SYSC4001: Assignment 3 Part 2 Report

In this assignment, deadlock would mean two or more TA processes are all blocked forever on semaphores . For example, two or more TA processes are all blocked forever in sem_wait on semaphores such as rubric_sem, question_sem, or exam_sem, so that no TA can continue, no more questions are marked, no new exams are loaded, and the program never reaches the exam with student 9999.

Livelock would show if the TAs are still running and using CPU, but they keep repeating actions without making progress, so for example, endlessly re-checking something or repeatedly reloading the same exam. The exam marking are never completed and the program never terminates.

In all of my runs there was no deadlock and livelock, the program always progressed through the exams, eventually reached the student 9999, and terminated normally.

The code uses rubric_sem to ensure that only one TA at a time can modify the rubric and write back to rubric.txt, question_sem to make the “find a free question and claim it” step smoother and exam_sem to ensure that only one TA loads the next exam and updates student_id and current_exam_index. When remaining_questions reaches zero, exactly one TA loads the next exam, so all five questions for the current student are fully marked before the next student is introduced.

Although the printed order of messages from the TAs may sometimes appear mixed together due to concurrent execution, each TA still follows the correct sequence: reviewing all five lines of the rubric and making a decision on changing or keeping it the same, marking questions on the current exam with one TA marking a question exclusively, and, if it finishes the last question, loading the next exam under semaphore protection. Because the operating system schedules processes unpredictably, the order of the messages may appear mixed, but it is only for the rubric-changing and marking actions within the same exam, so you know that the variation is caused entirely by the OS scheduler. The synchronization provided by the semaphores ensures that each TA completes its work, no resource is held forever, and all exams are processed in the correct logical order.