Kohl Johnson

Mutex and Semaphore

06-15-2024

# Semaphore

Scenario: We have a parking garage with a capacity of 300,000 and 3 gates where cars may enter. Without a synchronization mechanism, our actual number of used parking spots is dramatically off along with our total revenue collected. A semaphore would work nicely here to coordinate not only access to our actual count for occupied parking spots, but also with our revenue count.

# Mutex

Scenario: We have a single phone booth and two individuals who each need to make 1 million phone calls. Without a synchronization mechanism, like the semaphore example, our count for the total phone calls made is dramatically lower than our target of 2 million. Using a mutex, we can ensure the phone booth can only be used by 1 person (thread) at a time and ensure we reach the targeted amount of phone calls.

# Semaphore vs. Mutex

Mutex: One advantage of a mutex is that it creates a barrier that prevents two threads from accessing the same resource at the same time (phone booth). Some disadvantages are that it can not be locked/unlocked by any context other than the one that acquired it, it typically results in busy waiting that wastes CPU cycles, and if a thread acquires a lock and either goes to sleep or fails to do a task, the other threads may get stuck further.

Semaphore: Some advantages include efficient allocation, controlling multiple processes, and improved performance. Semaphores allow us to allocate system resources more efficiently which in turn means memory can be used more efficiently. They also allow us to control multiple processes and allocate memory as needed. Lastly, Semaphore-based memory management improves performance and system responsiveness. Some disadvantages however are that it is prone to programming errors, can be expensive in terms of memory and CPU usage, and that lower priority processes can enter the critical region while high-priority ones are forced to wait.

# Backup Screencast Links

Part 1: <https://www.loom.com/share/472e479fce174f67aa47102793e7355b?sid=12b338cd-9200-492a-9ccf-944f060ba121>

Part 2: <https://www.loom.com/share/985276d5fd134ea38185a6d94719f2e9?sid=e52c14ba-b921-4a82-87e2-065bca097cbc>