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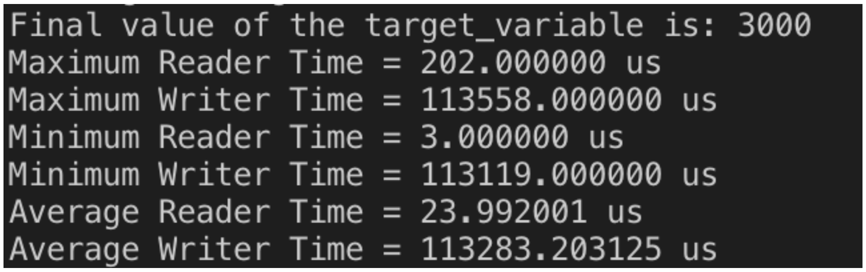
ECSE427 – Assignment 2

Starvation is the indefinite postponement of a process where some processes are making progress towards completion but some other processes are locked out of resource(s).

- Starvation can be observed when the reader and writer times are not matched. Below in the figure we can see a screen-shot of A2Q1.c. There are 10 writers and 500 readers:



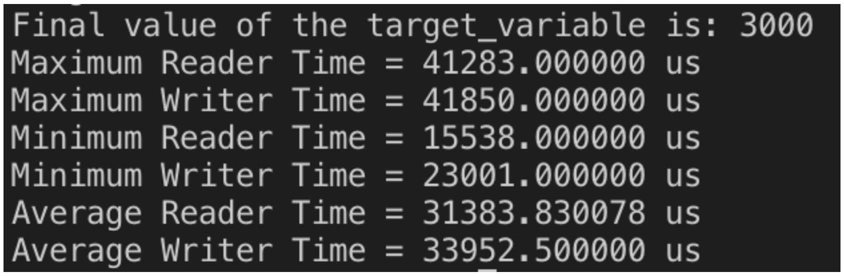
```
Final value of the target_variable is: 3000
Maximum Reader Time = 202.000000 us
Maximum Writer Time = 113558.000000 us
Minimum Reader Time = 3.000000 us
Minimum Writer Time = 113119.000000 us
Average Reader Time = 23.992001 us
Average Writer Time = 113283.203125 us
```

Figure 1 - Output of A2Q1.c

- The writer average time is significantly greater than the reader average time thus we can conclude the writer thread is **starving for resources**.
- The pseudo-code for Assignment 2 dictates that first reader waits for all writers to complete. While any number of readers are allowed to access the resource, only one writer is allowed to enter the critical section of the program. Writer must wait for all readers to complete, which is why the starvation is present in this code.

A possible solution for this problem is when the writer indicates intention to access the critical section, blocking new readers from accessing the resource. Reader must lock two mutexes to enter the working area. However, using this solution increases the total time processed during execution.

- The output of the A2Q3.c with the same number of readers and writers can be seen below. Notice the starvation problem is gone; the average reader and writer times are similar relative to the output of A2Q1.c. The pseudo-code for the solution can also be seen in the next page.



```
Final value of the target_variable is: 3000
Maximum Reader Time = 41283.000000 us
Maximum Writer Time = 41850.000000 us
Minimum Reader Time = 15538.000000 us
Minimum Writer Time = 23001.000000 us
Average Reader Time = 31383.830078 us
Average Writer Time = 33952.500000 us
```

Figure 2 - Output of A2Q3.c

Starvation Solution Pseudo-Code:

Global Variables:

```
semaphore wrt_mutex = 1;
semaphore in_mutex = 1;
semaphore mutex = 1;
int  read_count = 0;
```

Reader Thread:

```
do {
     wait(in_mutex);
     wait(mutex);
     read_count++;
     if(read_count == 1)
          wait(wrt_mutex);
     signal(mutex);
     signal(in_mutex);
          ...
     //Read is performed
          ...
     wait(mutex);
     read_count--;
     if(read_count == 0)
          signal(wrt_mutex);
     signal(mutex);
     } while(true);
```

Writer Thread:

```
do {
     wait(in_mutex);
     wait(wrt_mutex);
          ...
     //Write is performed
          ...
     signal(wrt_mutex);
     signal(in_mutex);
     } while(true);
```