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PARALLEL SORTING

TASK:

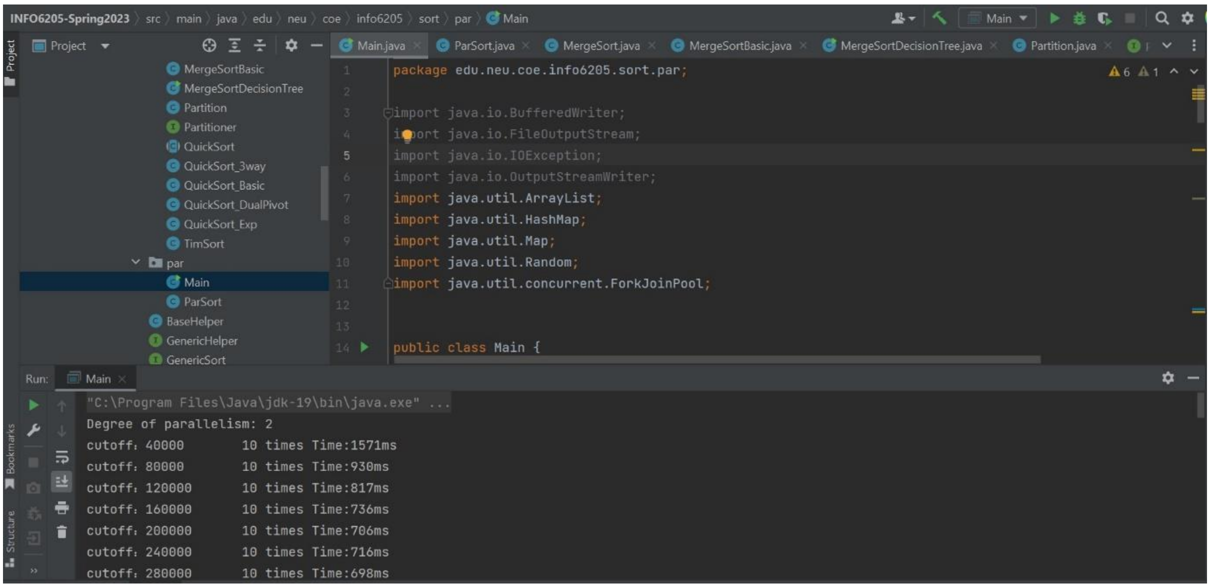
Your task is to implement a parallel sorting algorithm such that each partition of the array is sorted in parallel. You will consider two different schemes for deciding whether to sort in parallel.

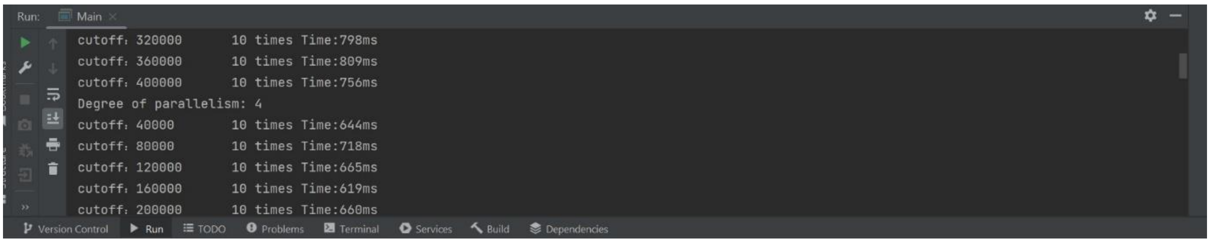
1. A cutoff (defaults to, say, 1000) which you will update according to the first argument in the command line when running. It's your job to experiment and come up with a good value for this cutoff. If there are fewer elements to sort than the cutoff, then you should use the system sort instead.
2. Recursion depth or the number of available threads. Using this determination, you might decide on an ideal number (*t*) of separate threads (stick to powers of 2) and arrange for that number of partitions to be parallelized (by preventing recursion after the depth of *lg t* is reached).
3. An appropriate combination of these.

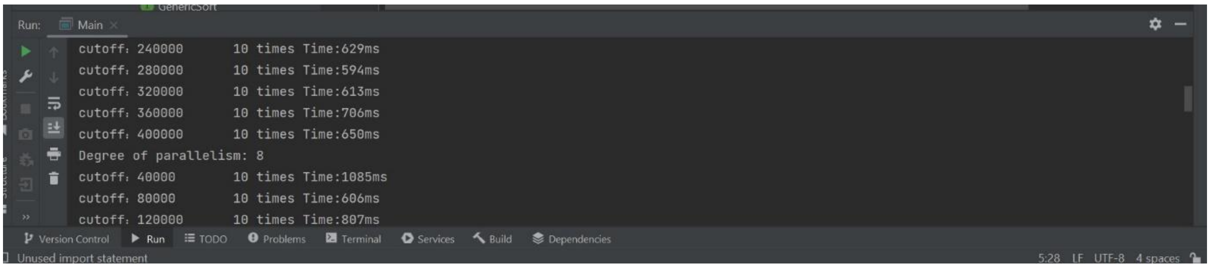
OUTPUT:

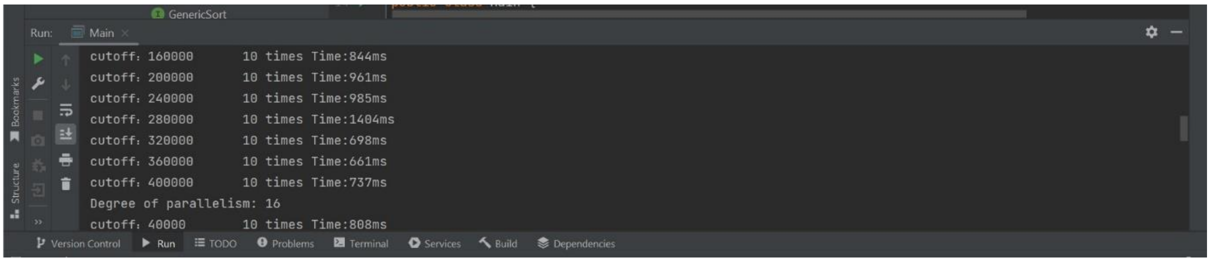
The below screenshot displays the output:

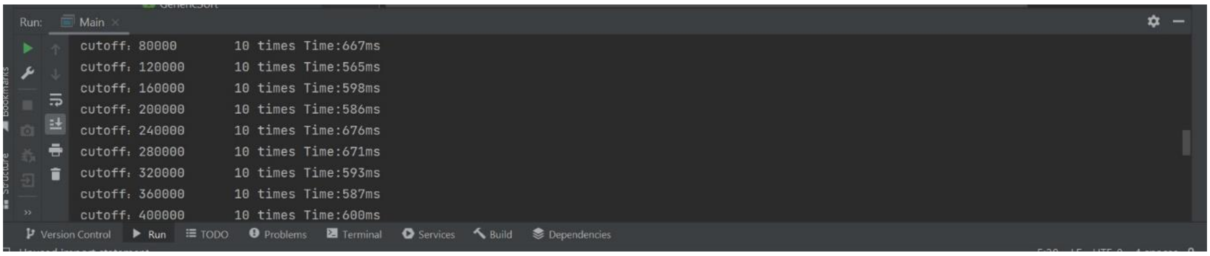
for arraySize = 800000 and cut_off value=40000.

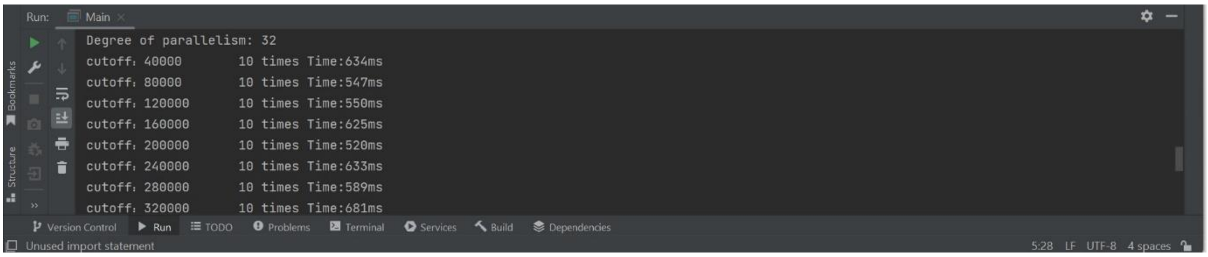



cutoff: 320000 10 times Time:798ms
cutoff: 360000 10 times Time:809ms
cutoff: 400000 10 times Time:756ms
Degree of parallelism: 4
cutoff: 40000 10 times Time:644ms
cutoff: 80000 10 times Time:718ms
cutoff: 120000 10 times Time:665ms
cutoff: 160000 10 times Time:619ms
cutoff: 200000 10 times Time:660ms


cutoff: 240000 10 times Time:629ms
cutoff: 280000 10 times Time:594ms
cutoff: 320000 10 times Time:613ms
cutoff: 360000 10 times Time:706ms
cutoff: 400000 10 times Time:650ms
Degree of parallelism: 8
cutoff: 40000 10 times Time:1085ms
cutoff: 80000 10 times Time:606ms
cutoff: 120000 10 times Time:807ms

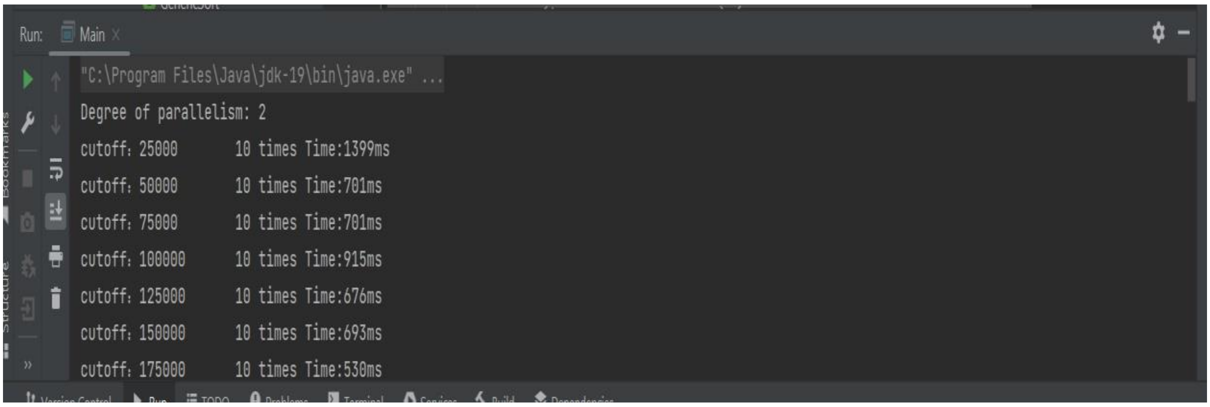

cutoff: 160000 10 times Time:844ms
cutoff: 200000 10 times Time:961ms
cutoff: 240000 10 times Time:985ms
cutoff: 280000 10 times Time:1404ms
cutoff: 320000 10 times Time:698ms
cutoff: 360000 10 times Time:661ms
cutoff: 400000 10 times Time:737ms
Degree of parallelism: 16
cutoff: 40000 10 times Time:808ms


cutoff: 80000 10 times Time:667ms
cutoff: 120000 10 times Time:565ms
cutoff: 160000 10 times Time:598ms
cutoff: 200000 10 times Time:586ms
cutoff: 240000 10 times Time:676ms
cutoff: 280000 10 times Time:671ms
cutoff: 320000 10 times Time:593ms
cutoff: 360000 10 times Time:587ms
cutoff: 400000 10 times Time:600ms

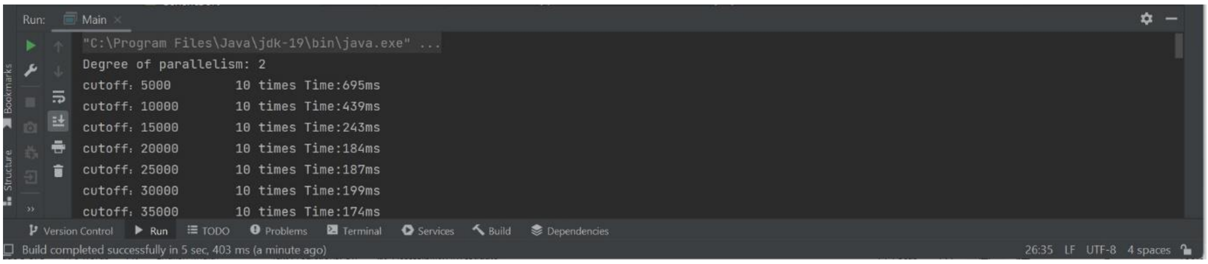

Degree of parallelism: 32
cutoff: 40000 10 times Time:634ms
cutoff: 80000 10 times Time:547ms
cutoff: 120000 10 times Time:550ms
cutoff: 160000 10 times Time:625ms
cutoff: 200000 10 times Time:520ms
cutoff: 240000 10 times Time:633ms
cutoff: 280000 10 times Time:589ms
cutoff: 320000 10 times Time:681ms


cutoff: 360000 10 times Time:600ms
cutoff: 400000 10 times Time:587ms
Degree of parallelism: 64
cutoff: 40000 10 times Time:630ms
cutoff: 80000 10 times Time:611ms
cutoff: 120000 10 times Time:521ms
cutoff: 160000 10 times Time:720ms
cutoff: 200000 10 times Time:597ms
cutoff: 240000 10 times Time:585ms

For arraySize:500,000 and cut off value 25000:



For arraySize:100,000 and cut off value 5000:

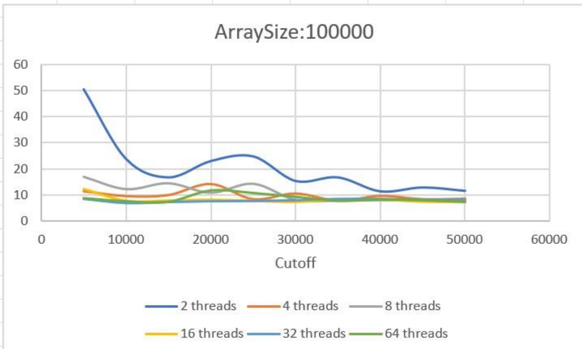


EVIDENCE/OBSERVATIONS:

Below is the table that displays the values of cutoff and the number of threads forked for various values of cutoff and array-size:

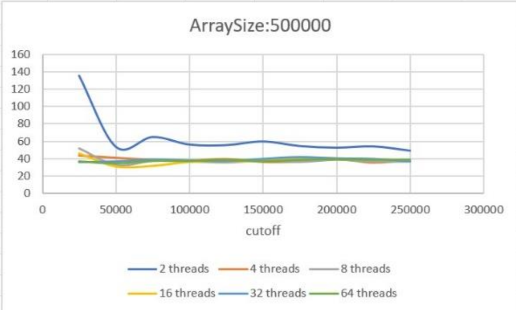
For array size:100000 and cutoff:5000

Cutoff	2 threads	4 threads	8 threads	16 threads	32 threads	64 threads
5000	50.7	11.4	16.9	12.1	8.3	8.8
10000	23.8	9.5	12.1	7.7	6.7	7.6
15000	16.7	9.9	14.4	7.8	7.1	7.4
20000	23	14.2	10.7	8.1	7.4	11.8
25000	24.8	8.3	14.2	7.7	7.5	10.8
30000	15.3	10.5	7.9	7.3	7.8	9.3
35000	16.7	7.7	7.6	8.2	8.3	7.8
40000	11.3	9.6	7.8	8.2	8.3	8.3
45000	12.8	8.3	7.5	7.4	8	8
50000	11.5	8.5	7	7.3	7.9	7.4



For arraySize:500,000 and cut off value 25000:

CutOff	2 threads	4 threads	8 threads	16 threads	32 threads	64 threads
25000	135.5	43.2	52	45.6	35.5	36.5
50000	53.4	40.7	32.8	31.1	36.2	34.2
75000	64.7	38.6	37.5	31.7	38.5	37.3
100000	56	37.6	37	36.2	37.5	37
125000	55.3	39.4	35.7	36.6	36.6	38.5
150000	59.6	36.1	37.9	37.8	39.3	36.8
175000	54.3	36.6	36.4	40.7	41.3	38.3
200000	52.4	39.4	38.9	40.3	39.8	39.1
225000	53.9	35.3	36.8	39.1	39.3	38.4
250000	49	38.4	36.8	37.8	36.3	38.6



for arraySize = 800000 and cut off value=40000:

CutOff	2 threads	4 threads	8 threads	16 threads	32 threads	64 threads
40000	148.2	75.7	75.7	86	60.3	53.2
80000	83.2	63.7	57.3	55.3	52.5	53.3
120000	88.5	62.1	54	56.7	59.3	58.6
160000	74.6	60.2	54.5	54.2	53.3	56.4
200000	78	60.8	55.7	54.8	62.5	61.4
240000	93.5	61.1	59	60.6	57	61.6
280000	79.4	60	60.5	65.8	63.1	64.9
320000	88.7	61.6	62.7	58.7	59.6	65.2
360000	86.3	66.2	58.1	60.4	66.7	59.9
400000	77.3	59.2	58.6	61.3	62.5	60.2

RELATIONSHIP CONCLUSION:

Comparing the above graphs and data from the tables, we can conclude the following:

• After changing the cutoff values and number of threads for different array sizes, the number of threads bigger than 8 does not improve the performance of the algorithm. Hence forking 8 threads is the best option.

• Referring to the graphs above, we can see that the optimal performance is seen around ~25% of the array size. With this, we can conclude that this leads to least algorithm performance time.