Final Review

Yang Wang

Content before Midterm

- Not required

Thread

- What is a thread?
- How is multi-threading different from multi-processing?
- pthread_create/pthread_join

Locks

- What does atomicity or synchronization mean?
- How to use locks to guarantee atomicity?
- Global lock vs fine-grained locks
- pthread_mutex_lock/unlock
- Build spinlocks with test_and_set or compare_and_swap
- Build locks with queues
- Use locks to protect data structures: counter, linked list, queue, and hashtable

Condition variable

- When do we need condition variables?
- Remember the rules
  - Use a lock with a condition variable
  - Always wait on some condition
  - Use while instead of if
  - Use broadcast and be careful of signal
- pthread_cond_wait and pthread_cond_signal/broadcast

Semaphore

- P() and V()
- How to implement a lock with semaphore?
- How to implement a condition variable with semaphore?

Classic problems

- Bounded buffer/producer-consumer
- Reader-writer lock
- The dining philosophers

Concurrency bugs

- Common bugs

- Deadlock: four conditions and how to prevent/avoid deadlock

I/O Device

- Polling vs Interrupts
- PIO vs DMA

- Device driver: what does it do?

Hard disks

- Seek, rotate, and transfer
  - Why is sequential I/O better?
- Disk scheduling: SSTF, SCAN (elevator), and C-SCAN
- RAID-0, RAID-1, RAID-5

File system

- Inode
- SimpleFS: direct pointer, indirect pointer, double indirect pointer, and triple indirect pointer
- FFS policies
- Crash Recovery: how can things go wrong?
  - Solution: Journaling
- LFS and data integrity not required

Security

- Password: how to store it?
- Hashing, symmetric encryption, and asymmetric encryption
  - How they work and when to use them?
- Buffer overflow: what can cause it and how to prevent it?
- Other materials are not required.

Useful ideas

- Locality: cache, TLB, FFS, ……
- Atomicity: system call, multi-threading, file system crash recovery
- Virtualization: virtual memory, file system
  - Key: indexing from a virtual address to a physical address.
- Mechanism and Policy
- ……

Go back to our earliest question

- When you run helloworld, what happens when you press return?