Program Structures and Algorithms
Spring 2024

NAME: Aneesh Arunjunai Saravanan
NUID: 002675639
GITHUB LINK: https://github.com/aneesharunjunai/INFO6205

Task: Assignment 5 – Parallel Sorting

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.

There is a Main class and the ParSort class in the sort.par package of the INFO6205 repository. The Main class can be used as is, but the ParSort class needs to be implemented where you see "TODO..." [it turns out that these TODOs are already implemented].

Unless you have a good reason not to, you should just go along with the Java8-style future implementations provided for you in the class repository.

You must prepare a report that shows the results of your experiments and draws a conclusion (or more) about the efficacy of this method of parallelizing sort. Your experiments should involve sorting arrays of sufficient size for the parallel sort to make a difference. You should run with many different array sizes (they must be sufficiently large to make parallel sorting worthwhile, obviously) and different cutoff schemes.

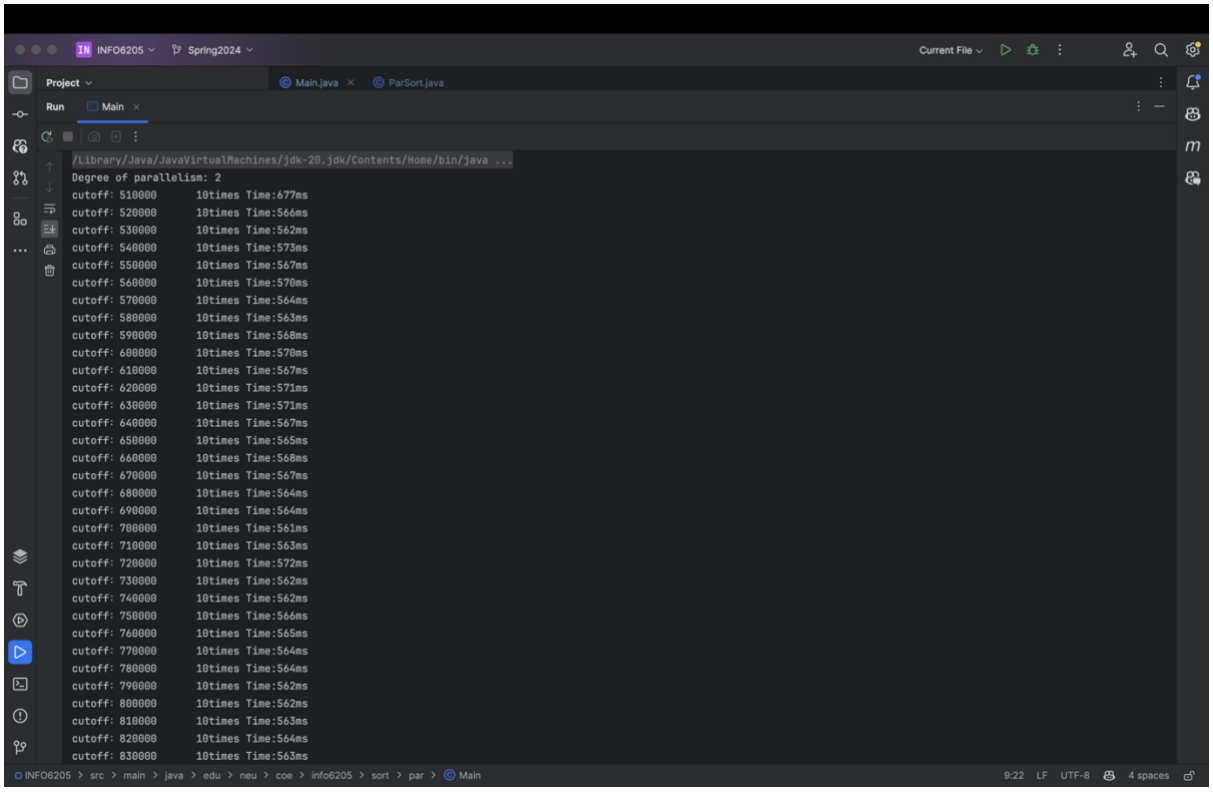
Observation & Conclusion:

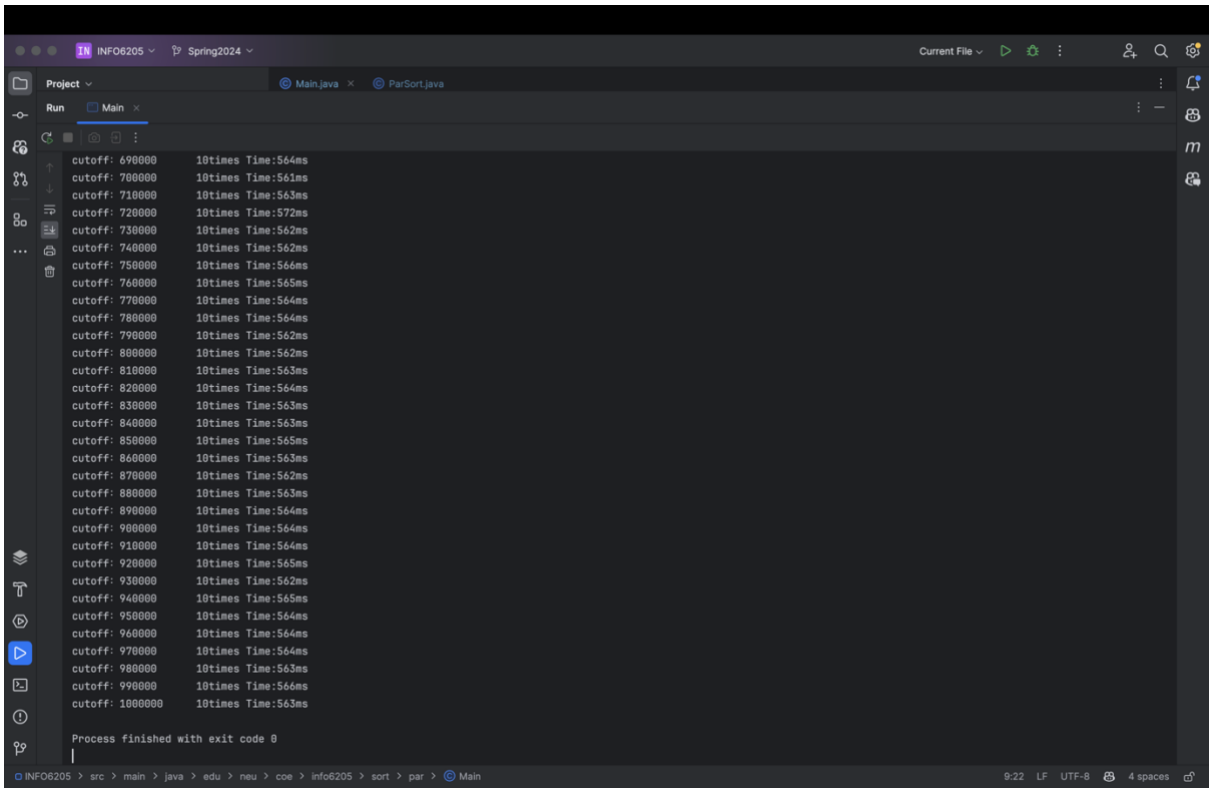
- The optimal cutoff value seems to be around 50,000 across all degrees of parallelism.
- Increasing the cutoff value beyond 50,000 generally leads to longer sorting times.
- Higher degrees of parallelism (11 DOP) can improve performance compared to lower DOP (2 DOP) at lower cutoff values (around 20,000).
- However, the benefit of higher DOP diminishes or even reverses at larger cutoff values (above 50,000).
- This suggests that the overhead of managing more threads outweighs the benefit of parallel processing for larger subtasks.

Overall, it appears that there's a trade-off between the cutoff value and the degree of parallelism. A cutoff of around 50,000 seems to be a good starting point, and the optimal DOP depends on the specific hardware and problem size.

With a smaller data set, the overhead of creating and managing parallel tasks might outweigh the benefits of parallelism, making a sequential sort potentially faster. Conversely, with a much larger data set, the benefits of parallelization could become more pronounced. Further experimentation with different array sizes would be necessary to establish a more comprehensive relationship between dataset size, optimal cutoff value, and the ideal degree of parallelism.

Console Output:





ParSort Graph: