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Program Structures & Algorithms Fall 2021

Assignment No. 05

Task:

1. To implement a parallel sorting algorithm such that each partition of the array is sorted in parallel.
2. You should run with many different array sizes (they must be sufficiently large to make parallel sorting worthwhile, obviously) and different cut-off schemes.

Relationship Conclusion:

1. Considering large range of cut off values for the large array sizes , the time for execution of sorting the array is performing better when the cut off value is close to the half the array size.
2. Cut off should be N/2

Findings:

The experiment is performed considering large values for different array sizes {2000000, 2500000, 3000000, 3500000} and multiple cut off values ranging from `510000` to `1010000` with degrees of parallelisms 2 and 4. Below are the experiment values for each array size and parallelism.

```
Degree of parallelism: 2     Array Size – 2000000
cutoff : 510000             10times Time:1459ms
cutoff : 530000             10times Time:1295ms
cutoff : 550000             10times Time:1312ms
cutoff : 570000             10times Time:1313ms
cutoff : 590000             10times Time:1306ms
cutoff : 610000             10times Time:1306ms
cutoff : 630000             10times Time:1316ms
cutoff : 650000             10times Time:1316ms
cutoff : 670000             10times Time:1312ms
cutoff : 690000             10times Time:1262ms
cutoff : 710000             10times Time:1243ms
cutoff : 730000             10times Time:1267ms
cutoff : 750000             10times Time:1252ms
```

```
cutoff : 770000            10times Time:1282ms
cutoff : 790000            10times Time:1312ms
cutoff : 810000            10times Time:1311ms
cutoff : 830000            10times Time:1331ms
cutoff : 850000            10times Time:1318ms
cutoff : 870000            10times Time:1289ms
cutoff : 890000            10times Time:1261ms
cutoff : 910000            10times Time:1254ms
cutoff : 930000            10times Time:1250ms
cutoff : 950000            10times Time:1251ms
cutoff : 970000            10times Time:1500ms
cutoff : 990000            10times Time:1335ms
cutoff : 1010000           10times Time:977ms


Degree of parallelism: 2       Array Size – 2500000
cutoff : 510000            10times Time:1631ms
cutoff : 530000            10times Time:1342ms
cutoff : 550000            10times Time:1393ms
cutoff : 570000            10times Time:1330ms
cutoff : 590000            10times Time:1371ms
cutoff : 610000            10times Time:1408ms
cutoff : 630000            10times Time:1312ms
cutoff : 650000            10times Time:1324ms
cutoff : 670000            10times Time:1327ms
cutoff : 690000            10times Time:1326ms
cutoff : 710000            10times Time:1292ms
cutoff : 730000            10times Time:1323ms
cutoff : 750000            10times Time:1300ms
cutoff : 770000            10times Time:1312ms
cutoff : 790000            10times Time:1502ms
cutoff : 810000            10times Time:1289ms
cutoff : 830000            10times Time:1347ms
cutoff : 850000            10times Time:1340ms
cutoff : 870000            10times Time:1356ms
cutoff : 890000            10times Time:1330ms
cutoff : 910000            10times Time:1358ms
cutoff : 930000            10times Time:1363ms
cutoff : 950000            10times Time:1308ms
cutoff : 970000            10times Time:1339ms
cutoff : 990000            10times Time:1284ms
cutoff : 1010000           10times Time:1284ms


Degree of parallelism: 2        Array Size – 3000000
cutoff : 510000            10times Time:1983ms
cutoff : 530000            10times Time:1600ms
cutoff : 550000            10times Time:1544ms
cutoff : 570000            10times Time:1632ms
cutoff : 590000            10times Time:1615ms
cutoff : 610000            10times Time:1673ms
cutoff : 630000            10times Time:1585ms
cutoff : 650000            10times Time:1653ms
```

```
cutoff : 670000            10times Time:1577ms
cutoff : 690000            10times Time:1486ms
cutoff : 710000            10times Time:1742ms
cutoff : 730000            10times Time:1657ms
cutoff : 750000            10times Time:1600ms
cutoff : 770000            10times Time:1596ms
cutoff : 790000            10times Time:1636ms
cutoff : 810000            10times Time:1632ms
cutoff : 830000            10times Time:1571ms
cutoff : 850000            10times Time:1483ms
cutoff : 870000            10times Time:1550ms
cutoff : 890000            10times Time:1762ms
cutoff : 910000            10times Time:1563ms
cutoff : 930000            10times Time:1599ms
cutoff : 950000            10times Time:1634ms
cutoff : 970000            10times Time:1606ms
cutoff : 990000            10times Time:1630ms
cutoff : 1010000           10times Time:1617ms
```

```
Degree of parallelism: 2    Array Size – 3500000
cutoff : 510000            10times Time:2235ms
cutoff : 530000            10times Time:1902ms
cutoff : 550000            10times Time:1874ms
cutoff : 570000            10times Time:1911ms
cutoff : 590000            10times Time:1954ms
cutoff : 610000            10times Time:1883ms
cutoff : 630000            10times Time:1878ms
cutoff : 650000            10times Time:1914ms
cutoff : 670000            10times Time:1807ms
cutoff : 690000            10times Time:2036ms
cutoff : 710000            10times Time:1926ms
cutoff : 730000            10times Time:1908ms
cutoff : 750000            10times Time:1868ms
cutoff : 770000            10times Time:1923ms
cutoff : 790000            10times Time:1891ms
cutoff : 810000            10times Time:1815ms
cutoff : 830000            10times Time:1795ms
cutoff : 850000            10times Time:1891ms
cutoff : 870000            10times Time:1854ms
cutoff : 890000            10times Time:2167ms
cutoff : 910000            10times Time:1963ms
cutoff : 930000            10times Time:1936ms
cutoff : 950000            10times Time:1892ms
cutoff : 970000            10times Time:1894ms
cutoff : 990000            10times Time:1905ms
cutoff : 1010000           10times Time:1899ms

Degree of parallelism: 4   Array Size – 2000000
cutoff : 510000            10times Time:1341ms
```

```
cutoff : 530000            10times Time:1057ms
cutoff : 550000            10times Time:1034ms
cutoff : 570000            10times Time:1005ms
cutoff : 590000            10times Time:1080ms
cutoff : 610000            10times Time:1092ms
cutoff : 630000            10times Time:1067ms
cutoff : 650000            10times Time:1084ms
cutoff : 670000            10times Time:1074ms
cutoff : 690000            10times Time:1073ms
cutoff : 710000            10times Time:1085ms
cutoff : 730000            10times Time:1081ms
cutoff : 750000            10times Time:1090ms
cutoff : 770000            10times Time:1101ms
cutoff : 790000            10times Time:1086ms
cutoff : 810000            10times Time:1103ms
cutoff : 830000            10times Time:1025ms
cutoff : 850000            10times Time:1020ms
cutoff : 870000            10times Time:1046ms
cutoff : 890000            10times Time:1035ms
cutoff : 910000            10times Time:1117ms
cutoff : 930000            10times Time:1302ms
cutoff : 950000            10times Time:1107ms
cutoff : 970000            10times Time:1134ms
cutoff : 990000            10times Time:1098ms
cutoff : 1010000           10times Time:975ms
```

Degree of parallelism: 4 Array Size – 2500000

```
cutoff : 510000            10times Time:1723ms
cutoff : 530000            10times Time:1362ms
cutoff : 550000            10times Time:1429ms
cutoff : 570000            10times Time:1485ms
cutoff : 590000            10times Time:1454ms
cutoff : 610000            10times Time:1469ms
cutoff : 630000            10times Time:948ms
cutoff : 650000            10times Time:955ms
cutoff : 670000            10times Time:947ms
cutoff : 690000            10times Time:946ms
cutoff : 710000            10times Time:934ms
cutoff : 730000            10times Time:1072ms
cutoff : 750000            10times Time:1007ms
cutoff : 770000            10times Time:970ms
cutoff : 790000            10times Time:960ms
cutoff : 810000            10times Time:965ms
cutoff : 830000            10times Time:987ms
cutoff : 850000            10times Time:993ms
cutoff : 870000            10times Time:984ms
cutoff : 890000            10times Time:988ms
cutoff : 910000            10times Time:931ms
cutoff : 930000            10times Time:935ms
cutoff : 950000            10times Time:937ms
cutoff : 970000            10times Time:936ms
cutoff : 990000            10times Time:954ms
```

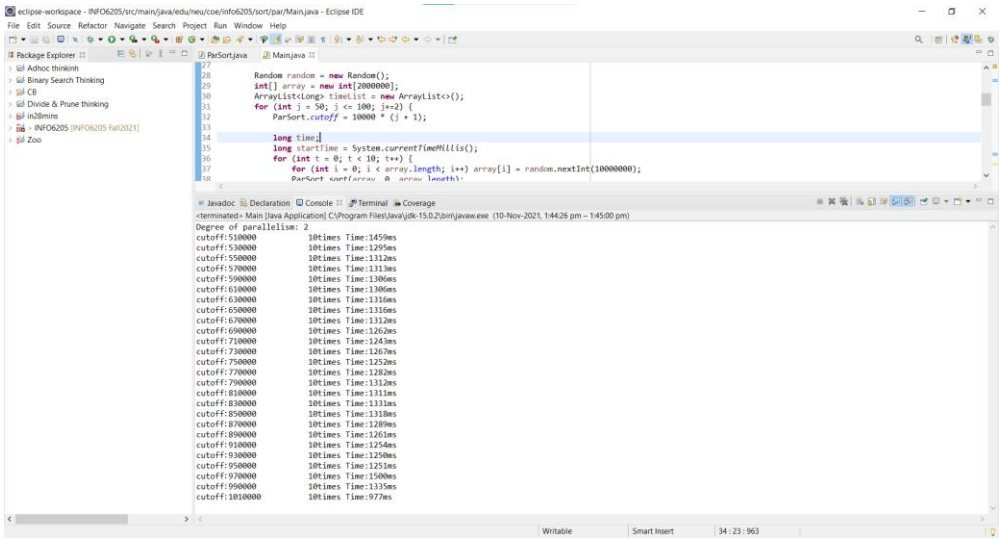
```
cutoff : 1010000           10times Time:950ms


Degree of parallelism: 4   Array Size – 3000000
cutoff : 510000            10times Time:2065ms
cutoff : 530000            10times Time:1730ms
cutoff : 550000            10times Time:1730ms
cutoff : 570000            10times Time:1770ms
cutoff : 590000            10times Time:1791ms
cutoff : 610000            10times Time:1829ms
cutoff : 630000            10times Time:1812ms
cutoff : 650000            10times Time:1757ms
cutoff : 670000            10times Time:1720ms
cutoff : 690000            10times Time:1863ms
cutoff : 710000            10times Time:1833ms
cutoff : 730000            10times Time:1833ms
cutoff : 750000            10times Time:1843ms
cutoff : 770000            10times Time:1239ms
cutoff : 790000            10times Time:1205ms
cutoff : 810000            10times Time:1217ms
cutoff : 830000            10times Time:1193ms
cutoff : 850000            10times Time:1171ms
cutoff : 870000            10times Time:1177ms
cutoff : 890000            10times Time:1429ms
cutoff : 910000            10times Time:1231ms
cutoff : 930000            10times Time:1190ms
cutoff : 950000            10times Time:1209ms
cutoff : 970000            10times Time:1235ms
cutoff : 990000            10times Time:1237ms
cutoff : 1010000           10times Time:1287ms


Degree of parallelism: 4   Array Size – 3500000
cutoff : 510000            10times Time:2329ms
cutoff : 530000            10times Time:2093ms
cutoff : 550000            10times Time:2083ms
cutoff : 570000            10times Time:2093ms
cutoff : 590000            10times Time:2083ms
cutoff : 610000            10times Time:2097ms
cutoff : 630000            10times Time:2137ms
cutoff : 650000            10times Time:2155ms
cutoff : 670000            10times Time:2097ms
cutoff : 690000            10times Time:1995ms
cutoff : 710000            10times Time:2184ms
cutoff : 730000            10times Time:2138ms
cutoff : 750000            10times Time:2125ms
cutoff : 770000            10times Time:2162ms
cutoff : 790000            10times Time:2070ms
cutoff : 810000            10times Time:1998ms
cutoff : 830000            10times Time:1979ms
cutoff : 850000            10times Time:2018ms
cutoff : 870000            10times Time:2007ms
cutoff : 890000            10times Time:1390ms
cutoff : 910000            10times Time:1426ms
```

```
cutoff : 930000              10times Time:1618ms
cutoff : 950000              10times Time:1481ms
cutoff : 970000              10times Time:1504ms
cutoff : 990000              10times Time:1470ms
cutoff : 1010000             10times Time:1472ms
```

Output Screenshots:

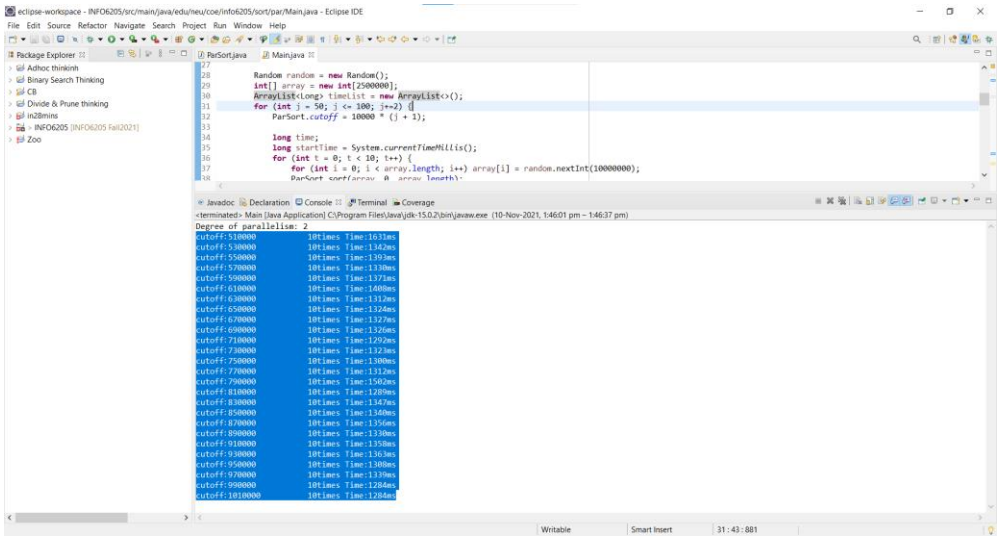
Array Size – 2000000

Degree of parallelism – 2



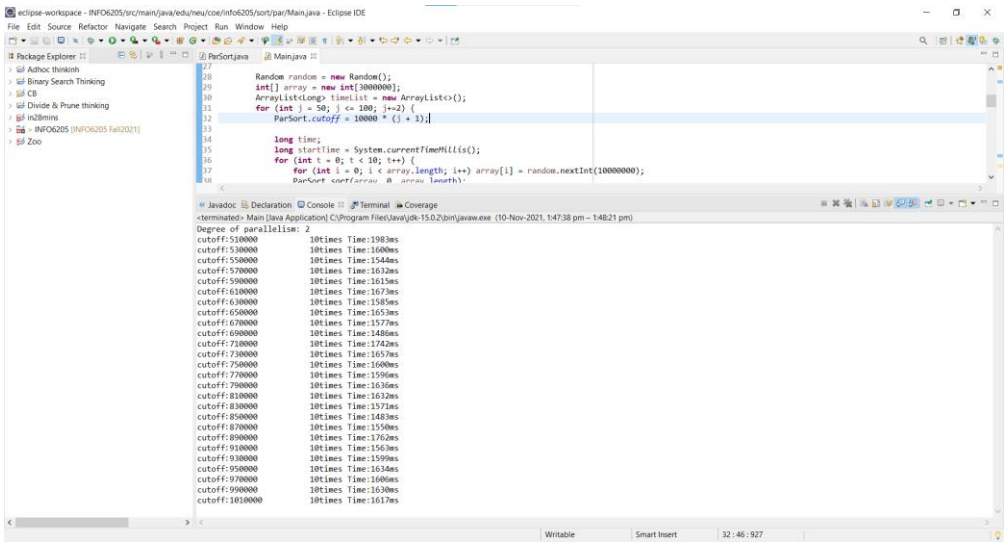
Array Size – 2500000

Degree of parallelism – 2



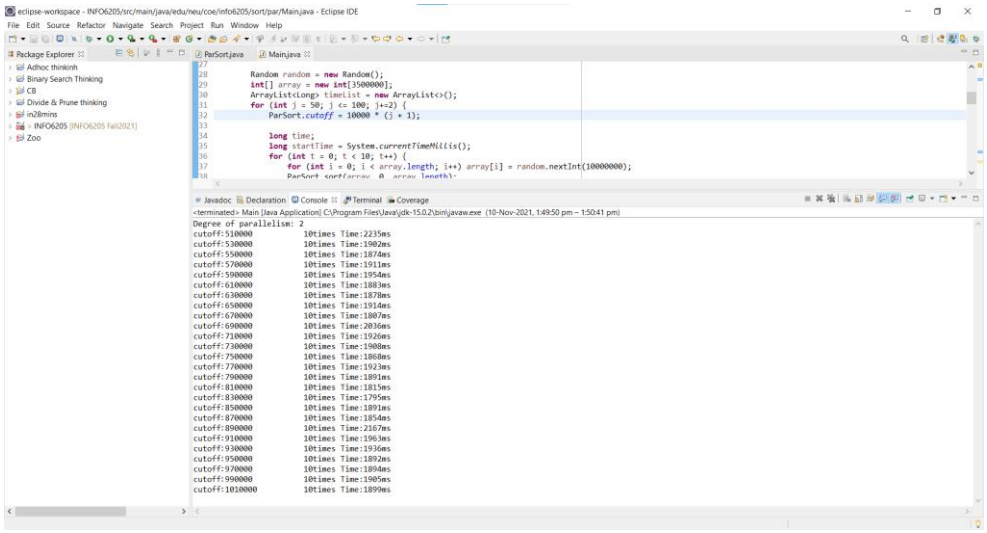
Array Size – 3000000

Degree of parallelism – 2



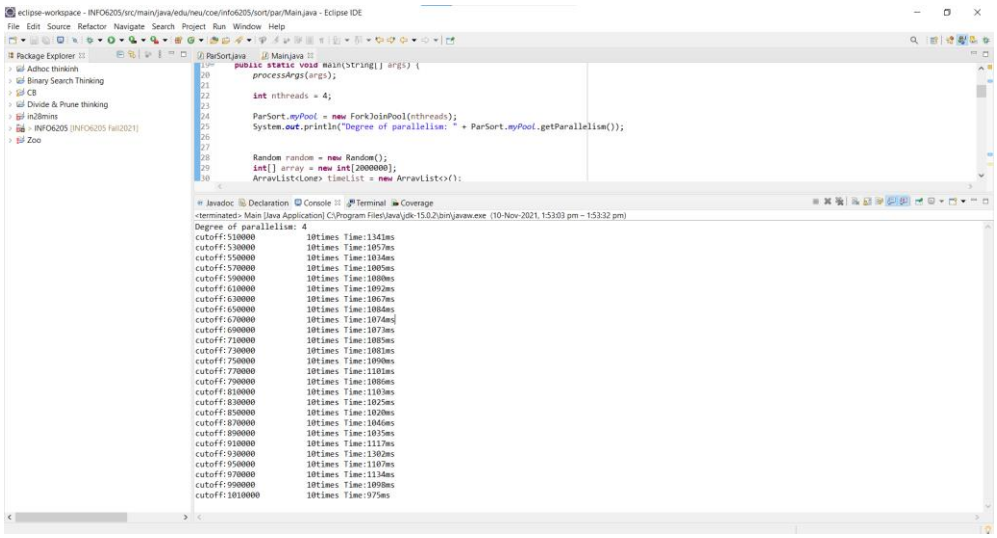
Array Size – 3500000

Degree of parallelism – 2



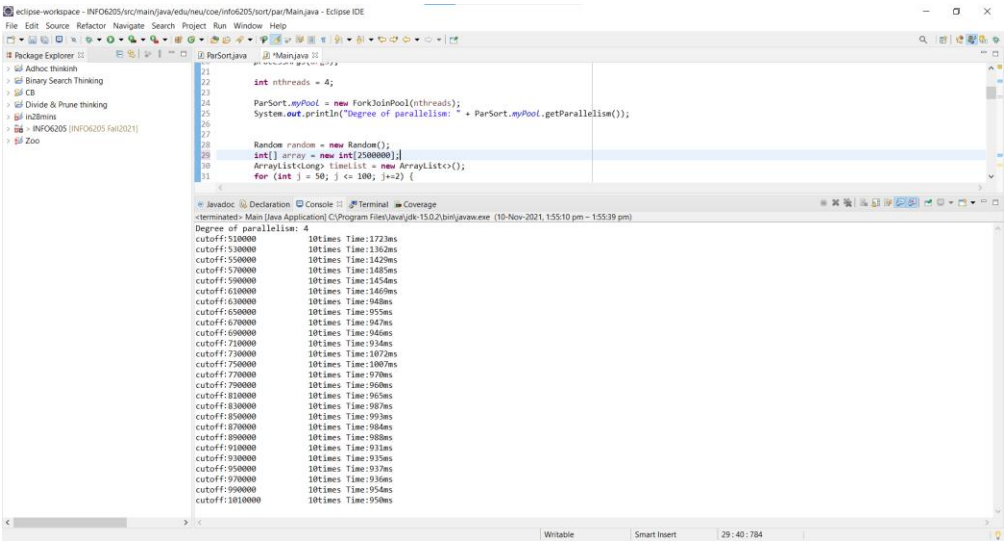
Array Size – 2000000

Degree of parallelism – 4



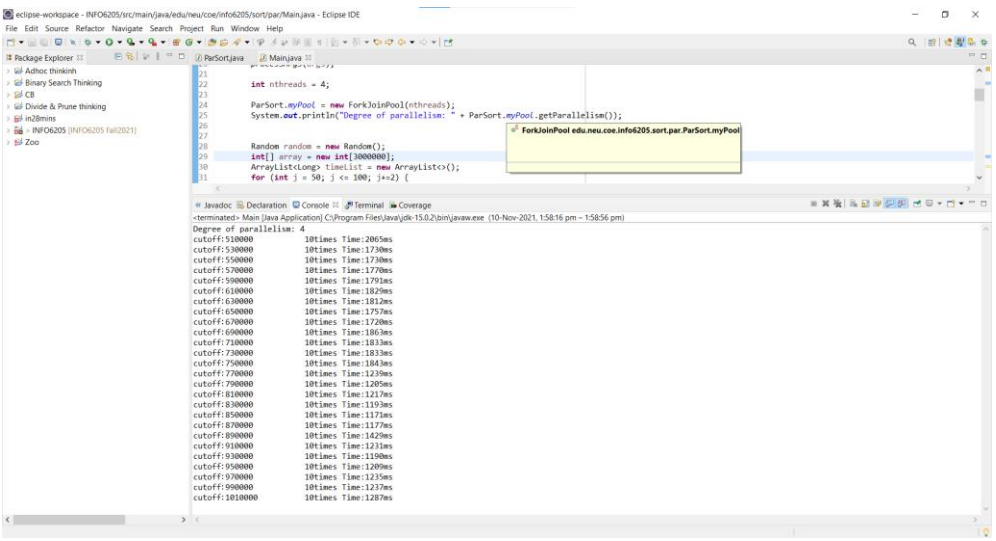
Array Size – 2500000

Degree of parallelism – 4



Array Size – 3000000

Degree of parallelism – 4



Array Size – 3500000

Degree of parallelism – 4