## Another Synchronization Construct Semaphore

An abstract data type to provide mutual exclusion described by Dijkstra in the "THE multiprogramming system" in 1968

- → Semaphores are "integers" that support two operations:
  - Semaphore::P() decrement, block until semaphore is open a.k.a wait(), or sem\_wait(), or sema\_down()
  - Semaphore::V() increment, allow another thread to enter a.k.a signal(), or sem\_post(), or sema\_up()
- ✓ Semaphore safety property the semaphore value is always greater than or equal to 0

## Blocking mechanism

Associated with each semaphore is a queue of waiting threads

- → When P () is called by a thread:
  - · If semaphore is open, thread continue
  - · If semaphore is closed, thread blocks on queue
- → Then V () opens the semaphore
  - · If a thread is waiting on the queue, the thread is unblocked
  - If no threads are waiting on the queue, the signal is remembered for the next thread