Implementing locking (Semaphores, etc.) requires hardware support

- CPU Test and Set Lock instruction (TSL)

  - Set a value in memory to 1 and return its old value in one atomic operation
  - Initialize the memory to 0 (unlocked state)
  - If TSL returns 0, it was unlocked and it is now locked so the process can proceed into the critical region
  - If TSL returns 1, it was already locked so the process must wait

- XCHG operation

  - Exchange the value of a register with a memory value in an atomic operation

- Both of these require the process to have exclusive access to the memory bus

Mutex

- Like a binary semaphore
- Locked or unlocked
- Lock variable implemented with TSL or XCHG

Barriers (also called fences)

- Point of execution that all processes must reach together before they can all proceed
- When a process reaches a barrier, it blocks until all processes reach the barrier