

Homework 5

☰ Student Name	Muhammed Oğuz
☰ Student Number	1801042634

Problem Solution Approach

This problem aims to use Mutexes and condition variables. Other problems related to other homeworks and I solved most of the problems on previous homework.

My Approach

There was a main problem for this homework. It was the being sync and waiting till all thread to finish to continue to second part. For solving that, I used a mutex and a condition variable.

Other challenge was the m and n variables are not fully divisible on some cases.

If m is already of 2^n , There is no problem.

But if not divisible exactly to 2^n . It should be handled.

So I handle this problem with detecting remaining columns and I calculated remaining columns to last thread.

If user enters $n=6$ ($2^n = 64$) and $m = 14$, Each thread will calculate 4 columns and last thread will calculated 8 columns.

Validation for homework

Threads working correctly. This screenshot shows that threads working without any problem.

```

> ./hw5 -i data/test1 -j data/test2 -o output -n 6 -m 8
Mon May 23 00:38:01 2022: Two matrices of size 64x64 have been read. The number of threads is 8
Mon May 23 00:38:01 2022: Thread 0 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 1 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 2 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 0 has reached the rendezvous point in 0.00046 seconds
Mon May 23 00:38:01 2022: Thread 1 has reached the rendezvous point in 0.00064 seconds
Mon May 23 00:38:01 2022: Thread 6 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 7 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 4 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 7 has reached the rendezvous point in 0.00032 seconds
Mon May 23 00:38:01 2022: Thread 6 has reached the rendezvous point in 0.00302 seconds
Mon May 23 00:38:01 2022: Thread 4 has reached the rendezvous point in 0.00308 seconds
Mon May 23 00:38:01 2022: Thread 5 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 2 has reached the rendezvous point in 0.00083 seconds
Mon May 23 00:38:01 2022: Thread 3 has started. Will handle 8 columns
Mon May 23 00:38:01 2022: Thread 5 has reached the rendezvous point in 0.00328 seconds
Mon May 23 00:38:01 2022: Thread 3 has reached the rendezvous point in 0.00362 seconds
Mon May 23 00:38:01 2022: Thread 3 advancing to the second part
Mon May 23 00:38:01 2022: Thread 0 advancing to the second part
Mon May 23 00:38:01 2022: Thread 6 advancing to the second part
Mon May 23 00:38:01 2022: Thread 4 advancing to the second part
: Thread 5 advancing to the second part
Mon May 23 00:38:01 2022: Thread 1 advancing to the second part
Mon May 23 00:38:01 2022: Thread 2 advancing to the second part
Mon May 23 00:38:01 2022: Thread 7 advancing to the second part

```



Note: Notice that, remarked prints are commented in on last code.

Running Results

```

> ./hw5 -i data/test1 -j data/test2 -o output -n 6 -m 14
Mon May 23 00:39:16 2022: Can not divide to equal parts of the work with given n and m values. Last Thread will do the rest
Mon May 23 00:39:16 2022: Last Thread will do 8
Mon May 23 00:39:16 2022: Two matrices of size 64x64 have been read. The number of threads is 14
Mon May 23 00:39:16 2022: Thread 0 has reached the rendezvous point in 0.00017 seconds
Mon May 23 00:39:16 2022: Thread 1 has reached the rendezvous point in 0.00030 seconds
Mon May 23 00:39:16 2022: Thread 2 has reached the rendezvous point in 0.00023 seconds
Mon May 23 00:39:16 2022: Thread 3 has reached the rendezvous point in 0.00022 seconds
Mon May 23 00:39:16 2022: Thread 4 has reached the rendezvous point in 0.00026 seconds
Mon May 23 00:39:16 2022: Thread 5 has reached the rendezvous point in 0.00035 seconds
Mon May 23 00:39:16 2022: Thread 10 has reached the rendezvous point in 0.00022 seconds
Mon May 23 00:39:16 2022: Thread 7 has reached the rendezvous point in 0.00022 seconds
Mon May 23 00:39:16 2022: Thread 6 has reached the rendezvous point in 0.00038 seconds
Mon May 23 00:39:16 2022: Thread 9 has reached the rendezvous point in 0.00030 seconds
Mon May 23 00:39:16 2022: Thread 8 has reached the rendezvous point in 0.00039 seconds
Mon May 23 00:39:16 2022: Thread 12 has reached the rendezvous point in 0.00029 seconds
Mon May 23 00:39:16 2022: Thread 11 has reached the rendezvous point in 0.00053 seconds
Mon May 23 00:39:16 2022: Thread 13 has reached the rendezvous point in 0.00051 seconds
Mon May 23 00:39:16 2022: Thread 3 advancing to the second part
Mon May 23 00:39:16 2022: Thread 1 advancing to the second part
Mon May 23 00:39:16 2022: Thread 6 advancing to the second part
Mon May 23 00:39:16 2022: Thread 9 advancing to the second part

```

```
..gramming/HW05
Mon May 23 00:39:16 2022: Thread 12 advancing to the second part
Mon May 23 00:39:16 2022: Thread 0 advancing to the second part
Mon May 23 00:39:16 2022: Thread 2 advancing to the second part
Mon May 23 00:39:16 2022: Thread 13 advancing to the second part
Mon May 23 00:39:16 2022: Thread 4 advancing to the second part
Mon May 23 00:39:16 2022: Thread 10 advancing to the second part
Mon May 23 00:39:16 2022: Thread 11 advancing to the second part
Mon May 23 00:39:16 2022: Thread 7 advancing to the second part
Mon May 23 00:39:16 2022: Thread 8 advancing to the second part
Mon May 23 00:39:16 2022: Thread 11 has has finished the second part in 1.243 seconds.
Mon May 23 00:39:16 2022: Thread 9 has has finished the second part in 1.389 seconds.
Mon May 23 00:39:16 2022: Thread 10 has has finished the second part in 1.361 seconds.
Mon May 23 00:39:16 2022: Thread 0 has has finished the second part in 1.418 seconds.
Mon May 23 00:39:16 2022: Thread 1 has has finished the second part in 1.464 seconds.
Mon May 23 00:39:16 2022: Thread 2 has has finished the second part in 1.449 seconds.
Mon May 23 00:39:16 2022: Thread 4 has has finished the second part in 1.414 seconds.
Mon May 23 00:39:16 2022: Thread 8 has has finished the second part in 1.400 seconds.
Mon May 23 00:39:16 2022: Thread 7 has has finished the second part in 1.444 seconds.
Mon May 23 00:39:16 2022: Thread 12 has has finished the second part in 1.538 seconds.
Mon May 23 00:39:16 2022: Thread 3 has has finished the second part in 1.516 seconds.
Mon May 23 00:39:16 2022: Thread 5 has has finished the second part in 1.566 seconds.
Mon May 23 00:39:16 2022: Thread 6 has has finished the second part in 1.591 seconds.
Mon May 23 00:39:16 2022: Thread 13 has has finished the second part in 1.613 seconds.
Mon May 23 00:39:16 2022: The process has written the output file. The total time spent is 1.693 second
Mon May 23 00:39:16 2022: Program finished
~/projects/GTU-University-Assignments/CSE344 - Systems Programming/HW05 on P master 18
```

Leak results

After running `make memory`, `make_zombies` and `make valgrind`, there is no un freed or zombie or unlinked shared mem or unfreed semaphore or not destroyed mutex or condition variable.



Notice that, Since I use static initialization, There is no need to use `pthread_destroy` for my mutexes.

Zombie result

```
> make zombies
ps aux | awk '"[Zz]" ~ $8 { printf("%s, PID = %d\n", $8, $2); }'
~/projects/GTU-University-Assignments/CSE344 - Systems Programming/HW05
```

Shared Mem Result

```

> make memory
tips
----- Message Queues -----
key      msqid      owner      perms      used-bytes      messages

----- Shared Memory Segments -----
key      shmid      owner      perms      bytes      nattch      status

----- Semaphore Arrays -----
key      semid      owner      perms      nsems

ls /dev/shm -a
..
~/projects/GTU-University-Assignments/CSE344 - Systems Programming/HW05 on master 18

```

Valgrind Result

```

> make valgrind
valgrind --leak-check=full --show-leak-kinds=all ./hw5 -i data/test1 -j data/test2 -o output -n 4 -m 2
=23123= Memcheck, a memory error detector
=23123= Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
=23123= Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
=23123= Command: ./hw5 -i data/test1 -j data/test2 -o output -n 4 -m 2
=23123=
Mon May 23 00:42:12 2022: Two matrices of size 16x16 have been read. The number of threads is 2
Mon May 23 00:42:13 2022: Thread 1 has reached the rendezvous point in 0.00127 seconds
Mon May 23 00:42:13 2022: Thread 0 has reached the rendezvous point in 0.00014 seconds
Mon May 23 00:42:13 2022: Thread 1 advancing to the second part
Mon May 23 00:42:13 2022: Thread 1 has has finished the second part in 0.102 seconds.
Mon May 23 00:42:13 2022: Thread 0 advancing to the second part
Mon May 23 00:42:13 2022: Thread 0 has has finished the second part in 0.096 seconds.
Mon May 23 00:42:13 2022: The process has written the output file. The total time spent is 0.370 seconds
Mon May 23 00:42:13 2022: Program finished
=23123=
=23123= HEAP SUMMARY:
=23123=   in use at exit: 0 bytes in 0 blocks
=23123=   total heap usage: 102 allocs, 102 frees, 25,148 bytes allocated
=23123=
=23123= All heap blocks were freed -- no leaks are possible
=23123=
=23123= For lists of detected and suppressed errors, rerun with: -s
=23123= ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
~/projects/GTU-University-Assignments/CSE344 - Systems Programming/HW05 on master 18
>

```

Missing Parts of Homework

I carefully checked my homework and it seems everything works fine.