

Analysis on Work Stealing Scheduler

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Abstract - We built a Work Stealing Scheduler to run Quick Sort. We then analyze the performances of the scheduler confronted with sequential sorting and depending on three parameters: the size of the array, the number of servers and the cutoff under which to operate sequentially.

1 Introduction

1.1 Work Staling Scheduler

Work stealing is a scheduling strategy designed to efficiently manage a dynamically multi-threaded computation using a fixed number of processors. The work stealing scheduler bounds the number of concurrently active threads within a limit, thus also positively affecting the memory requirements. Work Stealing causes an improvement in the execution time and memory usage. Moreover, the scheduler tries to maintain related threads on the same processor, minimizing the communication between different threads. Work stealing differs from work sharing because underutilized processors take the initiative, without relying solely on the scheduler: each processor owns a deque and, when it's empty, it tries to steal work from others. The number of migrations is lower in work stealing, because it is done only when absolutely necessary.

We built a work stealing scheduler that runs a Quick Sort application. We performed some analysis on the results, comparing the clock-time for a work stealing and a sequential scheduling, searching for a set of parameters that minimizes wall-clock time.

2 Our work

We developed a work-stealing scheduler and a Quick-Sort application using Java 8. The main routine takes three parameters, and we tried assigning different values to them to find a set that minimizes wall-clock time when compared to sequential sorting. For more information about the parameters used, see [Section 3](#). The classes that implement the algorithm are `Scheduler`, `Tasklet` and `QuickSort`. We then use `BatchQuickSortExecutors`, `IOFromCSVFile` and `Statistics` to efficiently gather and compute data. Details on the analysis performed can also be found in [Section 3](#).

2.1 Scheduler

The work stealing scheduler is implemented using the `WorkstealingScheduler` class, which implements the `Scheduler` interface. The `WorkstealingScheduler` class contains a private `ServerThread[]` array named `servers`. The array represents the number of servers available. `ServerThread` is a private inner class.

ServerThread Each server is represented using a `ServerThread`. Each server has the fields:

- `private int myIndex`: the identifier of the server;
- `public ConcurrentLinkedDeque<Tasklet> deque`: the deque that stores the Tasklets the server needs to run. When dealing with its own deque, a server always adds and polls from the bottom;
- `private Stack<Tasklet> stack`: the stack stores the Tasklet the server is currently running.

The `ServerThread` class implements `Runnable`, and its two most important methods are:

- `public void run()`: defines the standard behaviour of the server. If the server's deque is void, the server calls the steal method; otherwise it polls the last Tasklet from the bottom of the deque, pushes it into the stack and then executes it;
- `public void steal()`: having its own deque empty, the server tries stealing Tasklets from the top of someone else's deque. If the steal is successful the server may proceed with the Tasklet execution.

2.2 Tasklet

`Tasklet` is an abstract class designed to recursively perform a task. We mainly use the `QSortTasklet` class.

QSortTasklet This class was designed to recursively perform Quick Sort. Its most notable fields are:

- `public final int start, end` which are necessary to perform Quick Sort;
- `private ConcurrentLinkedDeque<Tasklet> originDeque` keeping a reference to the deque the Tasklet was piqued from we can add there one child while we execute the other;

As for its methods, since `QSortTasklet` extends `RecursiveAction`, it implements `compute()`.

- `public void compute()`: it's the main method of the class. It checks the size of the array or portion of array to sort and it confronts it with `cutOff`. If the size exceeds the cutoff we recursively call `compute`, otherwise we sort the remaining array sequentially.

2.3 QuickSort

It contains the `main` and the methods necessary to perform Quick Sort, `public void sequentialSortArray (int[] array, int left, int right)` and `public int partition (int arr[], int left, int right)`.

3 Analysis performed

The work-stealing scheduler module takes as input three different execution parameters:

- **arraySize**: sets the size of the array to sort;
- **numServers**: sets the number of servers;
- **cutOff**: sets the array size under which to perform sequential sorting. This threshold can be used to improve the performances of the work stealing algorithm.

All these parameters affect the execution time, and the possible speed-up compared to sequential sorting. On each run, the array is copied and sorted twice, once completely sequentially, and once using the specified parameters. We collected different data searching for the set of parameters that maximizes the speed-up. In order to evaluate the speed-up, we focused on wall-clock time, which is the actual time taken just before and after sorting the array. The speed-up reported is obtained dividing the concurrent clock time by the sequential one.

3.1 Results of analysis

We performed a series of analysis to determine the best set of parameters to maximize the speed-up.

Selecting the best number of servers First we tried to determine the optimal number of servers. We set the cutoff at 100 and considered arrays with a varying size, from 10^5 to 5×10^5 . For each size we executed the program 5 times and then considered the average value. We used 5, 10, 15, 20, 25 and 30 servers. Using 10, 15 and 20 servers we always had a speed-up, so we chose between them the one with the better results. We concluded that the best number of servers, given our data, was 20. Figures 1 and 2 show our results, while the detailed data can be found in [Appendix A](#).

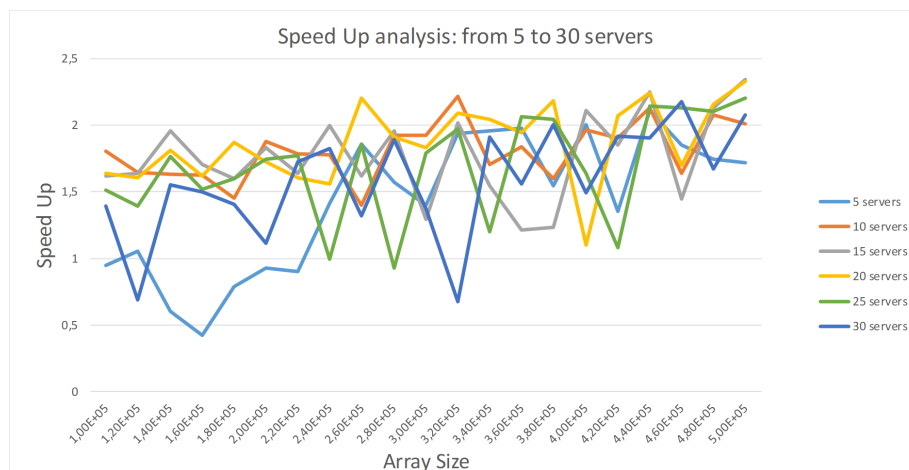


Figure 1: Speed-up with cutoff=100 and different values for size and servers

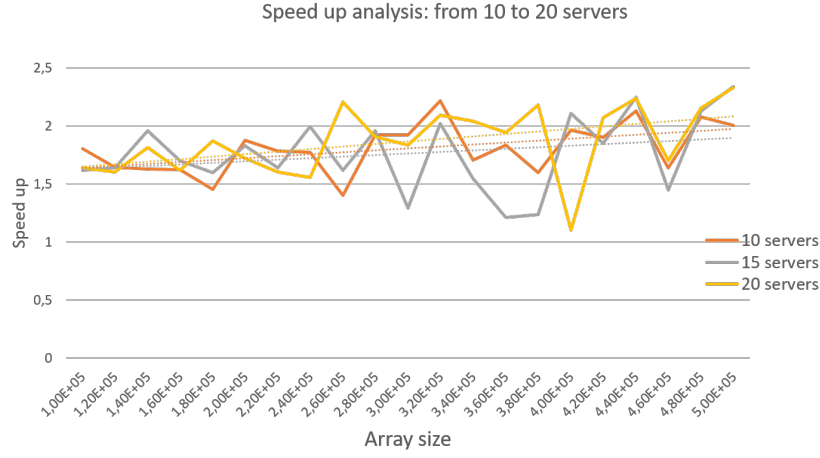


Figure 2: Detailed speed-up with cutoff=100 and different sizes and servers

Selecting the best cut-off We performed some analysis to see how a different cutoff affects the performance. We tried different cutoff values on different arrays, keeping the servers' number at 20. First, we tested cutoff values ranging from 50 to 5000 with a step of 50 in an array with 1000000 and then 5000000 elements. The detailed results can be find in [Appendix B1](#). Figure 3 shows the speed-up obtained in the two arrays depending on the different cutoffs.

After this first analysis we focused on some selected cutoff values: 50, 100, 500, 1000, 5000, 10000, 50000. While the detailed data can be found in [Appendix B2](#), Figure 4 shows the speed-up for the best values obtained during analysis.

Figures 5 and 6 show the performances using the selected cutoff values for growing array sizes. We determined that, with our data, 1000 was the best cutoff.

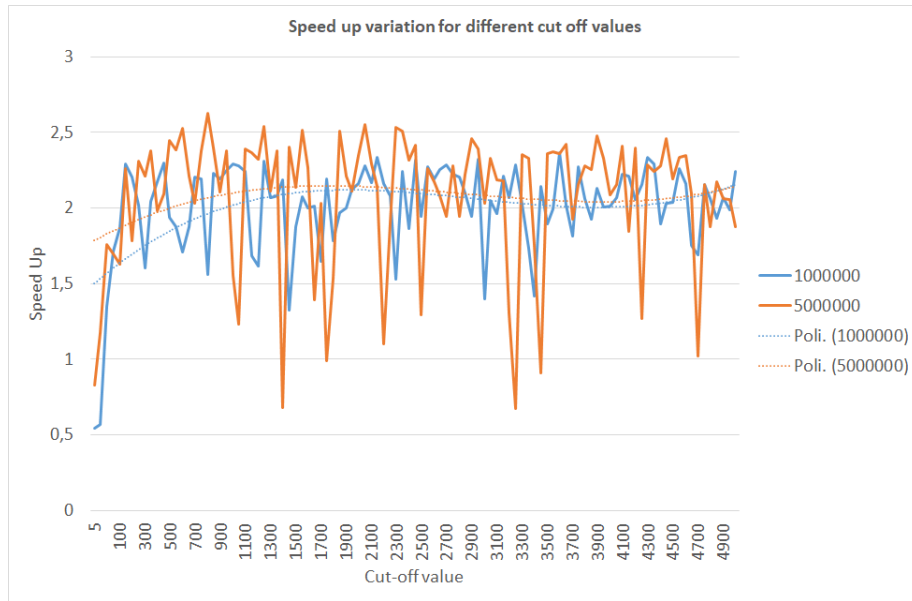


Figure 3: Speed-up on two arrays (given the size 1000000 and 5000000) with 20 servers and varying cut-off values

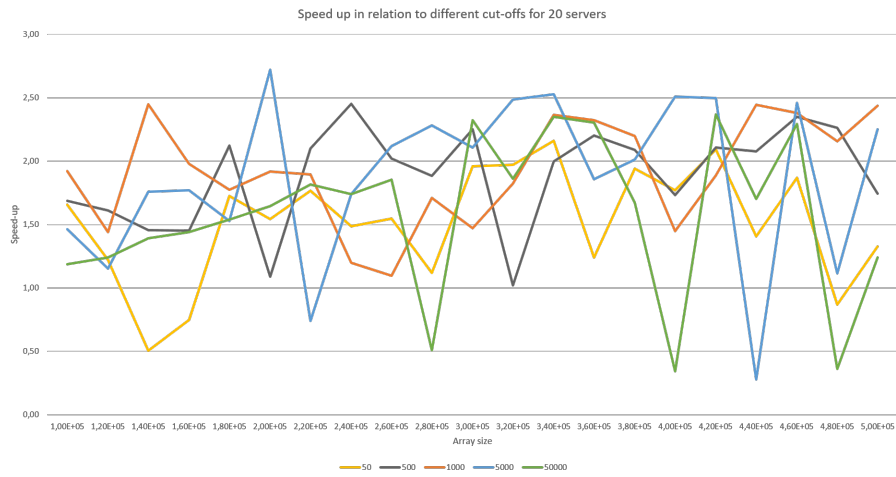


Figure 4: Speed-up given different cutoff values

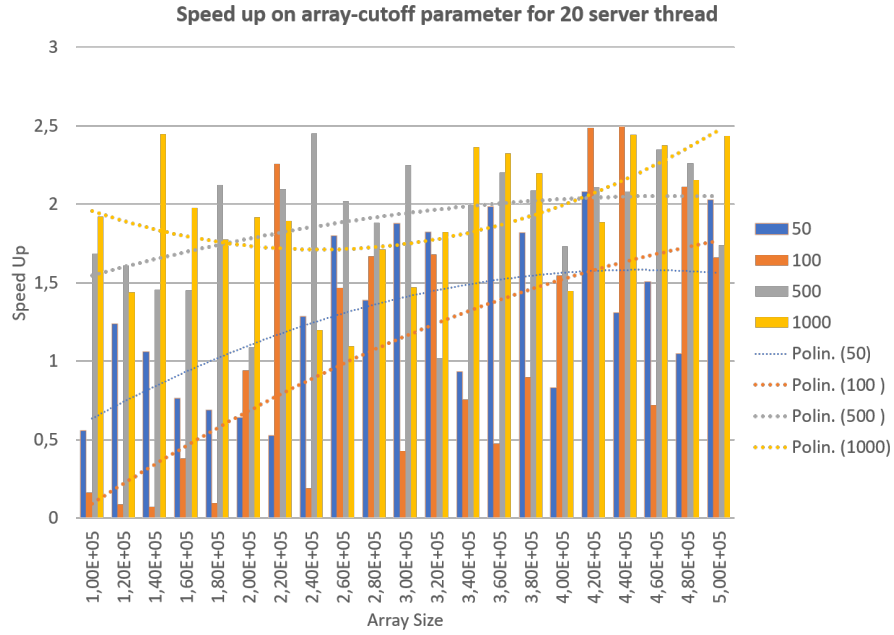


Figure 5: Speed-up compared to different cut-offs and a growing array (1)

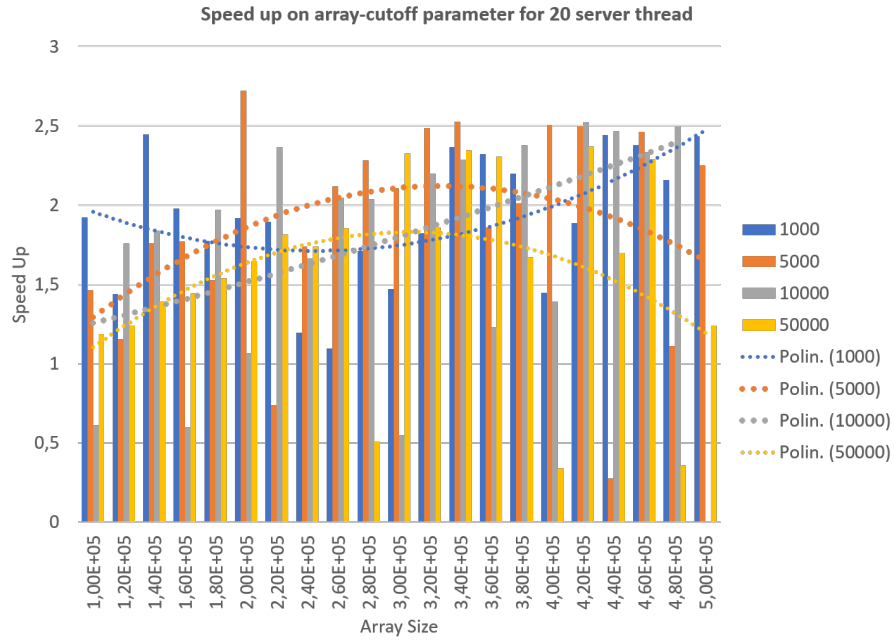


Figure 6: Speed-up compared to different cut-offs and a growing array (2)

4 Conclusion

In the tests we performed the work stealing scheduler generally showed better performances compared to sequential sorting. Given the range of array sizes we worked with, we determined that the best values for our parameters are 20 servers and a cutoff at 10000. We run the program using this values and as, expected, the execution time was better using the work stealing algorithm compared to the sequential one. Figure 7 shows the comparison between the two algorithms with the chosen parameters, while the complete data can be found in [Appendix C](#)

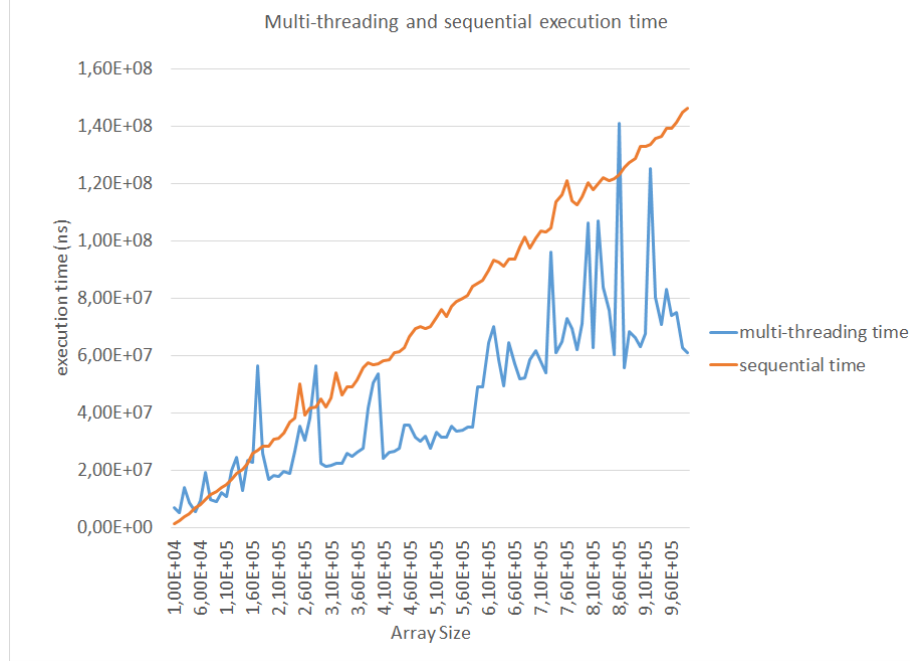


Figure 7: Work stealing (with 20 servers and a cutoff value of 1000) and sequential sorting performances

Finally, we plotted the average number of stolen tasks (Figure 8). With a fixed number of servers, the number of stolen tasks increases with the size of the array. At a certain point it drops, because the servers are too busy to actually steal from others. The peak in stolen tasks coincides with a peak in performance.

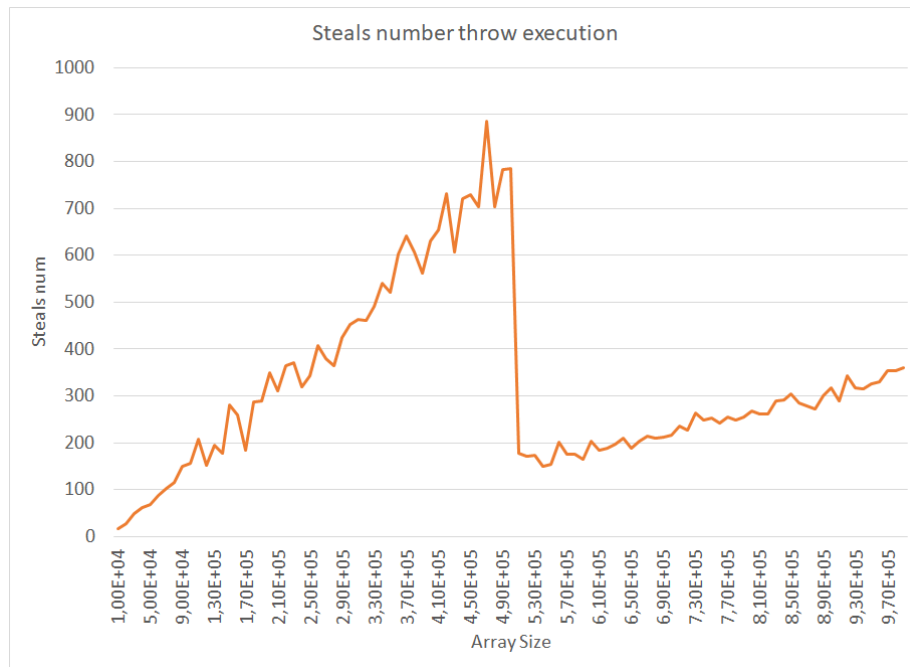


Figure 8: Number of stolen tasks with 20 servers and cutoff=1000

Appendix A Analysis on the number of servers

The table shows data collected while searching for an optimal number of servers. Green cells highlight the executions in which the work stealing algorithm had a better clock-time compared to the sequential one.

ARRAY SIZE	Num		Thread CLOCK					SEQ CLOCK					multithreading AVG	sequential AVG	SPEED UP
	SERVICES	CUTOFF	exec 1	exec 2	exec 3	exec 4	exec5	exec 1	exec 2	exec 3	exec 4	exec5			
1,00E+05	5	100	5,15E+07	6,12E+06	6,01E+06	5,71E+06	5,88E+06	1,82E+07	1,33E+07	1,28E+07	1,33E+07	1,35E+07	1,50E+07	1,42E+07	0,9450054
1,20E+05	5	100	4,69E+07	8,58E+06	8,09E+06	7,18E+06	8,72E+06	2,07E+07	1,62E+07	1,54E+07	1,53E+07	1,62E+07	1,59E+07	1,68E+07	1,05511597
1,40E+05	5	100	1,27E+08	8,12E+06	8,23E+06	8,78E+06	1,09E+07	2,53E+07	1,87E+07	1,88E+07	1,81E+07	1,79E+07	3,26E+07	1,98E+07	0,60549828
1,60E+05	5	100	2,34E+08	1,01E+07	9,67E+06	1,26E+07	1,09E+07	3,13E+07	2,06E+07	2,20E+07	2,20E+07	2,19E+07	5,55E+07	2,36E+07	0,42436518
1,80E+05	5	100	1,22E+08	1,05E+07	1,24E+07	1,05E+07	1,22E+07	3,39E+07	2,48E+07	2,42E+07	2,54E+07	2,36E+07	3,35E+07	2,64E+07	0,78753569
2,00E+05	5	100	1,10E+08	1,44E+07	1,71E+07	1,40E+07	1,56E+07	4,62E+07	2,87E+07	2,85E+07	2,88E+07	2,62E+07	3,42E+07	3,17E+07	0,92621212
2,20E+05	5	100	1,13E+08	2,19E+07	1,33E+07	1,64E+07	1,39E+07	3,91E+07	3,09E+07	2,97E+07	3,09E+07	3,04E+07	3,58E+07	3,22E+07	0,8994615
2,40E+05	5	100	6,70E+07	1,60E+07	1,66E+07	1,64E+07	1,93E+07	5,39E+07	3,40E+07	3,46E+07	3,41E+07	3,45E+07	2,70E+07	3,82E+07	1,41246608
2,60E+05	5	100	4,72E+07	1,53E+07	1,63E+07	1,77E+07	1,67E+07	5,92E+07	3,77E+07	3,78E+07	3,84E+07	3,69E+07	2,26E+07	4,20E+07	1,85464694
2,80E+05	5	100	6,34E+07	2,12E+07	2,33E+07	1,99E+07	1,82E+07	6,92E+07	4,05E+07	4,03E+07	3,98E+07	3,95E+07	2,92E+07	4,59E+07	1,57209853
3,00E+05	5	100	6,81E+07	2,46E+07	1,88E+07	2,25E+07	2,83E+07	5,69E+07	4,34E+07	4,07E+07	4,33E+07	4,33E+07	3,25E+07	4,55E+07	1,40251102
3,20E+05	5	100	4,21E+07	1,87E+07	2,15E+07	2,01E+07	2,19E+07	5,52E+07	4,57E+07	4,62E+07	4,68E+07	4,64E+07	2,49E+07	4,81E+07	1,93369802
3,40E+05	5	100	3,73E+07	2,44E+07	2,53E+07	2,32E+07	2,16E+07	6,27E+07	4,98E+07	4,77E+07	4,87E+07	4,90E+07	2,63E+07	5,16E+07	1,95961607
3,60E+05	5	100	3,13E+07	2,62E+07	2,26E+07	2,98E+07	2,94E+07	6,65E+07	5,27E+07	5,14E+07	5,18E+07	5,24E+07	2,78E+07	5,50E+07	1,97344492
3,80E+05	5	100	7,28E+07	2,41E+07	2,90E+07	2,54E+07	3,41E+07	6,66E+07	5,61E+07	5,41E+07	5,51E+07	5,43E+07	3,71E+07	5,72E+07	1,54394416
4,00E+05	5	100	7,11E+07	2,67E+07	2,44E+07	2,91E+07	2,68E+07	1,24E+08	5,91E+07	5,69E+07	5,85E+07	5,81E+07	3,56E+07	7,14E+07	2,00307083
4,20E+05	5	100	1,15E+08	2,87E+07	3,29E+07	3,11E+07	3,41E+07	8,64E+07	5,95E+07	6,00E+07	6,15E+07	6,04E+07	4,84E+07	6,56E+07	1,35526375
4,40E+05	5	100	5,37E+07	2,92E+07	2,82E+07	2,74E+07	2,78E+07	8,67E+07	6,50E+07	7,11E+07	6,43E+07	6,37E+07	3,33E+07	7,02E+07	2,10886846
4,60E+05	5	100	3,57E+07	3,71E+07	2,93E+07	5,85E+07	2,92E+07	8,28E+07	6,73E+07	6,83E+07	6,75E+07	6,50E+07	3,80E+07	7,02E+07	1,84873103
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5,00E+05	5	100	8,79E+07	2,84E+07	3,43E+07	3,29E+07	3,16E+07	7,91E+07	7,21E+07	7,27E+07	7,29E+07	7,26E+07	4,30E+07	7,39E+07	1,71770648
1,00E+05	10	100	8,41E+06	7,04E+06	6,74E+06	6,66E+06	6,54E+06	1,33E+07	1,29E+07	1,25E+07	1,27E+07	1,25E+07	7,08E+06	1,28E+07	1,80543285
1,20E+05	10	100	8,32E+06	1,48E+07	8,89E+06	7,84E+06	8,02E+06	1,57E+07	1,57E+07	1,57E+07	1,53E+07	1,63E+07	9,58E+06	1,57E+07	1,64270509
1,40E+05	10	100	1,98E+07	8,73E+06	1,11E+07	8,52E+06	1,16E+07	2,27E+07	1,84E+07	1,93E+07	1,80E+07	1,89E+07	1,19E+07	1,95E+07	1,63045258
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1,80E+05	10	100	3,46E+07	1,72E+07	1,29E+07	1,20E+07	1,21E+07	3,03E+07	2,42E+07	2,52E+07	2,39E+07	2,55E+07	1,78E+07	2,58E+07	1,45331313
2,00E+05	10	100	1,51E+07	1,27E+07	1,70E+07	1,67E+07	1,43E+07	2,85E+07	2,79E+07	2,96E+07	2,81E+07	2,81E+07	1,52E+07	2,84E+07	1,87463576
2,20E+05	10	100	1,72E+07	1,45E+07	2,10E+07	1,78E+07	1,72E+07	3,13E+07	3,37E+07	3,10E+07	3,07E+07	2,98E+07	1,75E+07	3,13E+07	1,78479026
2,40E+05	10	100	1,84E+07	2,18E+07	1,85E+07	2,24E+07	1,51E+07	3,41E+07	3,53E+07	3,33E+07	3,47E+07	3,32E+07	1,92E+07	3,41E+07	1,77438572
2,60E+05	10	100	2,59E+07	1,88E+07	2,41E+07	1,92E+07	4,72E+07	3,71E+07	3,68E+07	4,16E+07	3,67E+07	3,73E+07	2,70E+07	3,79E+07	1,40159702
2,80E+05	10	100	2,46E+07	2,26E+07	2,13E+07	1,80E+07	1,80E+07	4,02E+07	4,02E+07	4,08E+07	4,00E+07	3,98E+07	2,09E+07	4,02E+07	1,92333718
3,00E+05	10	100	1,87E+07	3,18E+07	1,92E+07	1,88E+07	2,48E+07	4,34E+07	4,37E+07	4,33E+07	4,39E+07	4,38E+07	2,27E+07	4,36E+07	1,92498548
3,20E+05	10	100	2,05E+07	2,49E+07	2,04E+07	1,94E+07	1,90E+07	4,89E+07	4,62E+07	4,55E+07	4,42E+07	4,63E+07	2,09E+07	4,62E+07	2,21710583
3,40E+05	10	100	2,97E+07	4,04E+07	2,10E+07	2,19E+07	2,94E+07	4,91E+07	4,94E+07	4,79E+07	4,99E+07	4,67E+07	2,85E+07	4,86E+07	1,70502898
3,60E+05	10	100	2,70E+07	2,75E+07	2,35E+07	3,24E+07	3,05E+07	5,19E+07	5,23E+07	5,15E+07	5,21E+07	5,09E+07	2,82E+07	5,18E+07	1,83580685
3,80E+05	10	100	2,67E+07	3,03E+07	3,79E+07	3,50E+07	4,01E+07	5,53E+07	5,49E+07	5,34E+07	5,50E+07	5,29E+07	3,40E+07	5,43E+07	1,59732623
4,00E+05	10	100	2,66E+07	2,74E+07	2,50E+07	3,62E+07	3,32E+07	5,86E+07	5,91E+07	5,65E+07	5,93E+07	5,81E+07	2,97E+07	5,83E+07	1,9647759
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1,20E+05	15	100	8,85E+06	1,33E+07	8,89E+06	8,71E+06	9,09E+06	1,58E+07	1,63E+07	1,56E+07	1,60E+07	1,62E+07	9,77E+06	1,60E+07	1,63698399
1,40E+05	15	100	1,03E+07	9,28E+06	9,39E+06	9,40E+06	8,96E+06	1,84E+07	1,83E+07	1,89E+07	1,80E+07	1,90E+07	9,46E+06	1,85E+07	1,95635855
1,60E+05	15	100	1,58E+07	1,28E+07	1,03E+07	1,16E+07	1,24E+07	2,09E+07	2,14E+07	2,19E+07	2,19E+07	2,09E+07	1,26E+07	2,14E+07	1,70196983
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2,20E+05	15	100	1,62E+07	2,34E+07	2,12E+07	1,48E+07	1,86E+07	3,08E+07	3,06E+07	3,10E+07	3,10E+07	3,10E+07	1,88E+07	3,09E+07	1,64061538
2,40E+05	15	100	1,70E+07	1,72E+07	1,62E+07	1,82E+07	1,57E+07	3,21E+07	3,44E+07	3,38E+07	3,43E+07	3,37E+07	1,69E+07	3,37E+07	1,99585706
2,60E+05	15	100	1,66E+07	1,83E+07	1,65E+07	3,63E+07	2,88E+07	3,69E+07	3,55E+07	3,75E+07	4,27E+07	3,59E+07	2,33E+07	3,77E+07	1,61891313
2,80E+05	15	100	2,08E+07	1,86E+07	2,12E+07	2,43E+07	1,99E+07	4,53E+07	3,85E+07	4,02E+07	4,07E+07	4,06E+07	2,10E+07	4,11E+07	1,95760982
3,00E+05	15	100	2,01E+07	7,73E+07	1,92E+07	2,55E+07	2,50E+07	4,33E+07	4,33E+07	4,23E+07	4,48E+07	4,25E+07	3,34E+07	4,32E+07	1,29382605
3,20E+05	15	100	2,22E+07	2,05E+07	2,61E+07	2,82E+07	2,01E+07	4,48E+07	4,64E+07	5,10E+07	4,85E+07	4,58E+07	2,34E+07	4,73E+07	2,01911643
3,40E+05	15	100	6,36E+07	2,57E+07	2,37E+07	2,84E+07	2,41E+07	5,57E+07	4,78E+07	5,18E+07	5,10E+07	4,92E+07	3,31E+07	5,11E+07	1,54372682
3,60E+05	15	100	3,08E+07	2,35E+07	2,99E+07	1,13E+08	2,35E+07	5,94E+07	4,99E+07	5,30E+07	5,26E+07	5,21E+07	4,41E+07	5,34E+07	1,21246883
3,80E+05	15	100	1,04E+08	3,95E+07	2,90E+07	3,11E+07	2,72E+07	6,49E+07	5,60E+07	5,50E+07	5,46E+07	5,47E+07	4,61E+07	5,70E+07	1,23683502
4,00E+05	15	100	3,42E+07	2,62E+07	2,73E+07	2,59E+07	2,56E+07	5,88E+07	5,91E+07	5,81E+07	5,77E+07	5,98E+07	2,78E+07	5,87E+07	2,10794189
4,20E+05	15	100	2,55E+07	2,61E+07	2,82E+07	2,74E+07	5,77E+07	6,12E+07	6,05E+07	6,12E+07	6,10E+07	6,09E+07	3,30E+07	6,09E+07	1,84848263
4,40E+05	15	100	2,76E+07	3,17E+07	2,78E+07	2,73E+07	2,77E+07	6,46E+07	6,45E+07	6,44E+07	6,23E+07	6,39E+07	2,84E+07	6,39E+07	2,24893076
4,60E+05	15	100	3,51E+07	4,30E+07	3,04E+07	4,13E+07	8,35E+07	6,90E+07	6,82E+07	6,78E+07	6,57E+07	6,71E+07	4,66E+07	6,76E+07	1,44829809
4,80E+05	15	100	3,19E+07	3,61E+07	3,57E+07	3,19E+07	3,11E+07	7,38E+07	7,13E+07	7,01E+07	7,01E+07	7,01E+07	3,34E+07	7,11E+07	2,13126661
5,00E+05	15	100	3,01E+07	2,94E+07	2,98E+07	3,42E+07	3,08E+07	7,30E+07	7,03E+07	7,13E+07	7,22E+07	7,47E+07	3,09E+07	7,23E+07	2,34226769
1,00E+05	20	100	7,78E+06	8,60E+06	8,84E+06	7,57E+06	7,85E+06	1,35E+07	1,28E+07	1,34E+07	1,35E+07	1,34E+07	8,13E+06	1,33E+07	1,63791791
1,20E+05	20	100	8,83E+06	1,12E+07	9,43E+06	9,90E+06	9,44E+06	1,54E+07	1,62E+07	1,53E+07	1,60E+07	1,55E+07	9,77E+06	1,57E+07	1,60406671
1,40E+05	20	100	1,06E+07	1,01E+07	1,00E+07	9,97E+06	9,71E+06	1,90E+07	1,79E+07	1,79E+07	1,78E+07	1,87E+07	1,01E+07	1,83E+07	1,8128395
1,60E+05	20	100	1,94E+07	1,37E+07	1,15E+07	1,10E+07	1,10E+07	2,20E+07	2,12E+07	2,12E+07	2,20E+07	2,15E+07	1,33E+07	2,16E+07	1,61891901
1,80E+05	20	100	1,38E+07	1,34E+07	1,30E+07	1,39E+07	1,22E+07	2,55E+07	2,40E+07	2,47E+07	2,50E+07	2,49E+07	1,32E+07	2,48E+07	1,87367935
2,00E+05	20	100	1,54E+07	1,52E+07	1,46E+07	1,48E+07	2,56E+07	3,44E+07	2,72E+07	2,86E+07	2,78E+07	2,92E+07	1,71E+07	2,94E+07	1,72183196
2,20E+05	20	100	1,90E+07	2,61E+07	1,68E+07	2,19E+07	1,70E+07	3,77E+07	3,13E+07	3,16E+07	2,99E+07	3,12E+07	2,02E+07	3,23E+07	1,60479079
2,40E+05	20	100	2,41E+07	1,82E+07	1,83E+07	1,62E+07	3,90E+07	4,27E+07	3,51E+07	3,48E+07	3,36E+07	3,40E+07	2,31E+07	3,61E+07	1,5586731
2,60E+05	20	100	1,96E+07	1,74E+07	1,72E+07	1,67E+07	1,67E+07	4,52E+07	3,68E+07	3,61E+07	3,89E+07	3,58E+07	1,75E+07	3,86E+07	2,20415093
2,80E+05	20	100	2,07E+07	2,14E+07	1,96E+07	2,12E+07	2,83E+07	4,72E+07	4,48E+07	4,00E+07	4,06E+07	3,97E+07	2,22E+07	4,25E+07	1,90874106
3,00E+05	20	100	2,43E+07	2,00E+07	2,02E+07	2,01E+07	3,73E+07	4,94E+07	4,40E+07	4,35E+07	4,32E+07	4,34E+07	2,44E+07	4,47E+07	1,83328876
3,20E+05	20	100	2,58E+07	2,27E+07	2,07E+07	2,13E+07	2,00E+07	4,83E+07	4,59E+07	4,46E+07	4,62E+07	4,60E+07	2,21E+07	4,62E+07	2,09102782
3,40E+05	20	100	2,21E+07	2,20E+07	2,99E+07	2,34E+07	2,37E+07	5,04E+07	4,97E+07	4,98E+07	4,76E+07	4,99E+07	2,42E+07	4,95E+07	2,04278801
3,60E+05	20	100	2,47E+07	2,42E+07	2,43E+07	3,53E+07	2,70E+07	5,29E+07	5,19E+07	5,32E+07	5,26E+07	5,32E+07	2,71E+07	5,27E+07	1,94462377
3,80E+05	20	100	2,64E+07	2,48E+07	2,53E+07	2,53E+07	2,45E+07	5,50E+07	5,50E+07	5,45E+07	5,59E+07	5,50E+07	2,53E+07	5,51E+07	2,17999083
4,00E+05	20	100	1,09E+08	2,93E+07	2,78E+07	2,81E+07	6,85E+07	5,82E+07	5,81E+07	5,60E+07	5,98E+07	5,81E+07	5,26E+07	5,80E+07	1,10334832
4,20E+05	20	100	2,67E+07	3,04E+07	3,32E+07	2,94E+07	2,74E+07	6,13E+07	6,06E+07	6,03E+07	6,10E+07	6,16E+07	2,94E+07	6,10E+07	2,07247574
4,40E+05	20	100	2,80E+07	2,92E+07	3,46E+07	2,99E+07	2,87E+07	7,89E+07	6,49E+07	6,50E+07	6,45E+07	6,34E+07	3,01E+07	6,74E+07	2,2391875
4,60E+05	20	100	4,29E+07	3,18E+07	6,86E+07	3,00E+07	3,04E+07	7,60E+07	6,79E+07	6,80E+07	6,84E+07	6,60E+07	4,07E+07	6,93E+07	1,70064838
4,80E+05	20	100	3,31E+07	3,15E+07	3,14E+07	3,52E+07	3,39E+07	7,66E+07	6,92E+07	7,02E+07	7,05E+07	6,90E+07	3,30E+07	7,11E+07	2,15270352
5,00E+05	20	100	3,04E+07	3,08E+07	3,04E+07	3,40E+07	3,03E+07	7,58E+07	7,00E+07	7,21E+07	7,33E+07	7,14E+07	3,12E+07	7,25E+07	2,32790037
1,00E+05	25	100	8,61E+06	9,22E+06	8,18E+06	8,70E+06	8,86E+06	1,32E+07	1,33E+07	1,27E+07	1,37E+07	1,30E+07	8,71E+06	1,32E+07	1,51374759
1,20E+05	25	100	1,03E+07	9,59E+06	1,01E+07	1,74E+07	9,22E+06	1,52E+07	1,62E+07	1,54E+07	1,61E+07	1,61E+07	1,13E+07	1,58E+07	1,39459324
1,40E+05	25	100	1,05E+07	1,05E+07	1,12E+07	1,02E+07	1,04E+07	1,88E+07	1,86E+07	1,89E+07	1,78E+07	1,92E+07	1,06E+07	1,86E+07	1,76727025
1,60E+05	25	100	1,88E+07	1,84E+07	1,15E+07	1,17E+07	1,19E+07	2,52E+07	2,22E+07	2,08E+07	2,06E+07	2,12E+07	1,45E+07	2,20E+07	1,5206662
1,80E+05	25	100	1,74E+07	1,49E+07	1,30E+07	1,83E+07	1,29E+07	2,51E+07	2,54E+07	2,36E+07	2,44E+07	2,37E+07	1,53E+07	2,44E+07	1,59624675

2,00E+05	25	100	1,47E+07	1,82E+07	1,50E+07	1,74E+07	1,59E+07	2,87E+07	2,84E+07	2,79E+07	2,82E+07	2,85E+07	1,62E+07	2,83E+07	1,74540818
2,20E+05	25	100	1,91E+07	1,62E+07	1,73E+07	1,99E+07	1,62E+07	3,13E+07	3,12E+07	3,15E+07	3,09E+07	3,23E+07	1,77E+07	3,14E+07	1,77102772
2,40E+05	25	100	3,90E+07	1,70E+07	2,28E+07	1,72E+07	8,13E+07	4,00E+07	3,42E+07	3,44E+07	3,39E+07	3,40E+07	3,55E+07	3,53E+07	0,99601904
2,60E+05	25	100	2,47E+07	2,13E+07	1,82E+07	2,08E+07	1,70E+07	4,25E+07	3,71E+07	3,59E+07	3,73E+07	3,66E+07	2,04E+07	3,79E+07	1,85687233
2,80E+05	25	100	2,63E+07	2,54E+07	1,95E+07	2,12E+07	1,26E+08	4,55E+07	3,83E+07	3,99E+07	3,96E+07	3,98E+07	4,37E+07	4,06E+07	0,92944736
3,00E+05	25	100	3,50E+07	2,06E+07	2,30E+07	2,23E+07	2,13E+07	4,53E+07	4,35E+07	4,35E+07	4,30E+07	4,36E+07	2,45E+07	4,38E+07	1,78990813
3,20E+05	25	100	2,98E+07	2,24E+07	2,21E+07	2,11E+07	2,08E+07	4,75E+07	4,63E+07	4,57E+07	4,55E+07	4,41E+07	2,32E+07	4,58E+07	1,97131179
3,40E+05	25	100	2,27E+07	2,53E+07	2,28E+07	1,09E+08	2,30E+07	4,94E+07	4,97E+07	4,74E+07	4,92E+07	4,67E+07	4,05E+07	4,85E+07	1,19782272
3,60E+05	25	100	2,68E+07	2,43E+07	2,58E+07	2,50E+07	2,45E+07	5,28E+07	5,32E+07	5,14E+07	5,18E+07	5,21E+07	2,53E+07	5,22E+07	2,06503746
3,80E+05	25	100	2,68E+07	2,94E+07	2,53E+07	2,57E+07	2,69E+07	5,48E+07	5,51E+07	5,45E+07	5,46E+07	5,51E+07	2,68E+07	5,48E+07	2,04299149
4,00E+05	25	100	3,60E+07	2,68E+07	2,67E+07	2,74E+07	6,09E+07	5,87E+07	5,84E+07	5,65E+07	5,86E+07	5,90E+07	3,56E+07	5,82E+07	1,63733109
4,20E+05	25	100	1,63E+08	3,26E+07	2,90E+07	2,71E+07	2,64E+07	6,12E+07	5,91E+07	6,01E+07	6,10E+07	5,86E+07	5,57E+07	6,00E+07	1,07823431
4,40E+05	25	100	2,78E+07	3,19E+07	3,01E+07	2,80E+07	2,93E+07	6,28E+07	6,11E+07	6,41E+07	6,31E+07	6,39E+07	2,94E+07	6,30E+07	2,14057287
4,60E+05	25	100	3,07E+07	3,05E+07	3,29E+07	3,27E+07	3,21E+07	6,88E+07	6,99E+07	6,70E+07	6,60E+07	6,73E+07	3,18E+07	6,78E+07	2,13116198
4,80E+05	25	100	3,51E+07	3,50E+07	3,20E+07	3,36E+07	3,32E+07	7,05E+07	7,11E+07	7,14E+07	7,08E+07	7,15E+07	3,38E+07	7,11E+07	2,1044877
5,00E+05	25	100	3,42E+07	3,38E+07	3,20E+07	3,10E+07	3,44E+07	7,40E+07	7,35E+07	7,27E+07	7,19E+07	7,17E+07	3,31E+07	7,28E+07	2,19964223
1,00E+05	30	100	9,13E+06	9,33E+06	9,23E+06	8,77E+06	1,00E+07	1,28E+07	1,31E+07	1,33E+07	1,27E+07	1,29E+07	9,29E+06	1,30E+07	1,3957947
1,20E+05	30	100	1,01E+07	1,05E+07	7,50E+07	1,01E+07	1,08E+07	1,56E+07	1,53E+07	1,74E+07	1,61E+07	1,55E+07	2,33E+07	1,60E+07	0,68689963
1,40E+05	30	100	1,08E+07	1,25E+07	1,33E+07	1,30E+07	1,11E+07	1,79E+07	1,90E+07	2,07E+07	1,88E+07	1,78E+07	1,21E+07	1,88E+07	1,55166853
1,60E+05	30	100	1,32E+07	1,24E+07	1,37E+07	1,81E+07	1,41E+07	2,08E+07	2,19E+07	2,19E+07	2,19E+07	2,10E+07	1,43E+07	2,15E+07	1,50016442
1,80E+05	30	100	2,38E+07	1,35E+07	1,34E+07	1,68E+07	2,03E+07	2,47E+07	2,40E+07	2,50E+07	2,53E+07	2,44E+07	1,75E+07	2,47E+07	1,40690843
2,00E+05	30	100	5,97E+07	1,63E+07	1,55E+07	1,67E+07	1,83E+07	2,88E+07	2,74E+07	2,80E+07	2,83E+07	2,83E+07	2,53E+07	2,81E+07	1,11261461
2,20E+05	30	100	1,90E+07	1,80E+07	1,64E+07	1,64E+07	2,07E+07	3,11E+07	3,10E+07	3,14E+07	3,12E+07	3,11E+07	1,81E+07	3,12E+07	1,72369731
2,40E+05	30	100	1,80E+07	1,84E+07	1,88E+07	1,94E+07	1,80E+07	3,41E+07	3,40E+07	3,43E+07	3,43E+07	3,22E+07	1,85E+07	3,38E+07	1,82427205
2,60E+05	30	100	2,27E+07	1,85E+07	4,97E+07	2,09E+07	2,76E+07	3,73E+07	3,67E+07	3,67E+07	3,75E+07	3,56E+07	2,79E+07	3,68E+07	1,31916425
2,80E+05	30	100	2,08E+07	2,02E+07	2,13E+07	2,06E+07	2,28E+07	4,04E+07	3,99E+07	4,05E+07	3,82E+07	4,08E+07	2,11E+07	4,00E+07	1,89000827
3,00E+05	30	100	2,12E+07	2,47E+07	2,23E+07	6,79E+07	2,23E+07	4,33E+07	4,50E+07	4,26E+07	4,35E+07	4,26E+07	3,17E+07	4,34E+07	1,37070349
3,20E+05	30	100	2,27E+07	2,13E+07	1,38E+08	1,37E+08	2,10E+07	4,52E+07	4,59E+07	4,60E+07	4,59E+07	4,64E+07	6,80E+07	4,59E+07	0,6747728
3,40E+05	30	100	2,48E+07	2,59E+07	2,50E+07	2,84E+07	2,44E+07	4,94E+07	4,90E+07	4,89E+07	4,91E+07	4,91E+07	2,57E+07	4,91E+07	1,91052789
3,60E+05	30	100	2,74E+07	2,52E+07	6,45E+07	2,52E+07	2,61E+07	5,35E+07	5,26E+07	5,26E+07	5,21E+07	5,21E+07	3,37E+07	5,26E+07	1,55966049
3,80E+05	30	100	2,79E+07	2,62E+07	2,80E+07	2,69E+07	2,70E+07	5,55E+07	5,23E+07	5,48E+07	5,53E+07	5,44E+07	2,72E+07	5,45E+07	2,00223734
4,00E+05	30	100	3,00E+07	7,92E+07	2,83E+07	2,72E+07	2,82E+07	5,88E+07	5,68E+07	5,60E+07	5,83E+07	5,82E+07	3,86E+07	5,76E+07	1,49326275
4,20E+05	30	100	3,26E+07	2,70E+07	3,20E+07	3,69E+07	2,84E+07	6,05E+07	5,89E+07	5,99E+07	6,06E+07	6,05E+07	3,14E+07	6,01E+07	1,91436925
4,40E+05	30	100	3,09E+07	2,88E+07	3,02E+07	3,11E+07	4,56E+07	6,28E+07	6,40E+07	6,17E+07	6,39E+07	6,46E+07	3,33E+07	6,34E+07	1,90286463
4,60E+05	30	100	3,15E+07	3,25E+07	3,10E+07	3,16E+07	3,13E+07	6,80E+07	6,68E+07	7,41E+07	6,78E+07	6,66E+07	3,16E+07	6,87E+07	2,17522984
4,80E+05	30	100	3,70E+07	3,33E+07	7,43E+07	3,84E+07	3,68E+07	7,07E+07	7,21E+07	8,30E+07	7,12E+07	7,06E+07	4,40E+07	7,35E+07	1,67229352
5,00E+05	30	100	3,55E+07	3,15E+07	4,19E+07	3,24E+07	3,23E+07	7,02E+07	7,27E+07	7,32E+07	7,16E+07	7,33E+07	3,47E+07	7,22E+07	2,07857661

Appendix B Cut-off analysis

B.1 First analysis

We search for the best speed-up trying cut-off values ranging from 50 to 5000, first in an array with 1000000 and then 5000000 elements. The green cells highlight cut-off values above the average.

Execution with Num servers = 20, Array size = 1000000														
CUT OFF	MultiThreading execution wall clock time						Sequential execution wall clock time						Speed-up	
	exec 1	exec 2	exec 3	exec 4	exec 5	mtHavg	exec 1	exec 2	exec 3	exec 4	exec 5	seqAVG	seqAVG/	
50	1.47E+08	8.26E+07	1.01E+08	7.02E+07	7.72E+07	9.55E+07	2.24E+08	1.47E+08	1.49E+08	1.51E+08	1.48E+08	1.64E+08	1.71	
100	1.03E+08	6.70E+07	6.35E+07	1.24E+08	6.90E+07	8.54E+07	1.90E+08	1.51E+08	1.52E+08	1.52E+08	1.54E+08	1.60E+08	1.87	
150	6.88E+07	6.38E+07	6.27E+07	6.72E+07	6.74E+07	6.60E+07	1.52E+08	1.49E+08	1.50E+08	1.51E+08	1.54E+08	1.51E+08	2.29	
200	6.23E+07	6.76E+07	7.07E+07	6.34E+07	7.16E+07	6.71E+07	1.46E+08	1.46E+08	1.46E+08	1.52E+08	1.50E+08	1.48E+08	2.21	
250	1.08E+08	6.70E+07	6.77E+07	6.02E+07	6.71E+07	7.40E+07	1.49E+08	1.48E+08	1.49E+08	1.52E+08	1.50E+08	1.50E+08	2.02	
300	2.08E+08	6.38E+07	5.90E+07	6.82E+07	6.70E+07	9.33E+07	1.53E+08	1.49E+08	1.49E+08	1.47E+08	1.49E+08	1.49E+08	1.60	
350	7.75E+07	8.01E+07	6.75E+07	6.92E+07	7.05E+07	7.30E+07	1.49E+08	1.51E+08	1.49E+08	1.49E+08	1.49E+08	1.49E+08	2.05	
400	6.09E+07	8.97E+07	6.91E+07	6.69E+07	5.80E+07	6.89E+07	1.51E+08	1.48E+08	1.50E+08	1.50E+08	1.50E+08	1.50E+08	2.17	
450	6.79E+07	6.39E+07	6.62E+07	5.84E+07	6.90E+07	6.51E+07	1.52E+08	1.46E+08	1.50E+08	1.53E+08	1.47E+08	1.50E+08	2.30	
500	7.15E+07	8.25E+07	6.56E+07	1.03E+08	6.79E+07	7.80E+07	1.49E+08	1.46E+08	1.52E+08	1.59E+08	1.49E+08	1.51E+08	1.94	
550	1.06E+08	1.02E+08	6.72E+07	5.80E+07	6.72E+07	8.01E+07	1.48E+08	1.51E+08	1.49E+08	1.52E+08	1.52E+08	1.50E+08	1.88	
600	7.95E+07	8.16E+07	8.00E+07	1.17E+08	7.82E+07	8.72E+07	1.50E+08	1.48E+08	1.50E+08	1.48E+08	1.50E+08	1.49E+08	1.71	
650	6.66E+07	1.04E+08	6.02E+07	5.94E+07	1.06E+08	7.93E+07	1.48E+08	1.48E+08	1.50E+08	1.48E+08	1.52E+08	1.49E+08	1.88	
700	6.99E+07	6.40E+07	6.70E+07	6.78E+07	6.76E+07	6.73E+07	1.49E+08	1.48E+08	1.50E+08	1.50E+08	1.47E+08	1.48E+08	2.21	
750	7.86E+07	6.82E+07	6.72E+07	5.84E+07	6.69E+07	6.79E+07	1.47E+08	1.48E+08	1.48E+08	1.50E+08	1.51E+08	1.49E+08	2.19	
800	6.17E+07	6.41E+07	7.01E+07	6.32E+07	2.21E+08	9.60E+07	1.48E+08	1.52E+08	1.50E+08	1.48E+08	1.51E+08	1.50E+08	1.56	
850	6.62E+07	6.76E+07	6.71E+07	6.65E+07	6.88E+07	6.73E+07	1.49E+08	1.51E+08	1.50E+08	1.52E+08	1.47E+08	1.50E+08	2.23	
900	6.72E+07	6.78E+07	6.74E+07	6.65E+07	7.46E+07	6.87E+07	1.48E+08	1.51E+08	1.48E+08	1.56E+08	1.50E+08	1.51E+08	2.19	
950	6.66E+07	6.26E+07	7.51E+07	6.27E+07	6.67E+07	6.67E+07	1.49E+08	1.48E+08	1.52E+08	1.51E+08	1.49E+08	1.50E+08	2.25	
1000	6.13E+07	6.15E+07	6.75E+07	6.72E+07	6.64E+07	6.48E+07	1.47E+08	1.47E+08	1.49E+08	1.50E+08	1.48E+08	1.48E+08	2.29	
1050	6.81E+07	6.07E+07	6.73E+07	7.01E+07	6.19E+07	6.56E+07	1.48E+08	1.51E+08	1.50E+08	1.49E+08	1.50E+08	1.50E+08	2.28	
1100	7.61E+07	6.65E+07	6.18E+07	6.73E+07	6.03E+07	6.64E+07	1.47E+08	1.50E+08	1.49E+08	1.48E+08	1.51E+08	1.49E+08	2.24	
1150	1.44E+08	7.29E+07	6.93E+07	6.66E+07	9.00E+07	8.86E+07	1.51E+08	1.49E+08	1.47E+08	1.50E+08	1.50E+08	1.49E+08	1.69	
1200	6.32E+07	9.96E+07	6.77E+07	1.64E+08	6.72E+07	9.24E+07	1.46E+08	1.52E+08	1.48E+08	1.51E+08	1.49E+08	1.49E+08	1.61	
1250	6.49E+07	6.84E+07	6.67E+07	6.72E+07	5.95E+07	6.53E+07	1.55E+08	1.52E+08	1.51E+08	1.49E+08	1.47E+08	1.51E+08	2.31	
1300	6.39E+07	6.32E+07	9.91E+07	6.63E+07	6.67E+07	7.18E+07	1.47E+08	1.46E+08	1.51E+08	1.52E+08	1.47E+08	1.48E+08	2.07	
1350	6.68E+07	1.01E+08	5.92E+07	7.04E+07	6.81E+07	7.31E+07	1.63E+08	1.51E+08	1.49E+08	1.49E+08	1.50E+08	1.52E+08	2.08	
1400	9.32E+07	6.08E+07	5.85E+07	7.76E+07	6.97E+07	7.19E+07	1.92E+08	1.49E+08	1.51E+08	1.48E+08	1.47E+08	1.57E+08	2.19	
1450	2.75E+08	6.85E+07	6.96E+07	5.77E+07	1.04E+08	1.15E+08	1.65E+08	1.48E+08	1.50E+08	1.51E+08	1.48E+08	1.52E+08	1.33	
1500	6.73E+07	6.04E+07	6.48E+07	7.04E+07	1.37E+08	7.99E+07	1.52E+08	1.50E+08	1.50E+08	1.51E+08	1.48E+08	1.50E+08	1.88	
1550	6.88E+07	1.01E+08	5.74E+07	6.84E+07	7.53E+07	7.41E+07	1.59E+08	1.49E+08	1.49E+08	1.49E+08	1.62E+08	1.54E+08	2.07	
1600	6.91E+07	6.65E+07	6.43E+07	7.10E+07	1.03E+08	7.49E+07	1.51E+08	1.48E+08	1.52E+08	1.49E+08	1.50E+08	1.50E+08	2.00	
1650	6.70E+07	6.71E+07	6.96E+07	6.01E+07	1.28E+08	7.83E+07	1.50E+08	1.50E+08	1.51E+08	1.49E+08	1.87E+08	1.58E+08	2.01	
1700	6.81E+07	6.69E+07	6.64E+07	7.49E+07	1.87E+08	9.27E+07	1.49E+08	1.50E+08	1.50E+08	1.50E+08	1.64E+08	1.53E+08	1.65	
1750	6.71E+07	6.52E+07	5.92E+07	6.77E+07	8.10E+07	6.80E+07	1.48E+08	1.50E+08	1.48E+08	1.50E+08	1.49E+08	1.49E+08	2.19	
1800	7.45E+07	1.37E+08	7.81E+07	5.84E+07	7.29E+07	8.42E+07	1.48E+08	1.52E+08	1.51E+08	1.49E+08	1.51E+08	1.50E+08	1.79	
1850	1.28E+08	6.77E+07	5.82E+07	6.13E+07	6.68E+07	7.63E+07	1.53E+08	1.50E+08	1.50E+08	1.49E+08	1.48E+08	1.50E+08	1.97	
1900	6.08E+07	8.09E+07	6.71E+07	9.97E+07	6.41E+07	7.45E+07	1.49E+08	1.48E+08	1.49E+08	1.50E+08	1.48E+08	1.49E+08	2.00	
1950	6.86E+07	6.99E+07	6.66E+07	5.75E+07	9.05E+07	7.06E+07	1.51E+08	1.50E+08	1.50E+08	1.49E+08	1.51E+08	1.50E+08	2.13	
2000	6.15E+07	7.54E+07	6.63E+07	7.19E+07	6.99E+07	6.90E+07	1.49E+08	1.51E+08	1.47E+08	1.48E+08	1.50E+08	1.49E+08	2.16	
2050	6.79E+07	6.82E+07	6.91E+07	5.83E+07	6.83E+07	6.64E+07	1.52E+08	1.53E+08	1.49E+08	1.51E+08	1.52E+08	1.51E+08	2.28	
2100	7.53E+07	6.79E+07	6.56E+07	6.78E+07	6.90E+07	6.91E+07	1.50E+08	1.50E+08	1.49E+08	1.48E+08	1.51E+08	1.50E+08	2.17	
2150	6.75E+07	6.93E+07	6.05E+07	5.81E+07	6.53E+07	6.41E+07	1.49E+08	1.48E+08	1.49E+08	1.52E+08	1.51E+08	1.50E+08	2.34	
2200	6.77E+07	7.96E+07	6.69E+07	6.51E+07	6.70E+07	6.92E+07	1.49E+08	1.48E+08	1.51E+08	1.49E+08	1.51E+08	1.50E+08	2.16	
2250	9.52E+07	6.71E+07	5.96E+07	6.76E+07	6.99E+07	7.19E+07	1.49E+08	1.46E+08	1.49E+08	1.52E+08	1.51E+08	1.49E+08	2.08	
2300	6.19E+07	6.74E+07	1.74E+08	1.22E+08	6.40E+07	9.80E+07	1.48E+08	1.52E+08	1.54E+08	1.49E+08	1.47E+08	1.50E+08	1.53	
2350	6.18E+07	6.80E+07	6.68E+07	6.72E+07	7.04E+07	6.68E+07	1.47E+08	1.49E+08	1.53E+08	1.51E+08	1.48E+08	1.50E+08	2.24	
2400	1.01E+08	7.22E+07	6.68E+07	6.72E+07	1.01E+08	8.15E+07	1.53E+08	1.48E+08	1.52E+08	1.54E+08	1.52E+08	1.52E+08	1.86	
2450	6.09E+07	6.83E+07	6.83E+07	6.22E+07	6.22E+07	6.44E+07	1.49E+08	1.48E+08	1.48E+08	1.48E+08	1.52E+08	1.49E+08	2.32	
2500	6.91E+07	7.27E+07	6.90E+07	6.90E+07	1.01E+08	7.62E+07	1.50E+08	1.46E+08	1.49E+08	1.49E+08	1.46E+08	1.48E+08	1.94	
2550	6.32E+07	6.47E+07	6.70E+07	6.74E+07	6.82E+07	6.61E+07	1.48E+08	1.51E+08	1.51E+08	1.52E+08	1.51E+08	1.50E+08	2.28	
2600	6.83E+07	6.68E+07	6.71E+07	6.21E+07	7.43E+07	6.77E+07	1.46E+08	1.51E+08	1.48E+08	1.51E+08	1.46E+08	1.49E+08	2.19	
2650	7.18E+07	6.51E+07	6.94E+07	5.81E+07	7.02E+07	6.69E+07	1.50E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	2.25	
2700	6.26E+07	6.71E+07	6.65E+07	6.14E+07	7.03E+07	6.56E+07	1.52E+08	1.48E+08	1.52E+08	1.50E+08	1.48E+08	1.50E+08	2.29	
2750	6.07E+07	7.29E+07	6.08E+07	6.99E+07	7.25E+07	6.74E+07	1.49E+08	1.49E+08	1.51E+08	1.52E+08	1.49E+08	1.50E+08	2.23	
2800	6.82E+07	6.74E+07	6.72E+07	6.66E+07	6.86E+07	6.76E+07	1.49E+08	1.46E+08	1.51E+08	1.49E+08	1.50E+08	1.49E+08	2.21	
2850	6.84E+07	9.33E+07	5.77E+07	6.69E+07	6.76E+07	7.08E+07	1.49E+08	1.48E+08	1.51E+08	1.47E+08	1.48E+08	1.49E+08	2.10	
2900	6.76E+07	6.38E+07	8.27E+07	6.73E+07	1.03E+08	7.69E+07	1.51E+08	1.49E+08	1.51E+08	1.50E+08	1.46E+08	1.49E+08	1.94	
2950	6.45E+07	6.67E+07	5.98E+07	6.32E+07	6.70E+07	6.42E+07	1.49E+08	1.47E+08	1.50E+08	1.52E+08	1.48E+08	1.49E+08	2.32	
3000	6.70E+07	1.89E+08	1.09E+08	8.92E+07	7.67E+07	1.06E+08	1.48E+08	1.49E+08	1.47E+08	1.55E+08	1.46E+08	1.49E+08	1.40	
3050	6.80E+07	6.26E+07	6.68E+07	5.88E+07	1.07E+08	7.27E+07	1.47E+08	1.52E+08	1.50E+08	1.47E+08	1.48E+08	1.49E+08	2.05	
3100	1.09E+08	6.94E+07	6.94E+07	6.71E+07	6.68E+07	7.63E+07	1.52E+08	1.49E+08	1.50E+08	1.49E+08	1.50E+08	1.50E+08	1.96	
3150	6.47E+07	8.69E+07	5.87E+07	5.77E+07	6.6.8									

3350	6,09E+07	6,45E+07	1,33E+08	1,02E+08	6,72E+07	8,55E+07	1,50E+08	1,48E+08	1,49E+08	1,49E+08	1,46E+08	1,48E+08	1,74
3400	1,94E+08	7,26E+07	5,81E+07	6,25E+07	1,39E+08	1,05E+08	1,48E+08	1,49E+08	1,50E+08	1,49E+08	1,50E+08	1,49E+08	1,42
3450	6,93E+07	6,76E+07	7,95E+07	6,40E+07	6,81E+07	6,97E+07	1,49E+08	1,48E+08	1,48E+08	1,49E+08	1,53E+08	1,49E+08	2,14
3500	6,81E+07	6,69E+07	6,52E+07	1,20E+08	7,13E+07	7,83E+07	1,47E+08	1,47E+08	1,49E+08	1,49E+08	1,50E+08	1,48E+08	1,89
3550	6,82E+07	6,86E+07	6,75E+07	1,02E+08	7,04E+07	7,53E+07	1,51E+08	1,48E+08	1,50E+08	1,52E+08	1,51E+08	1,50E+08	2,00
3600	6,45E+07	6,70E+07	5,97E+07	5,79E+07	6,85E+07	6,35E+07	1,52E+08	1,49E+08	1,49E+08	1,51E+08	1,51E+08	1,50E+08	2,37
3650	9,99E+07	6,62E+07	6,71E+07	6,85E+07	7,19E+07	7,47E+07	1,48E+08	1,51E+08	1,54E+08	1,53E+08	1,49E+08	1,51E+08	2,02
3700	7,14E+07	6,31E+07	1,45E+08	6,73E+07	6,54E+07	8,25E+07	1,51E+08	1,46E+08	1,50E+08	1,51E+08	1,51E+08	1,50E+08	1,82
3750	6,12E+07	6,58E+07	6,67E+07	6,76E+07	6,65E+07	6,56E+07	1,49E+08	1,50E+08	1,48E+08	1,50E+08	1,49E+08	1,49E+08	2,28
3800	6,69E+07	6,25E+07	7,14E+07	6,60E+07	9,72E+07	7,28E+07	1,48E+08	1,49E+08	1,52E+08	1,53E+08	1,48E+08	1,50E+08	2,06
3850	6,65E+07	6,85E+07	6,19E+07	1,22E+08	6,78E+07	7,74E+07	1,49E+08	1,47E+08	1,50E+08	1,51E+08	1,49E+08	1,49E+08	1,93
3900	6,69E+07	7,57E+07	7,94E+07	6,15E+07	6,78E+07	7,03E+07	1,48E+08	1,49E+08	1,47E+08	1,54E+08	1,50E+08	1,50E+08	2,13
3950	1,15E+08	6,35E+07	5,84E+07	7,24E+07	6,63E+07	7,52E+07	1,53E+08	1,51E+08	1,50E+08	1,51E+08	1,50E+08	1,51E+08	2,01
4000	1,09E+08	6,66E+07	6,72E+07	6,33E+07	6,68E+07	7,45E+07	1,53E+08	1,48E+08	1,49E+08	1,50E+08	1,50E+08	1,50E+08	2,01
4050	6,20E+07	6,73E+07	9,92E+07	7,04E+07	6,27E+07	7,23E+07	1,48E+08	1,47E+08	1,50E+08	1,50E+08	1,51E+08	1,49E+08	2,07
4100	6,11E+07	6,47E+07	6,92E+07	6,68E+07	7,34E+07	6,71E+07	1,47E+08	1,47E+08	1,50E+08	1,50E+08	1,52E+08	1,49E+08	2,23
4150	6,65E+07	6,96E+07	6,99E+07	6,15E+07	6,76E+07	6,70E+07	1,48E+08	1,48E+08	1,49E+08	1,50E+08	1,48E+08	1,48E+08	2,21
4200	9,47E+07	7,01E+07	6,61E+07	5,93E+07	7,44E+07	7,29E+07	1,47E+08	1,51E+08	1,52E+08	1,49E+08	1,50E+08	1,50E+08	2,05
4250	7,13E+07	7,11E+07	6,64E+07	7,02E+07	6,83E+07	6,95E+07	1,49E+08	1,49E+08	1,51E+08	1,51E+08	1,49E+08	1,50E+08	2,16
4300	6,75E+07	6,32E+07	5,84E+07	7,05E+07	6,17E+07	6,42E+07	1,48E+08	1,51E+08	1,50E+08	1,50E+08	1,49E+08	1,50E+08	2,33
4350	6,77E+07	6,42E+07	5,72E+07	6,69E+07	7,20E+07	6,56E+07	1,49E+08	1,48E+08	1,50E+08	1,52E+08	1,51E+08	1,50E+08	2,29
4400	6,67E+07	6,92E+07	6,12E+07	1,29E+08	7,00E+07	7,93E+07	1,48E+08	1,51E+08	1,53E+08	1,51E+08	1,48E+08	1,50E+08	1,89
4450	6,80E+07	6,76E+07	9,86E+07	6,19E+07	7,24E+07	7,37E+07	1,49E+08	1,51E+08	1,52E+08	1,51E+08	1,46E+08	1,50E+08	2,03
4500	1,07E+08	6,18E+07	6,76E+07	6,71E+07	6,87E+07	7,45E+07	1,54E+08	1,50E+08	1,52E+08	1,54E+08	1,50E+08	1,52E+08	2,04
4550	6,13E+07	6,90E+07	6,55E+07	6,47E+07	6,59E+07	6,53E+07	1,48E+08	1,46E+08	1,49E+08	1,48E+08	1,47E+08	1,48E+08	2,26
4600	9,29E+07	6,74E+07	5,99E+07	5,75E+07	6,71E+07	6,90E+07	1,51E+08	1,49E+08	1,48E+08	1,50E+08	1,49E+08	1,49E+08	2,17
4650	1,54E+08	6,81E+07	6,77E+07	6,74E+07	6,74E+07	8,49E+07	1,50E+08	1,51E+08	1,47E+08	1,47E+08	1,48E+08	1,49E+08	1,75
4700	7,11E+07	7,08E+07	1,78E+08	5,88E+07	6,30E+07	8,84E+07	1,52E+08	1,50E+08	1,50E+08	1,49E+08	1,47E+08	1,50E+08	1,69
4750	6,04E+07	6,32E+07	6,84E+07	6,26E+07	9,28E+07	6,95E+07	1,49E+08	1,49E+08	1,53E+08	1,48E+08	1,50E+08	1,50E+08	2,15
4800	6,08E+07	6,65E+07	6,76E+07	9,82E+07	7,12E+07	7,29E+07	1,49E+08	1,50E+08	1,51E+08	1,50E+08	1,50E+08	1,50E+08	2,06
4850	1,27E+08	6,73E+07	6,71E+07	6,55E+07	6,35E+07	7,81E+07	1,48E+08	1,49E+08	1,58E+08	1,50E+08	1,49E+08	1,51E+08	1,93
4900	6,73E+07	6,69E+07	1,02E+08	5,90E+07	6,56E+07	7,21E+07	1,46E+08	1,50E+08	1,50E+08	1,51E+08	1,48E+08	1,49E+08	2,07
4950	6,69E+07	7,15E+07	9,88E+07	7,06E+07	6,50E+07	7,46E+07	1,47E+08	1,48E+08	1,48E+08	1,52E+08	1,47E+08	1,48E+08	1,99
5000	6,67E+07	6,15E+07	6,78E+07	6,81E+07	7,10E+07	6,70E+07	1,49E+08	1,51E+08	1,51E+08	1,52E+08	1,48E+08	1,50E+08	2,24

Execution with Num servers = 20, Array size = 5000000													
CUT OFF	MultiThreading execution wall clock time						Sequential execution wall clock time						Speed-up seqAVG/mthAVG
	exec 1	exec 2	exec 3	exec 5	exec 5	mthAVG	exec 1	exec 2	exec 3	exec 5	exec 5	seqAVG	
50	3,60E+08	3,91E+08	6,32E+08	3,73E+08	6,20E+08	4,75E+08	8,07E+08	7,98E+08	8,07E+08	8,03E+08	8,12E+08	8,05E+08	1,7
100	5,15E+08	5,04E+08	3,54E+08	6,02E+08	5,05E+08	4,96E+08	8,10E+08	8,05E+08	8,10E+08	7,99E+08	8,16E+08	8,08E+08	1,6
150	3,66E+08	3,43E+08	3,39E+08	3,90E+08	3,37E+08	3,55E+08	8,06E+08	8,10E+08	7,98E+08	8,00E+08	8,03E+08	8,03E+08	2,3
200	3,27E+08	5,47E+08	3,39E+08	5,93E+08	4,51E+08	4,51E+08	8,04E+08	8,05E+08	8,09E+08	7,99E+08	8,07E+08	8,05E+08	1,8
250	3,39E+08	3,39E+08	3,38E+08	3,72E+08	3,62E+08	3,50E+08	8,09E+08	8,06E+08	8,06E+08	8,09E+08	8,08E+08	8,08E+08	2,3
300	3,66E+08	3,33E+08	4,42E+08	3,47E+08	3,32E+08	3,64E+08	8,04E+08	8,04E+08	8,09E+08	8,02E+08	8,01E+08	8,04E+08	2,2
350	3,00E+08	3,00E+08	3,27E+08	4,32E+08	3,27E+08	3,37E+08	8,02E+08	7,99E+08	8,02E+08	8,03E+08	8,04E+08	8,02E+08	2,4
400	5,17E+08	3,76E+08	4,13E+08	3,90E+08	3,32E+08	4,06E+08	8,06E+08	8,06E+08	8,07E+08	8,04E+08	8,01E+08	8,05E+08	2,0
450	4,55E+08	3,29E+08	4,77E+08	3,36E+08	3,28E+08	3,85E+08	8,07E+08	8,05E+08	8,03E+08	8,06E+08	8,07E+08	8,06E+08	2,1
500	3,27E+08	3,29E+08	3,01E+08	3,32E+08	3,65E+08	3,31E+08	8,05E+08	8,09E+08	8,02E+08	7,98E+08	8,37E+08	8,10E+08	2,4
550	3,89E+08	3,60E+08	3,27E+08	3,05E+08	3,03E+08	3,37E+08	8,01E+08	8,03E+08	8,03E+08	8,00E+08	8,10E+08	8,03E+08	2,4
600	3,14E+08	3,13E+08	3,32E+08	3,23E+08	3,06E+08	3,18E+08	8,07E+08	8,02E+08	8,01E+08	8,03E+08	7,99E+08	8,02E+08	2,5
650	4,53E+08	3,31E+08	3,32E+08	3,57E+08	3,44E+08	3,63E+08	8,04E+08	8,05E+08	8,02E+08	8,01E+08	8,06E+08	8,04E+08	2,2
700	3,22E+08	5,41E+08	3,69E+08	3,26E+08	4,20E+08	3,96E+08	8,00E+08	8,03E+08	8,04E+08	8,01E+08	8,07E+08	8,03E+08	2,0
750	2,99E+08	3,69E+08	3,35E+08	3,27E+08	3,61E+08	3,38E+08	8,05E+08	8,03E+08	8,00E+08	8,07E+08	8,04E+08	8,04E+08	2,4
800	3,02E+08	3,00E+08	2,98E+08	3,29E+08	3,02E+08	3,06E+08	8,03E+08	8,08E+08	8,05E+08	7,99E+08	8,06E+08	8,04E+08	2,6
850	3,27E+08	3,43E+08	3,26E+08	3,24E+08	3,58E+08	3,36E+08	8,12E+08	8,11E+08	8,03E+08	8,02E+08	8,00E+08	8,06E+08	2,4
900	5,82E+08	3,57E+08	3,28E+08	3,26E+08	3,24E+08	3,84E+08	8,09E+08	8,12E+08	8,13E+08	8,03E+08	7,99E+08	8,07E+08	2,1
950	3,80E+08	3,30E+08	3,29E+08	3,58E+08	2,97E+08	3,39E+08	8,06E+08	8,11E+08	8,06E+08	8,02E+08	8,09E+08	8,07E+08	2,4
1000	3,42E+08	1,07E+09	3,25E+08	4,09E+08	4,40E+08	5,17E+08	8,02E+08	8,01E+08	8,02E+08	8,00E+08	8,06E+08	8,02E+08	1,6
1050	3,94E+08	3,25E+08	3,26E+08	3,49E+08	1,88E+09	6,54E+08	8,01E+08	8,03E+08	8,14E+08	8,01E+08	8,02E+08	8,04E+08	1,2
1100	3,15E+08	3,31E+08	3,26E+08	3,80E+08	3,26E+08	3,35E+08	7,99E+08	8,04E+08	8,04E+08	8,02E+08	8,00E+08	8,02E+08	2,4
1150	3,25E+08	3,02E+08	3,69E+08	4,13E+08	2,92E+08	3,40E+08	8,03E+08	8,07E+08	8,15E+08	8,02E+08	8,02E+08	8,06E+08	2,4
1200	3,15E+08	3,21E+08	3,66E+08	4,42E+08	2,93E+08	3,47E+08	8,03E+08	8,06E+08	8,05E+08	8,06E+08	8,12E+08	8,06E+08	2,3
1250	2,93E+08	3,45E+08	2,95E+08	3,24E+08	3,25E+08	3,16E+08	8,00E+08	8,16E+08	8,01E+08	8,05E+08	8,01E+08	8,05E+08	2,5
1300	3,03E+08	4,49E+08	4,85E+08	3,48E+08	3,23E+08	3,82E+08	8,13E+08	7,99E+08	8,06E+08	8,06E+08	8,02E+08	8,05E+08	2,1
1350	3,02E+08	3,83E+08	3,35E+08	3,30E+08	3,37E+08	3,38E+08	8,06E+08	8,05E+08	8,01E+08	8,01E+08	8,08E+08	8,04E+08	2,4
1400	3,47E+08	3,14E+08	4,37E+09	3,20E+08	6,39E+08	1,20E+09	8,07E+08	8,37E+08	8,07E+08	8,04E+08	8,08E+08	8,13E+08	0,7
1450	3,61E+08	3,24E+08	3,61E+08	3,36E+08	2,97E+08	3,36E+08	8,10E+08	8,01E+08	8,04E+08	8,13E+08	8,07E+08	8,07E+08	2,4
1500	3,33E+08	3,06E+08	3,23E+08	5,23E+08	3,98E+08	3,77E+08	8,10E+08	8,04E+08	8,05E+08	8,06E+08	8,03E+08	8,06E+08	2,1
1550	3,34E+08	3,03E+08	3,05E+08	3,24E+08	3,29E+08	3,19E+08	8,02E+08	8,09E+08	8,00E+08	8,04E+08	8,04E+08	8,04E+08	2,5
1600	3,31E+08	3,79E+08	3,03E+08	3,91E+08	3,72E+08	3,55E+08	8,06E+08	8,10E+08	7,99E+08	8,02E+08	8,07E+08	8,05E+08	2,3
1650	1,53E+09	3,68E+08	3,04E+08	3,19E+08	3,66E+08	5,76E+08	8,02E+08	8,04E+08	8,00E+08	7,97E+08	8,08E+08	8,02E+08	1,4
1700	3,39E+08	4,76E+08	3,53E+08	4,00E+08	4,04E+08	3,94E+08	8,02E+08	8,02E+08	8,03E+08	8,03E+08	8,02E+08	8,02E+08	2,0
1750	3,28E+08	2,82E+09	3,26E+08	3,08E+08	3,32E+08	8,22E+08	8,07E+08	8,01E+08	8,02E+08	8,41E+08	8,10E+08	8,12E+08	1,0
1800	3,33E+08	1,24E+09	4,07E+08	3,03E+08	3,45E+08	5,25E+08	8,10E+08	8,06E+08	8,06E+08	8,09E+08	8,05E+08	8,07E+08	1,5
1850	2,97E+08	3,25E+08	3,30E+08	3,25E+08	3,22E+08	3,20E+08	8,00E+08	8,06E+08	8,05E+08	7,99E+08	8,06E+08	8,03E+08	2,5
1900	3,39E+08	3,23E+08	3,50E+08	3,07E+08	5,00E+08	3,64E+08	8,05E+08	8,04E+08	8,02E+08	8,12E+08	8,04E+08	8,06E+08	2,2
1950	4,03E+08	5,26E+08	3,26E+08	3,23E+08	3,27E+08	3,81E+08	8,04E+08	8,08E+08	8,03E+08	8,03E+08	8,07E+08	8,05E+08	2,1
2000	3,24E+08	3,89E+08	3,62E+08	3,28E+08	3,19E+08	3,44E+08	8,05E+08	8,02E+08	8,21E+08	8,02E+08	8,11E+08	8,08E+08	2,3
2050	3,05E+08	3,23E+08	3,09E+08	3,05E+08	3,37E+08	3,16E+08	8,06E+08	8,06E+08	8,05E+08	8,04E+08	8,12E+08	8,06E+08	2,6
2100	3,46E+08	3,14E+08	3,98E+08	3,72E+08	3,26E+08	3,51E+08	8,06E+08	8,04E+08	8,07E+08	8,02E+08	8,05E+08	8,05E+08	2,3
2150	4,39E+08	3,28E+08	3,32E+08	4,03E+08	3,70E+08	3,74E+08	8,00E+08	8,02E+08	8,01E+08	8,01E+08	8,09E+08	8,03E+08	2,1
2200	3,57E+08	3,41E+08	3,40E+08	3,71E+08	2,25E+09	7,31E+08	8,03E+08	8,08E+08	8,15E+08	8,04E+08	8,04E+08	8,07E+08	1,1
2250	5,85E+08	3,20E+08	5,03E+08	3,25E+08	3,72E+08	4,21E+08	8,01E+08	8,03E+08	8,04E+08	8,02E+08	8,04E+08	8,03E+08	1,9
2300	3,12E+08	3,04E+08	3,38E+08	3,05E+08	3,27E+08	3,17E+08	8,13E+08	8,07E+08	8,04E+08	8,01E+08	7,99E+08	8,05E+08	2,5
2350	3,00E+08	3,33E+08	3,04E+08	3,25E+08	3,42E+08	3,21E+08	8,06E+08	8,05E+08	8,02E+08	8,05E+08	8,04E+08	8,04E+08	2,5
2400	3,74E+08	2,99E+08	3,55E+08	3,70E+08	3,40E+08	3,47E+08	8,04E+08	8,04E+08	8,02E+08	8,05E+08	8,05E+08	8,04E+08	2,3
2450	3,06E+08	3,47E+08	3,23E+08	3,36E+08	3,50E+08	3,32E+08	8,03E+08	8,04E+08	8,02E+08	7,98E+08	8,08E+08	8,03E+08	2,4
2500	3,26E+08	4,65E+08	3,22E+08	3,39E+08	1,66E+09	6,23E+08	8,03E+08	8,05E+08	8,06E+08	8,11E+08	8,13E+08	8,08E+08	1,3
2550	4,82E+08	3,11E+08	3,26E+08	3,07E+08	3,58E+08	3,57E+08	8,02E+08	8,07E+08	8,09E+08	8,07E+08	8,04E+08	8,06E+08	2,3
2600	3,34E+08	3,44E+08	3,25E+08	4,88E+08	3,57E+08	3,70E+08	8,07E+08	8,04E+08	8,04E+08	8,07E+08	8,04E+08	8,05E+08	2,2
2650	4,36E+08	3,29E+08	4,41E+08	3,34E+08	3,94E+08	3,87E+08	8,08E+08	8,03E+08	8,09E+08	8,08E+08	8,06E+08	8,07E+08	2,1
2700	3,90E+08	5,48E+08	4,57E+08	3,26E+08	3,45E+08	4,13E+08	8,03E+08	8,06E+08	8,01E+08	8,02E+08	8,01E+08	8,03E+08	1,9
2750	4,34E+08	3,21E+08	3,73E+08	3,24E+08	3,25E+08	3,55E+08	8,02E+08	8,03E+08	8,34E+08	8,04E+08	8,03E+08	8,09E+08	2,3
2800	4,28E+08	3,41E+08	3,22E+08	6,62E+08	3,13E+08	4,13E+08	8,08E+08	8,06E+08	8,02E+08	7,99E+08	8,10E+08	8,05E+08	1,9
2850	4,59E+08	2,97E+08	3,53E+08	3,24E+08	3,71E+08	3,61E+08	8,06E+08	7,99E+08	8,01E+08	8,01E+08	8,04E+08	8,02E+08	2,2
2900	3,58E+08	3,35E+08	3,05E+08	3,32E+08	3,01E+08	3,26E+08	8,00E+08	8,01E+08	8,01E+08	8,04E+08	8,03E+08	8,02E+08	2,5
2950	3,73E+08	3,63E+08	3,29E+08	2,93E+08	3,28E+08	3,37E+08	8,10E+08	8,03E+08	8,10E+08	8,02E+08	8,10E+08	8,07E+08	2,4
3000	6,49E+08	3,58E+08	3,34E+08	3,38E+08	3,08E+08	3,97E+08	8,05E+08	8,08E+08	8,07E+08	8,03E+08	8,09E+08	8,07E+08	2,0
3050	3,25E+08	3,12E+08	3,76E+08	3,11E+08	4,03E+08	3,45E+08	8,02E+08	8,01E+08	8,10E+08	8,06E+08	8,03E+08	8,04E+08	2,3
3100	3,28E+08	5,10E+08	3,14E+08	3,86E+08	3,05E+08	3,69E+08	8,04E+08	8,10E+08	8,09E+08	8,03E+08	8,04E+08	8,06E+08	2,2
3150	3,61E+08	4,13E+08	4,19E+08	3,13E+08	3,54E+08	3,72E+08	8,29E+08	8,17E+08	8,07E+08	8,03E+08	8,03E+08	8,12E+08	2,2

3200	3,02E+08	8,79E+08	3,90E+08	1,20E+09	3,22E+08	6,19E+08	8,04E+08	8,22E+08	8,02E+08	8,07E+08	8,05E+08	8,08E+08	1,3
3250	3,57E+08	3,56E+08	4,58E+08	3,72E+08	4,40E+09	1,19E+09	8,00E+08	8,06E+08	8,12E+08	8,09E+08	8,00E+08	8,05E+08	0,7
3300	3,05E+08	3,28E+08	3,89E+08	3,27E+08	3,59E+08	3,42E+08	8,09E+08	8,04E+08	8,07E+08	7,98E+08	8,08E+08	8,05E+08	2,4
3350	3,14E+08	2,94E+08	4,44E+08	3,68E+08	3,06E+08	3,45E+08	8,04E+08	8,11E+08	7,99E+08	8,03E+08	8,05E+08	8,04E+08	2,3
3400	5,30E+08	3,90E+08	4,55E+08	4,08E+08	5,14E+08	4,59E+08	8,03E+08	7,99E+08	8,07E+08	8,03E+08	8,09E+08	8,04E+08	1,8
3450	1,35E+09	4,20E+08	1,97E+09	3,35E+08	3,34E+08	8,83E+08	8,03E+08	8,05E+08	8,00E+08	8,05E+08	8,00E+08	8,02E+08	0,9
3500	3,35E+08	3,82E+08	3,40E+08	3,39E+08	3,06E+08	3,40E+08	8,00E+08	8,05E+08	8,02E+08	8,07E+08	8,01E+08	8,03E+08	2,4
3550	3,34E+08	3,38E+08	2,94E+08	3,58E+08	3,72E+08	3,39E+08	8,01E+08	8,07E+08	8,05E+08	8,06E+08	8,04E+08	8,05E+08	2,4
3600	3,18E+08	4,35E+08	3,13E+08	3,43E+08	2,98E+08	3,41E+08	8,02E+08	8,10E+08	8,03E+08	8,04E+08	8,05E+08	8,05E+08	2,4
3650	3,04E+08	3,39E+08	3,33E+08	2,99E+08	4,03E+08	3,36E+08	8,00E+08	8,60E+08	8,04E+08	7,98E+08	8,07E+08	8,14E+08	2,4
3700	3,56E+08	4,16E+08	3,48E+08	3,60E+08	6,10E+08	4,18E+08	8,10E+08	8,12E+08	8,03E+08	7,97E+08	8,07E+08	8,06E+08	1,9
3750	4,32E+08	4,05E+08	3,47E+08	4,08E+08	3,02E+08	3,79E+08	8,06E+08	8,09E+08	7,99E+08	8,68E+08	7,99E+08	8,16E+08	2,2
3800	3,23E+08	5,12E+08	2,98E+08	3,24E+08	3,09E+08	3,53E+08	8,02E+08	8,08E+08	8,03E+08	8,06E+08	8,04E+08	8,05E+08	2,3
3850	3,44E+08	3,58E+08	4,41E+08	3,43E+08	2,97E+08	3,56E+08	8,00E+08	8,02E+08	8,09E+08	8,02E+08	8,01E+08	8,03E+08	2,3
3900	3,49E+08	3,16E+08	3,36E+08	3,05E+08	3,16E+08	3,24E+08	8,04E+08	8,02E+08	8,06E+08	8,03E+08	8,02E+08	8,04E+08	2,5
3950	3,07E+08	3,29E+08	3,62E+08	3,67E+08	3,56E+08	3,44E+08	8,01E+08	8,00E+08	8,02E+08	8,05E+08	8,03E+08	8,02E+08	2,3
4000	5,80E+08	4,17E+08	2,97E+08	3,07E+08	3,27E+08	3,86E+08	8,15E+08	8,04E+08	8,03E+08	8,04E+08	8,03E+08	8,06E+08	2,1
4050	3,21E+08	4,66E+08	4,53E+08	3,01E+08	3,27E+08	3,74E+08	8,11E+08	8,08E+08	8,02E+08	8,04E+08	8,04E+08	8,06E+08	2,2
4100	3,20E+08	3,66E+08	3,27E+08	3,29E+08	3,25E+08	3,33E+08	8,04E+08	8,04E+08	8,04E+08	8,08E+08	8,01E+08	8,04E+08	2,4
4150	3,41E+08	3,75E+08	5,18E+08	6,06E+08	3,69E+08	4,42E+08	8,08E+08	8,52E+08	8,06E+08	8,04E+08	8,00E+08	8,14E+08	1,8
4200	3,65E+08	3,04E+08	3,37E+08	3,39E+08	3,33E+08	3,35E+08	8,09E+08	8,03E+08	8,02E+08	8,02E+08	8,05E+08	8,04E+08	2,4
4250	3,14E+08	3,28E+08	1,85E+09	3,50E+08	3,28E+08	6,35E+08	8,05E+08	8,07E+08	8,04E+08	8,02E+08	8,05E+08	8,05E+08	1,3
4300	3,70E+08	3,32E+08	3,63E+08	3,31E+08	3,56E+08	3,50E+08	8,03E+08	8,01E+08	8,00E+08	8,00E+08	8,03E+08	8,01E+08	2,3
4350	3,05E+08	3,59E+08	3,36E+08	4,32E+08	3,60E+08	3,58E+08	8,08E+08	8,03E+08	8,02E+08	8,04E+08	7,99E+08	8,03E+08	2,2
4400	3,74E+08	3,01E+08	3,02E+08	4,09E+08	3,80E+08	3,53E+08	8,08E+08	8,07E+08	8,03E+08	8,04E+08	8,05E+08	8,05E+08	2,3
4450	3,04E+08	2,94E+08	3,94E+08	3,46E+08	2,97E+08	3,27E+08	8,03E+08	8,03E+08	8,06E+08	8,08E+08	8,07E+08	8,05E+08	2,5
4500	4,03E+08	3,83E+08	3,58E+08	3,40E+08	3,48E+08	3,66E+08	8,05E+08	8,04E+08	8,00E+08	8,02E+08	8,07E+08	8,04E+08	2,2
4550	3,27E+08	3,30E+08	3,46E+08	3,66E+08	3,50E+08	3,44E+08	8,04E+08	8,01E+08	8,01E+08	8,02E+08	8,01E+08	8,02E+08	2,3
4600	3,15E+08	3,53E+08	3,38E+08	3,71E+08	3,29E+08	3,41E+08	8,02E+08	8,02E+08	8,03E+08	8,01E+08	8,03E+08	8,02E+08	2,4
4650	3,58E+08	3,24E+08	3,51E+08	5,53E+08	3,38E+08	3,85E+08	8,03E+08	8,15E+08	8,05E+08	8,03E+08	8,05E+08	8,06E+08	2,1
4700	3,15E+08	2,61E+09	3,25E+08	3,24E+08	3,71E+08	7,89E+08	8,07E+08	8,04E+08	7,99E+08	8,01E+08	8,12E+08	8,05E+08	1,0
4750	3,36E+08	3,75E+08	3,93E+08	3,63E+08	4,03E+08	3,74E+08	8,02E+08	7,99E+08	8,04E+08	8,10E+08	8,10E+08	8,05E+08	2,2
4800	3,18E+08	7,55E+08	3,51E+08	3,87E+08	3,32E+08	4,29E+08	8,05E+08	8,01E+08	8,03E+08	8,03E+08	8,16E+08	8,06E+08	1,9
4850	3,87E+08	3,34E+08	3,57E+08	3,77E+08	3,93E+08	3,70E+08	8,00E+08	8,03E+08	8,04E+08	8,05E+08	8,05E+08	8,03E+08	2,2
4900	3,72E+08	4,05E+08	3,44E+08	3,26E+08	5,01E+08	3,89E+08	7,97E+08	8,02E+08	8,07E+08	8,02E+08	8,05E+08	8,03E+08	2,1
4950	3,96E+08	3,30E+08	3,83E+08	4,99E+08	3,60E+08	3,93E+08	8,27E+08	8,05E+08	7,99E+08	8,09E+08	8,07E+08	8,09E+08	2,1
5000	7,07E+08	3,27E+08	3,41E+08	4,10E+08	3,56E+08	4,28E+08	8,05E+08	8,00E+08	8,02E+08	7,97E+08	8,07E+08	8,02E+08	1,9

B.2 Further analysis

We focus on 7 different values for the cutoff and analyze the speed-up on different sizes of the array. Green cells highlight the executions in which the work stealing algorithm had a better clock-time.

array size		multitreading wallclock time (20 servers)	sequential wallclock time	speed-up		multitreading wallclock time (20 servers)	sequential wallclock time	speed-up
1,00E+05	cutoff: 50	9794180	16213553	1,66	cutoff: 100	109474690	17963743	0,16
1,20E+05		14082415	17158982	1,22		243893958	21266705	0,09
1,40E+05		38880893	19549720	0,50		311301915	22708996	0,07
1,60E+05		31472019	23544547	0,75		75437457	28783042	0,38
1,80E+05		16665741	28710595	1,72		404610744	37806872	0,09
2,00E+05		17934160	27664949	1,54		41348304	38938247	0,94
2,20E+05		18478717	32636598	1,77		37212205	84022985	2,26
2,40E+05		25130525	37357702	1,49		258269781	48826606	0,19
2,60E+05		24056504	37167531	1,55		31655550	46492618	1,47
2,80E+05		39148342	43717912	1,12		43254254	72115780	1,67
3,00E+05		23437689	45876217	1,96		164505745	70064333	0,43
3,20E+05		24534651	48361740	1,97		35329197	59341025	1,68
3,40E+05		25792808	55681867	2,16		109406469	82747925	0,76
3,60E+05		43667803	54155055	1,24		158426266	75132577	0,47
3,80E+05		29234022	56691290	1,94		94514463	84879667	0,90
4,00E+05		34845012	61609208	1,77		48592966	75054697	1,54
4,20E+05	cutoff: 500	30321928	63403470	2,09	cutoff: 1000	45151751	112283807	2,49
4,40E+05		48635830	68410739	1,41		40030983	99899058	2,50
4,60E+05		37060672	69222744	1,87		94243995	68010471	0,72
4,80E+05		103400041	89606205	0,87		40797709	86177668	2,11
5,00E+05		72113968	95639801	1,33		64403233	107058595	1,66
1,00E+05		7536863	12702911	1,69		7280885	13990650	1,92
1,20E+05		9660153	15553686	1,61		11482185	16539563	1,44
1,40E+05		12421577	18062754	1,45		9499563	23243894	2,45
1,60E+05		14678288	21301117	1,45		10652068	21060836	1,98
1,80E+05		11286580	23944211	2,12		13645924	24221923	1,78
2,00E+05		24709126	26906674	1,09		14026269	26892185	1,92
2,20E+05		14244213	29875174	2,10		15767403	29856459	1,89
2,40E+05		16112732	39487633	2,45		28726292	34389203	1,20
2,60E+05		17647392	35667281	2,02		37546064	41159339	1,10
2,80E+05		20387686	38412404	1,88		22728316	38882704	1,71
3,00E+05		18556597	41778154	2,25		28662901	42166347	1,47
3,20E+05	cutoff: 500	52529836	53613517	1,02		26409208	48138363	1,82
3,40E+05		27502548	54916952	2,00		20566388	48643074	2,37
3,60E+05		29284735	64441268	2,20		25864651	60090244	2,32
3,80E+05		30215674	63122739	2,09		24318519	53487338	2,20
4,00E+05		32789944	56783056	1,73		41045839	59467203	1,45
4,20E+05		32233312	67916291	2,11		34887273	65768852	1,89
4,40E+05		34480365	71658761	2,08		27750074	67783471	2,44
4,60E+05		27783882	65267763	2,35		28030201	66657530	2,38
4,80E+05		30305628	68590044	2,26		34624654	74674956	2,16
5,00E+05		47118073	82055455	1,74		30375056	73956527	2,43

array size		multithreading wallclock time (20 servers)	sequential wallclock time	speed-up		multithreading wallclock time (20 servers)	sequential wallclock time	speed-up
1,00E+05	cutoff: 1000	7280885	13990650	1,92	cutoff: 5000	9186231	13447904	1,46
1,20E+05		11482185	16539563	1,44		17480162	20172157	1,15
1,40E+05		9499563	23243894	2,45		11261224	19794227	1,76
1,60E+05		10652068	21060836	1,98		13623587	24130157	1,77
1,80E+05		13645924	24221923	1,78		16551637	25297756	1,53
2,00E+05		14026269	26892185	1,92		13816778	37585910	2,72
2,20E+05		15767403	29856459	1,89		52477312	38880893	0,74
2,40E+05		28726292	34389203	1,20		22864153	39784664	1,74
2,60E+05		37546064	41159339	1,10		27303320	57817835	2,12
2,80E+05		22728316	38882704	1,71		19278649	43975702	2,28
3,00E+05		28662901	42166347	1,47		20758975	43764398	2,11
3,20E+05		26409208	48138363	1,82		21126642	52497839	2,48
3,40E+05		20566388	48643074	2,37		20986579	53009795	2,53
3,60E+05		25864651	60090244	2,32		29433854	54654333	1,86
3,80E+05		24318519	53487338	2,20		29059546	58422161	2,01
4,00E+05		41045839	59467203	1,45		24621587	61722708	2,51
4,20E+05	cutoff: 10000	34887273	65768852	1,89	cutoff: 50000	36132147	90188796	2,50
4,40E+05		27750074	67783471	2,44		256312515	70687977	0,28
4,60E+05		28030201	66657530	2,38		28505933	70124705	2,46
4,80E+05		34624654	74674956	2,16		66761371	74321175	1,11
5,00E+05		30375056	73956527	2,43		36156900	81349101	2,25
1,00E+05		23251743	17488010	0,75		11141082	13227545	1,19
1,20E+05		33333897	20400968	0,61		13074804	16182160	1,24
1,40E+05		12299624	21636183	1,76		13075407	18169612	1,39
1,60E+05		31048809	57118725	1,84		14181426	20446851	1,44
1,80E+05		50441563	30346078	0,60		15209564	23389994	1,54
2,00E+05		16849272	33212548	1,97		17347342	28544572	1,65
2,20E+05		35108235	37514067	1,07		18033775	32721119	1,81
2,40E+05		15637602	37014185	2,37		21591508	37526141	1,74
2,60E+05		24811156	41214278	1,66		24987443	46312105	1,85
2,80E+05		22668547	46378515	2,05		102083927	51810199	0,51
3,00E+05		24375268	49694759	2,04		21143546	49143560	2,32
3,20E+05		87546305	47886612	0,55		27957150	51968374	1,86
3,40E+05		22481997	49410406	2,20		23644161	55501959	2,35
3,60E+05		22832156	52204430	2,29		25835068	59555951	2,31
3,80E+05		44524484	54846316	1,23		35176456	58752396	1,67
4,00E+05		24450734	58181879	2,38		190068534	64967109	0,34
4,20E+05		44446001	61803004	1,39		29825670	70648735	2,37
4,40E+05		25372014	63977005	2,52		37741670	64186497	1,70
4,60E+05		27509793	67800376	2,46		30710725	70382494	2,29
4,80E+05		29213495	68204265	2,33		280012219	101021980	0,36
5,00E+05		28365266	70829249	2,50		65397563	81075012	1,24

Appendix C Average steals and execution time

The table shows the average results with obtained with arrays of varying size (first column), 20 servers and cutoff=1000. The green cells highlight the executions in which the work stealing algorithm had a better clock-time compared to the sequential one.

ARRAY SIZE	Num STEALS			Multi-Thread CLOCK TIME (20 servers, 1000 cut-off)	Sequential CLOCK TIME			AVG Multi-Thread		AVGSequential CLOCK		
								CLOCK TIME	TIME			
1,00E+04	21	21	11	1,48E+07	3,12E+06	2,96E+06	1,51E+06	1,11E+06	1,22E+06	17,67	6,97E+06	1,28E+06
2,00E+04	34	33	18	8,26E+06	3,54E+06	3,58E+06	3,14E+06	2,20E+06	2,20E+06	28,33	5,13E+06	2,51E+06
3,00E+04	49	46	51	3,35E+07	4,91E+06	3,88E+06	4,31E+06	3,55E+06	3,37E+06	48,67	1,41E+07	3,74E+06
4,00E+04	72	54	57	1,61E+07	5,01E+06	4,61E+06	4,98E+06	4,83E+06	4,85E+06	61,00	8,57E+06	4,89E+06
5,00E+04	71	77	58	7,74E+06	4,75E+06	4,61E+06	8,14E+06	6,06E+06	6,12E+06	68,67	5,70E+06	6,77E+06
6,00E+04	122	91	47	1,78E+07	5,36E+06	5,03E+06	9,90E+06	7,06E+06	7,32E+06	86,67	9,41E+06	8,09E+06
7,00E+04	90	107	108	4,40E+07	6,99E+06	6,47E+06	1,16E+07	8,97E+06	8,69E+06	101,67	1,92E+07	9,77E+06
8,00E+04	156	110	82	1,62E+07	6,07E+06	6,74E+06	1,34E+07	1,01E+07	1,06E+07	116,00	9,68E+06	1,14E+07
9,00E+04	179	146	124	1,16E+07	8,49E+06	6,74E+06	1,51E+07	1,15E+07	1,15E+07	149,67	8,95E+06	1,27E+07
1,00E+05	167	160	141	1,70E+07	1,17E+07	8,22E+06	1,58E+07	1,33E+07	1,30E+07	156,00	1,23E+07	1,40E+07
1,10E+05	235	183	208	1,56E+07	8,86E+06	8,33E+06	1,65E+07	1,46E+07	1,42E+07	208,67	1,09E+07	1,51E+07
1,20E+05	231	164	59	4,05E+07	9,41E+06	9,58E+06	1,92E+07	1,58E+07	1,48E+07	151,33	1,98E+07	1,66E+07
1,30E+05	191	200	191	5,51E+07	9,84E+06	8,41E+06	2,30E+07	1,62E+07	1,79E+07	194,00	2,44E+07	1,90E+07
1,40E+05	192	210	128	1,88E+07	9,25E+06	1,05E+07	2,32E+07	1,83E+07	1,88E+07	176,67	1,28E+07	2,01E+07
1,50E+05	260	305	275	3,72E+07	2,14E+07	1,20E+07	2,50E+07	2,04E+07	2,12E+07	280,00	2,35E+07	2,22E+07
1,60E+05	247	235	293	4,32E+07	1,14E+07	1,39E+07	3,31E+07	2,24E+07	2,18E+07	258,33	2,29E+07	2,58E+07
1,70E+05	264	289	0	1,47E+08	1,18E+07	1,11E+07	3,33E+07	2,52E+07	2,24E+07	184,33	5,65E+07	2,70E+07
1,80E+05	301	300	257	5,13E+07	1,41E+07	1,24E+07	3,19E+07	3,03E+07	2,29E+07	286,00	2,59E+07	2,84E+07
1,90E+05	375	287	207	2,38E+07	1,34E+07	1,27E+07	3,26E+07	2,62E+07	2,64E+07	289,67	1,66E+07	2,84E+07
2,00E+05	337	329	381	1,86E+07	1,58E+07	2,02E+07	3,74E+07	2,79E+07	2,75E+07	349,00	1,82E+07	3,09E+07
2,10E+05	350	351	231	2,40E+07	1,49E+07	1,47E+07	3,65E+07	2,89E+07	2,79E+07	310,67	1,79E+07	3,11E+07
2,20E+05	445	332	314	2,94E+07	1,52E+07	1,42E+07	3,94E+07	3,04E+07	2,86E+07	363,67	1,96E+07	3,28E+07
2,30E+05	375	479	260	2,72E+07	1,50E+07	1,43E+07	4,87E+07	3,08E+07	3,05E+07	371,33	1,88E+07	3,67E+07
2,40E+05	349	346	262	3,73E+07	1,61E+07	2,66E+07	4,84E+07	3,29E+07	3,36E+07	319,00	2,66E+07	3,83E+07
2,50E+05	378	390	262	6,36E+07	2,33E+07	1,93E+07	8,19E+07	3,37E+07	3,46E+07	343,33	3,54E+07	5,00E+07
2,60E+05	410	382	430	5,70E+07	1,88E+07	1,53E+07	4,88E+07	3,40E+07	3,48E+07	407,33	3,04E+07	3,92E+07
2,70E+05	538	413	186	8,20E+07	1,63E+07	1,62E+07	5,20E+07	3,55E+07	3,75E+07	379,00	3,82E+07	4,17E+07
2,80E+05	428	418	245	1,33E+08	1,87E+07	1,85E+07	4,45E+07	4,34E+07	3,86E+07	363,67	5,66E+07	4,22E+07
2,90E+05	434	421	417	2,13E+07	2,65E+07	1,90E+07	5,11E+07	4,43E+07	3,88E+07	424,00	2,22E+07	4,47E+07
3,00E+05	456	472	426	2,67E+07	1,90E+07	1,83E+07	4,55E+07	4,07E+07	4,01E+07	451,33	2,13E+07	4,21E+07
3,10E+05	480	432	476	2,27E+07	1,92E+07	2,27E+07	5,02E+07	4,17E+07	4,38E+07	462,67	2,16E+07	4,52E+07
3,20E+05	474	461	445	2,77E+07	1,91E+07	2,04E+07	7,38E+07	4,45E+07	4,34E+07	460,00	2,24E+07	5,39E+07
3,30E+05	489	491	490	2,66E+07	2,04E+07	2,00E+07	4,69E+07	4,50E+07	4,66E+07	490,00	2,23E+07	4,61E+07
3,40E+05	523	623	475	2,95E+07	2,04E+07	2,76E+07	4,79E+07	5,10E+07	4,79E+07	540,33	2,58E+07	4,89E+07
3,50E+05	458	567	536	2,08E+07	3,17E+07	2,15E+07	4,91E+07	5,07E+07	4,73E+07	520,33	2,47E+07	4,90E+07
3,60E+05	547	542	717	3,11E+07	2,40E+07	2,35E+07	5,66E+07	4,89E+07	4,85E+07	602,00	2,62E+07	5,13E+07
3,70E+05	582	598	742	3,78E+07	2,30E+07	2,25E+07	6,30E+07	5,12E+07	5,24E+07	640,67	2,78E+07	5,55E+07
3,80E+05	627	774	420	7,58E+07	2,55E+07	2,42E+07	6,84E+07	5,27E+07	5,11E+07	607,00	4,18E+07	5,74E+07
3,90E+05	510	621	556	5,50E+07	7,38E+07	2,27E+07	5,94E+07	5,64E+07	5,40E+07	562,33	5,05E+07	5,66E+07
4,00E+05	577	620	695	1,05E+08	2,41E+07	3,16E+07	5,69E+07	5,68E+07	5,72E+07	630,67	5,34E+07	5,70E+07
4,10E+05	638	658	664	2,46E+07	2,41E+07	2,42E+07	5,74E+07	5,86E+07	5,83E+07	653,33	2,43E+07	5,81E+07
4,20E+05	646	861	685	2,47E+07	2,54E+07	2,91E+07	5,74E+07	5,90E+07	5,93E+07	730,67	2,64E+07	5,86E+07
4,30E+05	612	595	610	2,73E+07	2,62E+07	2,67E+07	6,07E+07	6,13E+07	6,07E+07	605,67	2,67E+07	6,09E+07
4,40E+05	776	710	677	2,53E+07	3,01E+07	2,70E+07	6,02E+07	6,11E+07	6,22E+07	721,00	2,75E+07	6,12E+07
4,50E+05	753	745	690	5,25E+07	2,74E+07	2,76E+07	6,50E+07	6,21E+07	6,13E+07	729,33	3,58E+07	6,28E+07
4,60E+05	734	684	692	2,84E+07	2,97E+07	4,88E+07	6,61E+07	6,74E+07	6,63E+07	703,33	3,57E+07	6,66E+07
4,70E+05	728	964	965	3,72E+07	2,93E+07	2,81E+07	7,56E+07	6,62E+07	6,62E+07	885,67	3,15E+07	6,93E+07
4,80E+05	686	743	682	3,21E+07	2,88E+07	2,98E+07	6,99E+07	7,01E+07	7,03E+07	703,67	3,02E+07	7,01E+07
4,90E+05	746	743	860	3,38E+07	3,09E+07	3,06E+07	7,01E+07	7,02E+07	6,82E+07	783,00	3,18E+07	6,95E+07

5,00E+05	767	804	782	2,76E+07	2,74E+07	2,76E+07	7,13E+07	6,96E+07	6,91E+07	784,33	2,75E+07	7,00E+07
5,10E+05	174	165	194	3,47E+07	3,27E+07	3,25E+07	7,40E+07	7,39E+07	7,15E+07	177,67	3,33E+07	7,31E+07
5,20E+05	148	209	155	3,15E+07	3,22E+07	3,13E+07	7,59E+07	7,71E+07	7,49E+07	170,67	3,17E+07	7,60E+07
5,30E+05	174	169	180	3,33E+07	3,02E+07	3,07E+07	7,21E+07	7,41E+07	7,41E+07	174,33	3,14E+07	7,34E+07
5,40E+05	149	147	150	3,48E+07	3,43E+07	3,69E+07	7,55E+07	7,84E+07	7,70E+07	148,67	3,53E+07	7,70E+07
5,50E+05	150	154	156	3,34E+07	3,52E+07	3,18E+07	7,63E+07	8,45E+07	7,63E+07	153,33	3,35E+07	7,90E+07
5,60E+05	180	192	230	3,59E+07	3,31E+07	3,33E+07	7,98E+07	8,05E+07	7,93E+07	200,67	3,41E+07	7,98E+07
5,70E+05	179	172	173	3,43E+07	3,57E+07	3,54E+07	8,13E+07	8,00E+07	8,14E+07	174,67	3,51E+07	8,09E+07
5,80E+05	171	173	182	3,65E+07	3,50E+07	3,39E+07	8,45E+07	8,36E+07	8,42E+07	175,33	3,51E+07	8,41E+07
5,90E+05	166	169	162	3,76E+07	7,01E+07	3,89E+07	8,44E+07	8,59E+07	8,55E+07	165,67	4,89E+07	8,53E+07
6,00E+05	235	188	189	3,48E+07	7,68E+07	3,56E+07	8,51E+07	8,61E+07	8,76E+07	204,00	4,91E+07	8,63E+07
6,10E+05	163	171	220	6,88E+07	8,43E+07	4,03E+07	8,77E+07	9,36E+07	8,75E+07	184,67	6,45E+07	8,96E+07
6,20E+05	183	185	196	4,01E+07	9,11E+07	7,95E+07	9,06E+07	1,02E+08	8,80E+07	188,00	7,02E+07	9,34E+07
6,30E+05	197	195	197	4,11E+07	6,76E+07	6,72E+07	9,00E+07	9,48E+07	9,25E+07	196,33	5,86E+07	9,24E+07
6,40E+05	249	182	197	6,61E+07	4,50E+07	3,70E+07	9,22E+07	9,06E+07	9,03E+07	209,33	4,94E+07	9,10E+07
6,50E+05	188	173	202	4,67E+07	3,67E+07	1,10E+08	9,52E+07	9,17E+07	9,34E+07	187,67	6,46E+07	9,34E+07
6,60E+05	199	202	212	4,46E+07	8,79E+07	3,86E+07	9,61E+07	9,12E+07	9,37E+07	204,33	5,70E+07	9,37E+07
6,70E+05	241	198	200	3,97E+07	4,67E+07	6,95E+07	9,65E+07	9,84E+07	9,84E+07	213,00	5,19E+07	9,77E+07
6,80E+05	207	223	200	4,17E+07	6,65E+07	4,85E+07	9,64E+07	1,11E+08	9,66E+07	210,00	5,22E+07	1,01E+08
6,90E+05	229	208	200	6,69E+07	6,83E+07	4,05E+07	1,01E+08	9,50E+07	9,72E+07	212,33	5,86E+07	9,76E+07
7,00E+05	214	212	221	7,04E+07	4,80E+07	6,69E+07	1,01E+08	1,03E+08	9,92E+07	215,67	6,18E+07	1,01E+08
7,10E+05	224	203	277	4,67E+07	6,64E+07	6,05E+07	1,02E+08	1,06E+08	1,02E+08	234,67	5,79E+07	1,03E+08
7,20E+05	232	225	226	4,64E+07	4,88E+07	6,64E+07	1,03E+08	1,03E+08	1,03E+08	227,67	5,39E+07	1,03E+08
7,30E+05	251	288	248	5,46E+07	6,78E+07	1,66E+08	1,04E+08	1,05E+08	1,05E+08	262,33	9,61E+07	1,05E+08
7,40E+05	235	269	240	4,74E+07	6,76E+07	6,80E+07	1,29E+08	1,07E+08	1,05E+08	248,00	6,10E+07	1,14E+08
7,50E+05	253	257	250	6,62E+07	7,19E+07	5,66E+07	1,35E+08	1,07E+08	1,06E+08	253,33	6,49E+07	1,16E+08
7,60E+05	232	246	248	1,21E+08	4,72E+07	5,02E+07	1,37E+08	1,13E+08	1,13E+08	242,00	7,29E+07	1,21E+08
7,70E+05	232	269	263	7,31E+07	6,75E+07	6,76E+07	1,19E+08	1,12E+08	1,11E+08	254,67	6,94E+07	1,14E+08
7,80E+05	246	259	239	4,68E+07	6,86E+07	7,06E+07	1,13E+08	1,15E+08	1,10E+08	248,00	6,20E+07	1,13E+08
7,90E+05	251	258	254	6,36E+07	4,84E+07	1,02E+08	1,16E+08	1,15E+08	1,14E+08	254,33	7,12E+07	1,15E+08
8,00E+05	265	270	266	2,04E+08	5,12E+07	6,44E+07	1,24E+08	1,18E+08	1,19E+08	267,00	1,06E+08	1,20E+08
8,10E+05	238	264	283	7,62E+07	6,75E+07	4,48E+07	1,19E+08	1,18E+08	1,16E+08	261,67	6,28E+07	1,18E+08
8,20E+05	270	252	263	5,04E+07	8,40E+07	1,86E+08	1,20E+08	1,21E+08	1,19E+08	261,67	1,07E+08	1,20E+08
8,30E+05	282	291	292	4,98E+07	6,28E+07	1,39E+08	1,24E+08	1,23E+08	1,19E+08	288,33	8,37E+07	1,22E+08
8,40E+05	293	292	286	6,95E+07	6,54E+07	9,17E+07	1,23E+08	1,21E+08	1,18E+08	290,33	7,55E+07	1,21E+08
8,50E+05	302	298	313	4,74E+07	6,70E+07	6,67E+07	1,23E+08	1,21E+08	1,21E+08	304,33	6,04E+07	1,22E+08
8,60E+05	302	250	303	6,69E+07	2,88E+08	6,74E+07	1,23E+08	1,24E+08	1,22E+08	285,00	1,41E+08	1,23E+08
8,70E+05	298	251	289	4,94E+07	6,90E+07	4,88E+07	1,26E+08	1,28E+08	1,23E+08	279,33	5,57E+07	1,26E+08
8,80E+05	251	300	262	7,04E+07	6,74E+07	6,74E+07	1,27E+08	1,28E+08	1,26E+08	271,00	6,84E+07	1,27E+08
8,90E+05	300	293	309	7,04E+07	6,96E+07	5,91E+07	1,28E+08	1,28E+08	1,30E+08	300,67	6,64E+07	1,29E+08
9,00E+05	321	314	319	6,71E+07	6,80E+07	5,42E+07	1,36E+08	1,31E+08	1,32E+08	318,00	6,31E+07	1,33E+08
9,10E+05	278	275	314	6,93E+07	6,67E+07	6,67E+07	1,31E+08	1,33E+08	1,35E+08	289,00	6,76E+07	1,33E+08
9,20E+05	348	343	337	5,67E+07	2,50E+08	6,82E+07	1,34E+08	1,30E+08	1,36E+08	342,67	1,25E+08	1,34E+08
9,30E+05	324	304	321	5,55E+07	5,46E+07	1,31E+08	1,35E+08	1,36E+08	1,36E+08	316,33	8,03E+07	1,36E+08
9,40E+05	297	296	350	8,11E+07	6,25E+07	6,90E+07	1,34E+08	1,37E+08	1,39E+08	314,33	7,09E+07	1,37E+08
9,50E+05	329	320	328	7,42E+07	9,73E+07	7,73E+07	1,38E+08	1,41E+08	1,40E+08	325,67	8,29E+07	1,39E+08
9,60E+05	346	341	305	6,66E+07	9,53E+07	5,99E+07	1,38E+08	1,38E+08	1,41E+08	330,67	7,40E+07	1,39E+08
9,70E+05	347	353	358	6,09E+07	6,05E+07	1,03E+08	1,44E+08	1,39E+08	1,41E+08	352,67	7,49E+07	1,41E+08
9,80E+05	358	346	359	6,63E+07	6,05E+07	6,09E+07	1,46E+08	1,44E+08	1,45E+08	354,33	6,26E+07	1,45E+08
9,90E+05	365	358	360	5,84E+07	5,76E+07	6,69E+07	1,46E+08	1,44E+08	1,48E+08	361,00	6,10E+07	1,46E+08