

CSE 344 – HW05 Report
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1 Overview

- First, all requirements are done.
- Error handling of command line arguments is done.
- All system call error handling is done.
- Each input file must be contains at least $2^n * 2^n$ characters.
- atexit function is set. If the program gets SIGINT signal at any point, the opened files and allocated memories are given back to the system.
- After the threads do the first calculation, they come to the synchronzation barrier and are blocked. The last incoming thread wakes up other threads and the second calculation is started. After the second calculation is done, threads return the results of their calculations. The main process collects the return values of these threads and prints them to the output file.
- Since the threads do not work the same address, that is, there is no conflict in the threads, I didn't use the mutex etc. in these sections.

2 Compile And Run

- make -> Compiles the whole program
- Type make in the file contains the makefile
- make clean -> Cleans all objects files
- ./hw5 -i filePath1 -j filePath2 -o output -n 4 -m 2

3 Output Results

- For n = 6, m is taken respectively 2, 4 and 8. The results are following.
- For n = 6, m = 2. Results:

```
abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 2
[19/05/2022 - 16:51:15]Two matrices of size 64x64 have been read. The number of thread is 2
[19/05/2022 - 16:51:15]Thread 1 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:51:15]Thread 0 has reached the rendezvous point in 0.0018 seconds.
[19/05/2022 - 16:51:15]Thread 0 is advancing to the second part
[19/05/2022 - 16:51:15]Thread 1 is advancing to the second part
[19/05/2022 - 16:51:16]Thread 0 has finished the second part in 1.6048 seconds.
[19/05/2022 - 16:51:16]Thread 1 has finished the second part in 1.6391 seconds.
[19/05/2022 - 16:51:16]The process has written the output file. The total time spent is 1.655 seconds.
```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 2
[19/05/2022 - 16:51:49]Two matrices of size 64x64 have been read. The number of thread is 2
[19/05/2022 - 16:51:49]Thread 0 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:51:49]Thread 1 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:51:49]Thread 1 is advancing to the second part
[19/05/2022 - 16:51:49]Thread 0 is advancing to the second part
[19/05/2022 - 16:51:50]Thread 0 has finished the second part in 1.6065 seconds.
[19/05/2022 - 16:51:50]Thread 1 has finished the second part in 1.6377 seconds.
[19/05/2022 - 16:51:50]The process has written the output file. The total time spent is 1.652 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 2
[19/05/2022 - 16:51:52]Two matrices of size 64x64 have been read. The number of thread is 2
[19/05/2022 - 16:51:52]Thread 0 has reached the rendezvous point in 0.0010 seconds.
[19/05/2022 - 16:51:52]Thread 1 has reached the rendezvous point in 0.0012 seconds.
[19/05/2022 - 16:51:52]Thread 1 is advancing to the second part
[19/05/2022 - 16:51:52]Thread 0 is advancing to the second part
[19/05/2022 - 16:51:53]Thread 0 has finished the second part in 1.5940 seconds.
[19/05/2022 - 16:51:53]Thread 1 has finished the second part in 1.6273 seconds.
[19/05/2022 - 16:51:53]The process has written the output file. The total time spent is 1.640 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 2
[19/05/2022 - 16:51:55]Two matrices of size 64x64 have been read. The number of thread is 2
[19/05/2022 - 16:51:55]Thread 0 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:51:55]Thread 1 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:51:55]Thread 1 is advancing to the second part
[19/05/2022 - 16:51:55]Thread 0 is advancing to the second part
[19/05/2022 - 16:51:55]Thread 0 has finished the second part in 1.6131 seconds.
[19/05/2022 - 16:51:55]Thread 1 has finished the second part in 1.6426 seconds.
[19/05/2022 - 16:51:55]The process has written the output file. The total time spent is 1.656 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 2
[19/05/2022 - 16:51:57]Two matrices of size 64x64 have been read. The number of thread is 2
[19/05/2022 - 16:51:57]Thread 0 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:51:57]Thread 1 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:51:57]Thread 1 is advancing to the second part
[19/05/2022 - 16:51:57]Thread 0 is advancing to the second part
[19/05/2022 - 16:51:58]Thread 0 has finished the second part in 1.6059 seconds.
[19/05/2022 - 16:51:58]Thread 1 has finished the second part in 1.6356 seconds.
[19/05/2022 - 16:51:58]The process has written the output file. The total time spent is 1.649 seconds.

```

- For $n = 6$, $m = 4$. Results:

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 4
[19/05/2022 - 16:53:28]Two matrices of size 64x64 have been read. The number of thread is 4
[19/05/2022 - 16:53:28]Thread 0 has reached the rendezvous point in 0.0004 seconds.
[19/05/2022 - 16:53:28]Thread 1 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:53:28]Thread 2 has reached the rendezvous point in 0.0015 seconds.
[19/05/2022 - 16:53:28]Thread 3 has reached the rendezvous point in 0.0020 seconds.
[19/05/2022 - 16:53:28]Thread 3 is advancing to the second part
[19/05/2022 - 16:53:28]Thread 0 is advancing to the second part
[19/05/2022 - 16:53:28]Thread 1 is advancing to the second part
[19/05/2022 - 16:53:28]Thread 2 is advancing to the second part
[19/05/2022 - 16:53:29]Thread 0 has finished the second part in 1.5740 seconds.
[19/05/2022 - 16:53:29]Thread 1 has finished the second part in 1.6362 seconds.
[19/05/2022 - 16:53:29]Thread 2 has finished the second part in 1.6612 seconds.
[19/05/2022 - 16:53:29]Thread 3 has finished the second part in 1.6651 seconds.
[19/05/2022 - 16:53:29]The process has written the output file. The total time spent is 1.680 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 4
[19/05/2022 - 16:53:31]Two matrices of size 64x64 have been read. The number of thread is 4
[19/05/2022 - 16:53:31]Thread 1 has reached the rendezvous point in 0.0004 seconds.
[19/05/2022 - 16:53:31]Thread 0 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:53:31]Thread 3 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:53:31]Thread 2 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:53:31]Thread 2 is advancing to the second part
[19/05/2022 - 16:53:31]Thread 1 is advancing to the second part
[19/05/2022 - 16:53:31]Thread 3 is advancing to the second part
[19/05/2022 - 16:53:31]Thread 0 is advancing to the second part
[19/05/2022 - 16:53:32]Thread 0 has finished the second part in 1.5847 seconds.
[19/05/2022 - 16:53:32]Thread 1 has finished the second part in 1.6365 seconds.
[19/05/2022 - 16:53:32]Thread 3 has finished the second part in 1.6789 seconds.
[19/05/2022 - 16:53:32]Thread 2 has finished the second part in 1.6831 seconds.
[19/05/2022 - 16:53:32]The process has written the output file. The total time spent is 1.698 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 4
[19/05/2022 - 16:53:33]Two matrices of size 64x64 have been read. The number of thread is 4
[19/05/2022 - 16:53:33]Thread 0 has reached the rendezvous point in 0.0004 seconds.
[19/05/2022 - 16:53:33]Thread 2 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:53:33]Thread 3 has reached the rendezvous point in 0.0010 seconds.
[19/05/2022 - 16:53:33]Thread 1 has reached the rendezvous point in 0.0012 seconds.
[19/05/2022 - 16:53:33]Thread 1 is advancing to the second part
[19/05/2022 - 16:53:33]Thread 0 is advancing to the second part
[19/05/2022 - 16:53:33]Thread 2 is advancing to the second part
[19/05/2022 - 16:53:33]Thread 3 is advancing to the second part
[19/05/2022 - 16:53:34]Thread 0 has finished the second part in 1.5729 seconds.
[19/05/2022 - 16:53:34]Thread 1 has finished the second part in 1.6359 seconds.
[19/05/2022 - 16:53:34]Thread 2 has finished the second part in 1.6460 seconds.
[19/05/2022 - 16:53:34]Thread 3 has finished the second part in 1.6506 seconds.
[19/05/2022 - 16:53:34]The process has written the output file. The total time spent is 1.665 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 4
[19/05/2022 - 16:53:36]Two matrices of size 64x64 have been read. The number of thread is 4
[19/05/2022 - 16:53:36]Thread 0 has reached the rendezvous point in 0.0003 seconds.
[19/05/2022 - 16:53:36]Thread 1 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:53:36]Thread 2 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:53:36]Thread 3 has reached the rendezvous point in 0.0021 seconds.
[19/05/2022 - 16:53:36]Thread 3 is advancing to the second part
[19/05/2022 - 16:53:36]Thread 0 is advancing to the second part
[19/05/2022 - 16:53:36]Thread 1 is advancing to the second part
[19/05/2022 - 16:53:36]Thread 2 is advancing to the second part
[19/05/2022 - 16:53:36]Thread 0 has finished the second part in 1.5989 seconds.
[19/05/2022 - 16:53:36]Thread 1 has finished the second part in 1.6610 seconds.
[19/05/2022 - 16:53:36]Thread 2 has finished the second part in 1.7103 seconds.
[19/05/2022 - 16:53:36]Thread 3 has finished the second part in 1.7146 seconds.
[19/05/2022 - 16:53:36]The process has written the output file. The total time spent is 1.730 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 4
[19/05/2022 - 16:53:38]Two matrices of size 64x64 have been read. The number of thread is 4
[19/05/2022 - 16:53:38]Thread 1 has reached the rendezvous point in 0.0004 seconds.
[19/05/2022 - 16:53:38]Thread 0 has reached the rendezvous point in 0.0008 seconds.
[19/05/2022 - 16:53:38]Thread 3 has reached the rendezvous point in 0.0015 seconds.
[19/05/2022 - 16:53:38]Thread 2 has reached the rendezvous point in 0.0022 seconds.
[19/05/2022 - 16:53:38]Thread 2 is advancing to the second part
[19/05/2022 - 16:53:38]Thread 1 is advancing to the second part
[19/05/2022 - 16:53:38]Thread 0 is advancing to the second part
[19/05/2022 - 16:53:38]Thread 3 is advancing to the second part
[19/05/2022 - 16:53:38]Thread 0 has finished the second part in 1.5985 seconds.
[19/05/2022 - 16:53:38]Thread 1 has finished the second part in 1.6707 seconds.
[19/05/2022 - 16:53:38]Thread 2 has finished the second part in 1.7114 seconds.
[19/05/2022 - 16:53:38]Thread 3 has finished the second part in 1.7136 seconds.
[19/05/2022 - 16:53:38]The process has written the output file. The total time spent is 1.729 seconds.

```

- For $n = 6$, $m = 8$. Results:

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 8
[19/05/2022 - 16:54:48]Two matrices of size 64x64 have been read. The number of thread is 8
[19/05/2022 - 16:54:48]Thread 0 has reached the rendezvous point in 0.0005 seconds.
[19/05/2022 - 16:54:48]Thread 2 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:54:48]Thread 6 has reached the rendezvous point in 0.0010 seconds.
[19/05/2022 - 16:54:48]Thread 7 has reached the rendezvous point in 0.0008 seconds.
[19/05/2022 - 16:54:48]Thread 4 has reached the rendezvous point in 0.0014 seconds.
[19/05/2022 - 16:54:48]Thread 5 has reached the rendezvous point in 0.0015 seconds.
[19/05/2022 - 16:54:48]Thread 3 has reached the rendezvous point in 0.0011 seconds.
[19/05/2022 - 16:54:48]Thread 1 has reached the rendezvous point in 0.0014 seconds.
[19/05/2022 - 16:54:48]Thread 1 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 0 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 2 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 6 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 7 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 5 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 3 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 4 is advancing to the second part
[19/05/2022 - 16:54:48]Thread 0 has finished the second part in 2.1126 seconds.
[19/05/2022 - 16:54:48]Thread 1 has finished the second part in 2.1698 seconds.
[19/05/2022 - 16:54:48]Thread 3 has finished the second part in 2.2434 seconds.
[19/05/2022 - 16:54:48]Thread 5 has finished the second part in 2.2456 seconds.
[19/05/2022 - 16:54:48]Thread 2 has finished the second part in 2.2481 seconds.
[19/05/2022 - 16:54:48]Thread 7 has finished the second part in 2.2507 seconds.
[19/05/2022 - 16:54:48]Thread 6 has finished the second part in 2.2539 seconds.
[19/05/2022 - 16:54:48]Thread 4 has finished the second part in 2.2208 seconds.
[19/05/2022 - 16:54:48]The process has written the output file. The total time spent is 2.277 seconds.

```



```
abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 8
[19/05/2022 - 16:54:50]Two matrices of size 64x64 have been read. The number of thread is 8
[19/05/2022 - 16:54:50]Thread 0 has reached the rendezvous point in 0.0004 seconds.
[19/05/2022 - 16:54:50]Thread 2 has reached the rendezvous point in 0.0010 seconds.
[19/05/2022 - 16:54:50]Thread 1 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:54:50]Thread 3 has reached the rendezvous point in 0.0016 seconds.
[19/05/2022 - 16:54:50]Thread 4 has reached the rendezvous point in 0.0016 seconds.
[19/05/2022 - 16:54:50]Thread 7 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:54:50]Thread 5 has reached the rendezvous point in 0.0010 seconds.
[19/05/2022 - 16:54:50]Thread 6 has reached the rendezvous point in 0.0014 seconds.
[19/05/2022 - 16:54:50]Thread 6 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 0 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 2 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 1 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 3 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 4 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 7 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 5 is advancing to the second part
[19/05/2022 - 16:54:50]Thread 0 has finished the second part in 2.9918 seconds.
[19/05/2022 - 16:54:50]Thread 1 has finished the second part in 3.0509 seconds.
[19/05/2022 - 16:54:50]Thread 7 has finished the second part in 3.1469 seconds.
[19/05/2022 - 16:54:50]Thread 2 has finished the second part in 3.1477 seconds.
[19/05/2022 - 16:54:50]Thread 5 has finished the second part in 3.1485 seconds.
[19/05/2022 - 16:54:50]Thread 3 has finished the second part in 3.1504 seconds.
[19/05/2022 - 16:54:50]Thread 4 has finished the second part in 3.1523 seconds.
[19/05/2022 - 16:54:50]Thread 6 has finished the second part in 3.1555 seconds.
[19/05/2022 - 16:54:50]The process has written the output file. The total time spent is 3.172 seconds.
```

```
abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 8
[19/05/2022 - 16:54:52]Two matrices of size 64x64 have been read. The number of thread is 8
[19/05/2022 - 16:54:52]Thread 5 has reached the rendezvous point in 0.0002 seconds.
[19/05/2022 - 16:54:52]Thread 0 has reached the rendezvous point in 0.0007 seconds.
[19/05/2022 - 16:54:52]Thread 2 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:54:52]Thread 6 has reached the rendezvous point in 0.0022 seconds.
[19/05/2022 - 16:54:52]Thread 3 has reached the rendezvous point in 0.0016 seconds.
[19/05/2022 - 16:54:52]Thread 4 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:54:52]Thread 1 has reached the rendezvous point in 0.0016 seconds.
[19/05/2022 - 16:54:52]Thread 7 has reached the rendezvous point in 0.0020 seconds.
[19/05/2022 - 16:54:52]Thread 7 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 5 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 0 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 2 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 3 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 4 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 1 is advancing to the second part
[19/05/2022 - 16:54:52]Thread 6 is advancing to the second part
[19/05/2022 - 16:54:53]Thread 0 has finished the second part in 2.0450 seconds.
[19/05/2022 - 16:54:53]Thread 1 has finished the second part in 2.2690 seconds.
[19/05/2022 - 16:54:53]Thread 3 has finished the second part in 2.2702 seconds.
[19/05/2022 - 16:54:53]Thread 5 has finished the second part in 2.2920 seconds.
[19/05/2022 - 16:54:53]Thread 7 has finished the second part in 2.2947 seconds.
[19/05/2022 - 16:54:53]Thread 4 has finished the second part in 2.2975 seconds.
[19/05/2022 - 16:54:53]Thread 6 has finished the second part in 2.2905 seconds.
[19/05/2022 - 16:54:53]Thread 2 has finished the second part in 2.3068 seconds.
[19/05/2022 - 16:54:53]The process has written the output file. The total time spent is 2.324 seconds.
```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 8
[19/05/2022 - 16:54:54]Two matrices of size 64x64 have been read. The number of thread is 8
[19/05/2022 - 16:54:54]Thread 0 has reached the rendezvous point in 0.0009 seconds.
[19/05/2022 - 16:54:54]Thread 5 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:54:54]Thread 1 has reached the rendezvous point in 0.0011 seconds.
[19/05/2022 - 16:54:54]Thread 6 has reached the rendezvous point in 0.0022 seconds.
[19/05/2022 - 16:54:54]Thread 7 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:54:54]Thread 3 has reached the rendezvous point in 0.0020 seconds.
[19/05/2022 - 16:54:54]Thread 2 has reached the rendezvous point in 0.0020 seconds.
[19/05/2022 - 16:54:54]Thread 4 has reached the rendezvous point in 0.0016 seconds.
[19/05/2022 - 16:54:54]Thread 4 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 0 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 5 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 6 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 3 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 1 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 7 is advancing to the second part
[19/05/2022 - 16:54:54]Thread 2 is advancing to the second part
[19/05/2022 - 16:54:55]Thread 0 has finished the second part in 2.1533 seconds.
[19/05/2022 - 16:54:55]Thread 1 has finished the second part in 2.2395 seconds.
[19/05/2022 - 16:54:55]Thread 6 has finished the second part in 2.3378 seconds.
[19/05/2022 - 16:54:55]Thread 3 has finished the second part in 2.3396 seconds.
[19/05/2022 - 16:54:55]Thread 4 has finished the second part in 2.3420 seconds.
[19/05/2022 - 16:54:55]Thread 5 has finished the second part in 2.3453 seconds.
[19/05/2022 - 16:54:55]Thread 7 has finished the second part in 2.3517 seconds.
[19/05/2022 - 16:54:55]Thread 2 has finished the second part in 2.3371 seconds.
[19/05/2022 - 16:54:55]The process has written the output file. The total time spent is 2.375 seconds.

```

```

abdcelik@abdcelik:~/Desktop/HW5$ ./hw5 -i in1 -j in2 -o out.csv -n 6 -m 8
[19/05/2022 - 16:54:57]Two matrices of size 64x64 have been read. The number of thread is 8
[19/05/2022 - 16:54:57]Thread 0 has reached the rendezvous point in 0.0006 seconds.
[19/05/2022 - 16:54:57]Thread 1 has reached the rendezvous point in 0.0009 seconds.
[19/05/2022 - 16:54:57]Thread 3 has reached the rendezvous point in 0.0021 seconds.
[19/05/2022 - 16:54:57]Thread 4 has reached the rendezvous point in 0.0017 seconds.
[19/05/2022 - 16:54:57]Thread 2 has reached the rendezvous point in 0.0021 seconds.
[19/05/2022 - 16:54:57]Thread 7 has reached the rendezvous point in 0.0013 seconds.
[19/05/2022 - 16:54:57]Thread 5 has reached the rendezvous point in 0.0019 seconds.
[19/05/2022 - 16:54:57]Thread 6 has reached the rendezvous point in 0.0023 seconds.
[19/05/2022 - 16:54:57]Thread 6 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 0 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 1 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 3 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 2 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 4 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 7 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 5 is advancing to the second part
[19/05/2022 - 16:54:57]Thread 0 has finished the second part in 2.2284 seconds.
[19/05/2022 - 16:54:57]Thread 1 has finished the second part in 2.2885 seconds.
[19/05/2022 - 16:54:57]Thread 2 has finished the second part in 2.3129 seconds.
[19/05/2022 - 16:54:57]Thread 3 has finished the second part in 2.3331 seconds.
[19/05/2022 - 16:54:57]Thread 7 has finished the second part in 2.3334 seconds.
[19/05/2022 - 16:54:57]Thread 6 has finished the second part in 2.3381 seconds.
[19/05/2022 - 16:54:57]Thread 4 has finished the second part in 2.3482 seconds.
[19/05/2022 - 16:54:57]Thread 5 has finished the second part in 2.3194 seconds.
[19/05/2022 - 16:54:57]The process has written the output file. The total time spent is 2.369 seconds.

```

- As can be seen from the results, the threads did not run in parallel. This is because my computer is running on a single core. Since there is a thread switch, the total time increased as the number of threads increased.