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Program Structures & Algorithms

Fall 2021

Assignment No. 5(Parallel Sorting)

- **Task (List down the tasks performed in the Assignment)**
- **Relationship Conclusion: (For ex : z = a * b)**
- **Evidence to support the conclusion:**

1. **Output (Snapshot of Code output in the terminal)**
2. **Graphical Representation(Observations from experiments should be tabulated and analyzed by plotting graphs(usually in excel) to arrive on the relationship conclusion)**

- **Unit tests result:(Snapshot of successful unit test run)**

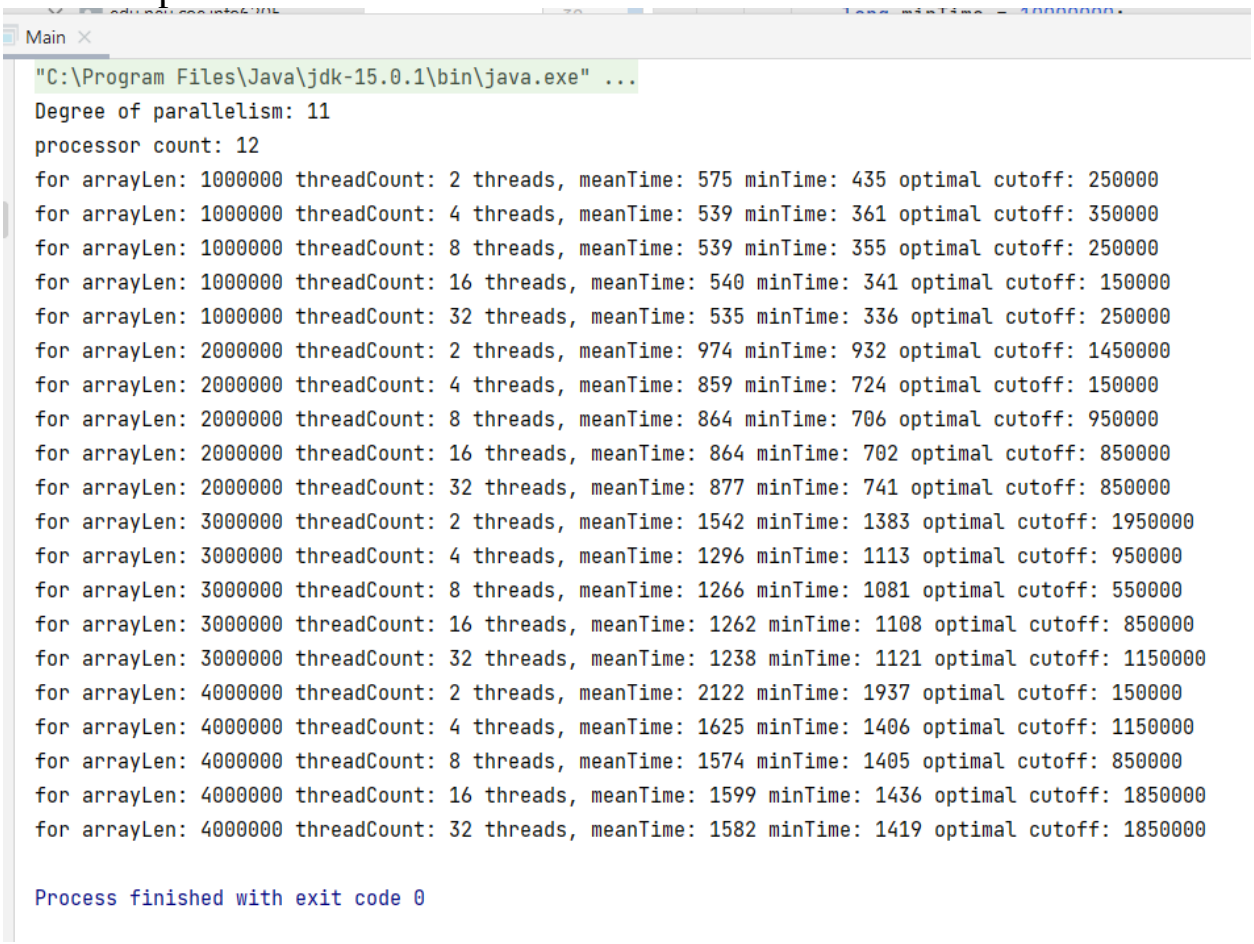
Parallel sorting algorithm has been implemented such that each partition is sorted in parallel.
https://github.com/venkteshgm/INFO6205-Assignments/blob/Fall2021/src/main/java/edu/neu/coe/info6205/union_find/UF_HWQUPC.java

The system that the experiment is being run on has 12 processor units.

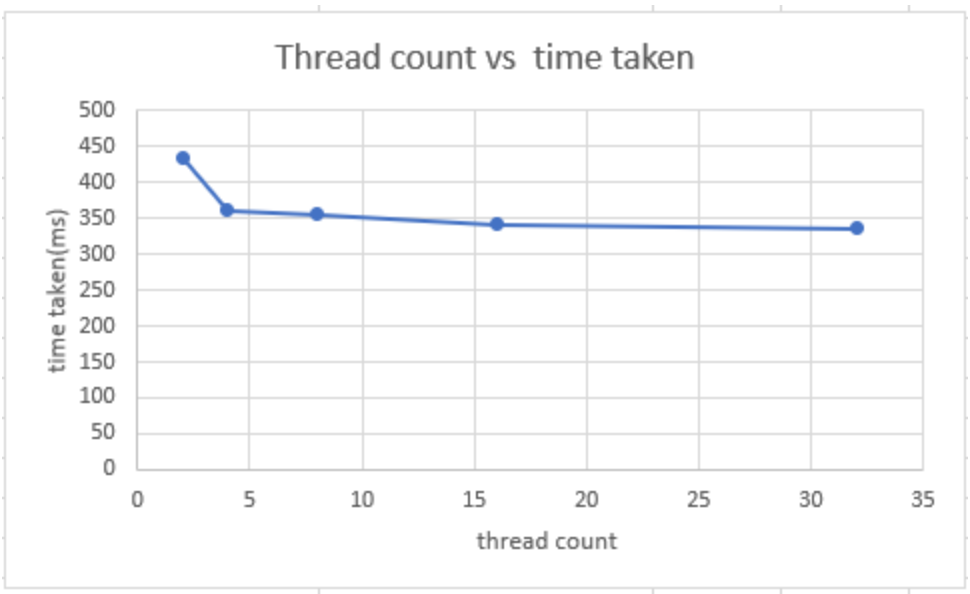
Program was run for array lengths from 1 million to 4 million, with 1 million increments, totalling 4 runs per array length.
Thread counts were varied from 2 to 32 in powers of 2(2,4,8,16,32).
Cutoff times were varied from 50,000 to 2,000,000 in increments of 100,000.

Minimum time taken for each array length and thread count, and its corresponding cutoff values have been recorded, as follows.

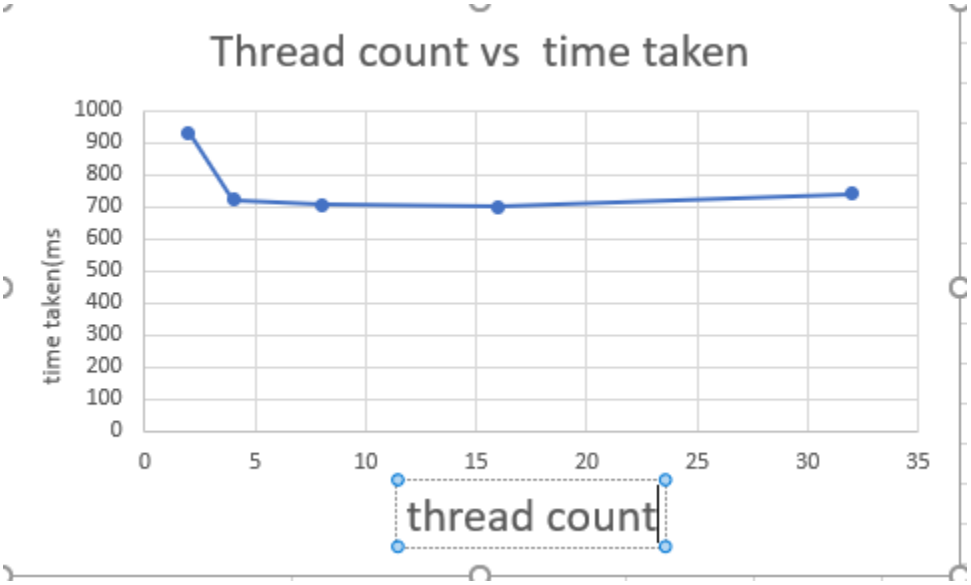
Main output:



From the results, the following graphs have been plotted of thread count vs time taken



For array length of 1,000,000



For array length of 2,000,000

Similar results can be found for array lengths of 3 and 4 million as well, as seen from the ouput.

The performance seems to be maximum around the 8-16 thread count, which is the closest to the processor count of the system.

Having all processors running and not having them remain idle, while not leaving any threads waiting for processors to pick it up, results in the best performance.
In other words, most processor engagement and minimal context switching between threads is present when the number of thread executions are the same or closest to the number of processors available.
8-16 threads is closest to the processor count of 12.

Cutoff determines the number of subtasks created for the different threads to pick up and execute. The lower the cutoff value, the greater the number of subtasks.
Hence, performance improvements can be seen when the cutoff value results in number of subtasks nearing number of threads of the experiment. It is not optimal in all cases, but in the results posted above, for array length 1,000,000, the optimal cutoff is 150,000. The ratio is 6.67 which is closest to 8 among the thread counts.

Thus, having the thread count be the closest to the processor count, and choosing a cutoff time C for array length A,
Such that A/C = thread count T leads to optimal results.