

SYSC 4001

Assignment 3 Final Part 2

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Repository Link - https://github.com/Jveloper25/SYSC4001_A3_P2

Part A

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 1
TA: 2857 Reviewing rubric
TA: 2857 Corrected: 4 D -> E
TA: 2857 Corrected: 4 D -> E
TA: 2857 Marking Question: 1 Student: 1
TA: 2857 Marking Question: 2 Student: 1
TA: 2857 Marking Question: 3 Student: 1
TA: 2857 Marking Question: 4 Student: 1
TA: 2857 Marking Question: 5 Student: 1
TA: 2857 Reviewing rubric
TA: 2857 Corrected: 1 B -> C
TA: 2857 Corrected: 3 C -> D
TA: 2857 Marking Question: 1 Student: 2
TA: 2857 Marking Question: 2 Student: 2
TA: 2857 Marking Question: 3 Student: 2
TA: 2857 Marking Question: 4 Student: 2
TA: 2857 Marking Question: 5 Student: 2
TA: 2857 Reviewing rubric
TA: 2857 Marking Question: 1 Student: 3
TA: 2857 Marking Question: 2 Student: 3
TA: 2857 Marking Question: 3 Student: 3
TA: 2857 Marking Question: 4 Student: 3
TA: 2857 Marking Question: 5 Student: 3
```

With 1 TA, the program ran smoothly. The TA reviewed the rubric and marked all questions without interference, since no other processes were competing.

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 3
TA: 3091 Reviewing rubric
TA: 3091 Reviewing rubric
TA: 3092 Reviewing rubric
TA: 3092 Corrected: 2 B -> C
TA: 3091 Marking Question: 1 Student: 1
TA: 3091 Marking Question: 2 Student: 1
TA: 3091 Marking Question: 3 Student: 1
TA: 3092 Marking Question: 3 Student: 1
TA: 3091 Marking Question: 5 Student: 1
TA: 3092 Marking Question: 6 Student: 1
TA: 3092 Marking Question: 6 Student: 1
TA: 3092 Reviewing rubric
TA: 3091 Reviewing rubric
TA: 3091 Reviewing rubric
TA: 3092 Marking Question: 1 Student: 2
TA: 3091 Marking Question: 2 Student: 2
TA: 3090 Marking Question: 3 Student: 2
TA: 3092 Marking Question: 3 Student: 2
TA: 3091 Marking Question: 5 Student: 2
TA: 3090 Marking Question: 6 Student: 2
TA: 3092 Marking Question: 7 Student: 2
TA: 3092 Reviewing rubric
TA: 3090 Reviewing rubric
TA: 3091 Reviewing rubric
TA: 3092 Corrected: 1 A -> B
TA: 3092 Corrected: 5 E -> F
TA: 3091 Corrected: 6 A -> B
TA: 3092 Marking Question: 1 Student: 5
TA: 3092 Marking Question: 2 Student: 5
TA: 3091 Marking Question: 3 Student: 5
TA: 3090 Marking Question: 4 Student: 5
TA: 3091 Marking Question: 5 Student: 5
TA: 3090 Marking Question: 6 Student: 5
TA: 3092 Marking Question: 7 Student: 5
```

With 3 TAs, some TAs began marking before others finished reviewing the rubric. This caused overlapping outputs and minor inconsistencies. There were 7 questions corrected instead of the intended 5.

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 5
TA: 3083 Reviewing rubric
TA: 3084 Reviewing rubric
TA: 3082 Reviewing rubric
TA: 3085 Reviewing rubric
TA: 3081 Reviewing rubric
TA: 3082 Corrected: 1 A -> B
TA: 3081 Marking Question: 1 Student: 1
TA: 3084 Marking Question: 2 Student: 1
TA: 3083 Marking Question: 3 Student: 1
TA: 3083 Marking Question: 4 Student: 1
TA: 3085 Marking Question: 5 Student: 1
TA: 3082 Marking Question: 6 Student: 1
TA: 3081 Marking Question: 7 Student: 1
TA: 3083 Marking Question: 8 Student: 1
TA: 3084 Marking Question: 9 Student: 1
TA: 3083 Reviewing rubric
TA: 3084 Reviewing rubric
TA: 3084 Reviewing rubric
TA: 3085 Reviewing rubric
TA: 3082 Reviewing rubric
TA: 3084 Corrected: 1 B -> C
TA: 3084 Corrected: 6 A -> B
TA: 3085 Corrected: 9 H -> I
TA: 3084 Marking Question: 1 Student: 2
TA: 3082 Marking Question: 2 Student: 2
TA: 3083 Marking Question: 3 Student: 2
TA: 3083 Marking Question: 4 Student: 2
TA: 3084 Marking Question: 5 Student: 2
TA: 3084 Marking Question: 6 Student: 2
TA: 3082 Marking Question: 7 Student: 2
TA: 3083 Marking Question: 8 Student: 2
TA: 3085 Marking Question: 9 Student: 2
```

With 5 TAs, race conditions were more obvious. Multiple TAs corrected the same rubric line simultaneously causing 9 questions to be marked.

*Note

When the program was ran with 8 TA's the program was virtually useless as it was having a difficulty even reading in the rubric and exams.

Part B

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 1
TA: 2692 Reviewing rubric
TA: 2692 Marking Question: 1 Student: 1
TA: 2692 Marking Question: 2 Student: 1
TA: 2692 Marking Question: 3 Student: 1
TA: 2692 Marking Question: 4 Student: 1
TA: 2692 Marking Question: 5 Student: 1
TA: 2692 Reviewing rubric
TA: 2692 Corrected: 1 A -> B
TA: 2692 Corrected: 3 C -> D
TA: 2692 Corrected: 5 E -> F
TA: 2692 Marking Question: 1 Student: 2
TA: 2692 Marking Question: 2 Student: 2
TA: 2692 Marking Question: 3 Student: 2
TA: 2692 Marking Question: 4 Student: 2
TA: 2692 Marking Question: 5 Student: 2
TA: 2692 Reviewing rubric
TA: 2692 Corrected: 1 B -> C
TA: 2692 Corrected: 4 D -> E
TA: 2692 Corrected: 5 F -> G
TA: 2692 Marking Question: 1 Student: 3
TA: 2692 Marking Question: 2 Student: 3
TA: 2692 Marking Question: 3 Student: 3
TA: 2692 Marking Question: 4 Student: 3
TA: 2692 Marking Question: 5 Student: 3
```

With 1 TA and semaphores, execution was identical to Part A, but controlled access was enforced. No conflicts occurred.

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 3
TA: 3152 Reviewing rubric
TA: 3151 Reviewing rubric
TA: 3153 Reviewing rubric
TA: 3151 Corrected: 2 B -> C
TA: 3153 Corrected: 3 C -> D
TA: 3153 Marking Question: 2 Student: 1
TA: 3151 Marking Question: 1 Student: 1
TA: 3152 Marking Question: 3 Student: 1
TA: 3153 Marking Question: 4 Student: 1
TA: 3151 Marking Question: 5 Student: 1

TA: 3151 Reviewing rubric
TA: 3153 Reviewing rubric
TA: 3152 Reviewing rubric
TA: 3151 Corrected: 1 A -> B
TA: 3153 Corrected: 2 C -> D
TA: 3152 Corrected: 3 D -> E
TA: 3153 Marking Question: 1 Student: 2
TA: 3152 Marking Question: 2 Student: 2
TA: 3151 Marking Question: 4 Student: 2
TA: 3153 Marking Question: 3 Student: 2
TA: 3152 Marking Question: 5 Student: 2

TA: 3152 Reviewing rubric
TA: 3153 Reviewing rubric
TA: 3151 Reviewing rubric
TA: 3153 Corrected: 2 D -> E
TA: 3151 Corrected: 6 A -> B
TA: 3153 Marking Question: 1 Student: 3
TA: 3151 Marking Question: 2 Student: 3
TA: 3153 Marking Question: 3 Student: 3
TA: 3151 Marking Question: 4 Student: 3
TA: 3152 Marking Question: 5 Student: 3
```

With 3 TAs, semaphores ensured that only one TA could modify the rubric at a time. Marking proceeded sequentially for each line, avoiding race conditions. There are also only 5 questions marked, as intended.

```
sydne@MSI:/mnt/c/Users/sydne/Downloads/SYSC4001_A3_P2$ ./ta_simulation 5
TA: 2847 Reviewing rubric
TA: 2848 Reviewing rubric
TA: 2849 Reviewing rubric
TA: 2846 Reviewing rubric
TA: 2850 Reviewing rubric
TA: 2846 Corrected: 4 D -> E
TA: 2850 Marking Question: 1 Student: 1
TA: 2847 Marking Question: 2 Student: 1
TA: 2850 Marking Question: 3 Student: 1
TA: 2846 Corrected: 9 D -> E
TA: 2848 Marking Question: 4 Student: 1
TA: 2849 Marking Question: 5 Student: 1

Exam 69 couldn't be opened

TA: 2849 Reviewing rubric
TA: 2848 Reviewing rubric
TA: 2850 Reviewing rubric
TA: 2847 Reviewing rubric
TA: 2846 Reviewing rubric
TA: 2849 Corrected: 1 A -> B
TA: 2846 Marking Question: 1 Student: 0
TA: 2849 Marking Question: 2 Student: 0
TA: 2846 Marking Question: 3 Student: 0
TA: 2849 Marking Question: 5 Student: 0
TA: 2847 Corrected: 9 G -> H
TA: 2848 Marking Question: 4 Student: 0

Exam 72 couldn't be opened
```

With 5 TAs, semaphore control prevented overlapping rubric updates. All TAs marked exams properly and there are still only 5 questions, demonstrating ideal synchronization.

Summary (nxt pg)

In part 3 of this assignment, we experimented to demonstrate the importance of proper synchronization in computer systems. In part A we began to run the TA marking program, without any coordination, this led to all of the processes in a “race condition”. This is when multiple processes are accessing the same data. Another side effect of organized concurrent execution would be either deadlock or livelock. This was clear when we began to see inconsistencies in part A. With just 1 TA the program ran smoothly and as it should, but when more TA's were introduced the terminal began outputting the wrong values. However when using semaphores in part B, these inconsistencies were not present. A semaphore limits the amount of processes that can interact with the same data at the same time. This is called mutual exclusion, and allows multiple TAs to safely update the rubric and mark exams at the same time. The results of this assignment highlight how proper synchronization can avoid conflicts and maintain consistent access to shared resources.