, 2146945475, 2146949340, 2146949901, 2146950590, 2146952570, 2146953096, 2146959595, 2146959655, 2146961212, 2146961733, 2146
73524, 2146979617, 2146981297, 2146986995, 2146988751, 2146989851, 2146994211, 2146996149, 2146999208, 2147006674, 2147008604, 2147010873, 2147011072, 2147014612, 2147015818, 2147021878, 2147021925, 214702
204, 2147026303, 2147029131, 2147030074, 2147032148, 2147039259, 2147048930, 2147056052, 2147056275, 2147063600, 2147064605, 2147065603, 2147066775, 2147069653, 2147073627, 2147076578, 2147084254, 21470855
0, 2147088599, 2147092293, 2147095182, 2147101008, 2147101137, 2147103338, 2147105968, 2147109053, 2147113776, 2147115412, 2147116261, 2147128913, 2147132356, 2147141593, 2147142330, 2147142768, 2147144380
 2147148622, 2147149679, 2147155824, 2147158864, 2147164147, 2147165389, 2147168357, 2147168808, 2147169153, 2147173554, 2147177192, 2147184140, 2147191474, 2147197565, 2147201509, 2147201581, 2147207280,
147215025, 2147217548, 2147248025, 2147249607, 2147253846, 2147258308, 2147261096, 2147261290, 2147262063, 2147262652, 2147265271, 2147273570, 2147276740, 2147277188, 2147284763, 2147285994, 2147292911, 21
7300990, 2147303362, 2147312868, 2147315367, 2147315546, 2147333028, 2147333278, 2147342527, 2147345485, 2147354849, 2147356060, 2147372464, 2147372902, 2147387644, 2147390732, 2147392615, 2147394167, 2147
98620, 2147409456, 2147410377, 2147417539, 2147421591, 2147427477, 2147427927, 2147428943, 2147432841, 2147433256, 2147433588, 2147434797, 2147438584, 2147444337, 2147445430, 2147449060, 2147453424, 214745
622, 2147466779, 2147469991, 2147470335, 2147473424, 2147477398, 2147478577]
```

1b



```
 Array Size: 1000
Average RANDOM time:   0.7 ms
Average SORTED time:   0.3 ms
Average REVERSED time: 0.3 ms

 Array Size: 5000
Average RANDOM time:   2.3 ms
Average SORTED time:   1.2 ms
Average REVERSED time: 1.8 ms

 Array Size: 10000
Average RANDOM time:   4.7 ms
Average SORTED time:   2.8 ms
Average REVERSED time: 2.7 ms

 Array Size: 50000
Average RANDOM time:   19.3 ms
Average SORTED time:   8.1 ms
Average REVERSED time: 10.0 ms

 Array Size: 75000
Average RANDOM time:   23.2 ms
Average SORTED time:   11.7 ms
Average REVERSED time: 11.7 ms

 Array Size: 100000
Average RANDOM time:   30.2 ms
Average SORTED time:   17.7 ms
Average REVERSED time: 17.0 ms

 Array Size: 500000
Average RANDOM time:   179.6 ms
Average SORTED time:   97.0 ms
Average REVERSED time: 96.8 ms
```

1c



```
Array Size: 1000
Average RANDOM time:   0.5 ms
Average SORTED time:   0.2 ms
Average REVERSED time: 0.3 ms

Array Size: 5000
Average RANDOM time:   1.8 ms
Average SORTED time:   1.0 ms
Average REVERSED time: 0.5 ms

Array Size: 10000
Average RANDOM time:   3.7 ms
Average SORTED time:   1.8 ms
Average REVERSED time: 2.2 ms

Array Size: 50000
Average RANDOM time:   18.7 ms
Average SORTED time:   6.2 ms
Average REVERSED time: 6.3 ms

Array Size: 75000
Average RANDOM time:   21.1 ms
Average SORTED time:   9.3 ms
Average REVERSED time: 9.2 ms

Array Size: 100000
Average RANDOM time:   23.6 ms
Average SORTED time:   13.1 ms
Average REVERSED time: 13.0 ms

Array Size: 500000
Average RANDOM time:   148.8 ms
Average SORTED time:   81.2 ms
Average REVERSED time: 78.2 ms
```