Exercise 1

Answer the following questions (be clear and precise):

1. What is safety? Give one concrete example of a safety violation.

2. What is liveness? Give a concrete example of a liveness violation.

3. Using the implementation in the slides, can a binary semaphore lead to a deadlock? Can it lead to starvation? Explain with the aid of an example.

4. Why do we need synchronization mechanisms in concurrent programs?

5. How exactly do monitors differ from semaphores?

6. How are monitors and message passing similar? And how are they different?

Exercise 2

\[ x := 1 \]

Thread 1 \( \rightarrow x := x + 5 \).

Thread 2 \( \rightarrow x := x \times 3 \).

Considering the previous code, give all possible values of \( x \) at the end of the execution of both threads with their corresponding execution traces.

Exercise 3

Implement a monitor using semaphores. Use pseudo-code and comment it.