

- 1. Last time
 - 2. Midterm, logistics
 - 3. Midterm review, class overview
 - 4. Your questions
-

2. Logistics

- 75-minute exam
- closed book
- only exam PDF, answer sheet, new forum open
- You get one two-sided sheet of notes
- Need to send us selfies at the beginning/end:
id, notes sheet, screen, desk

3. Class overview (not comprehensive list, not guaranteed to be necessary or sufficient for exam)

Material

- readings
- labs
- HWs
- lectures/classes

Lectures/classes:

- OSes: what are they?
 - goals, purpose
- Processes:
 - process's view of memory, registers
 - stack frames
 - OS's view of processes
- System calls

- Process/OS control transfers
- Process birth: `fork()`/`exec()`
- Shell
- File descriptors
- Redirection, pipelines
- threads
- concurrency
 - hard to deal with! abstractions help (but not fully):
 - critical sections
 - mutexes
 - spinlocks
 - condition variables
 - monitors
 - lots of things can go wrong: safety problems, liveness problems, etc.
 - lack of sequential consistency makes the problem worse
- safety: build primitives that get help from HW
- liveness: deadlock
- tradeoffs
 - perf. vs. complexity
- "advice"

- software safety (Theorem 2.5)

- scheduling

- when scheduling happens, which metrics, costs

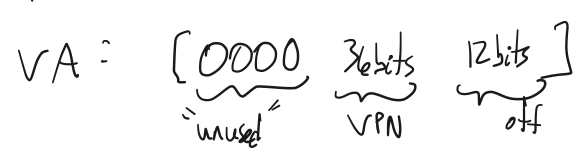
- specific disciplines

- lessons + conclusions

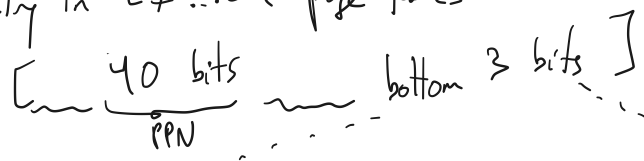
- virtual memory

- paging

- virt. mem on the x86-64

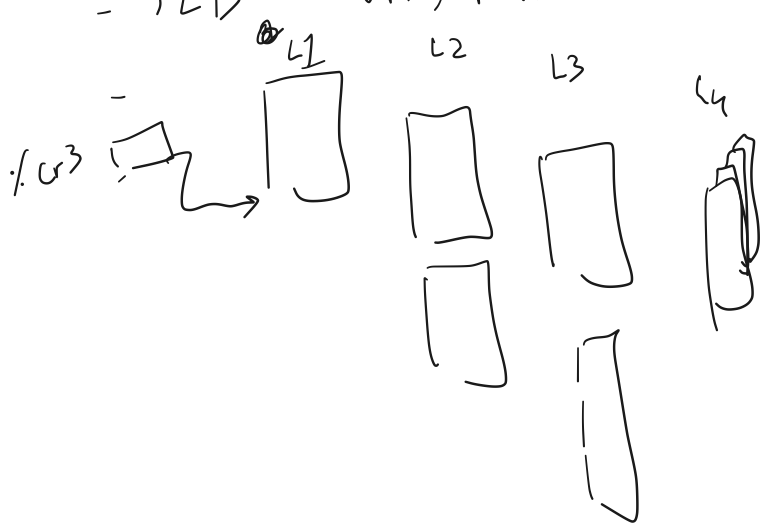


- entry in L1...L4 page tables:



- protection (user/kernel | R/w | present/not)

- TLB: <VPN, PPN>

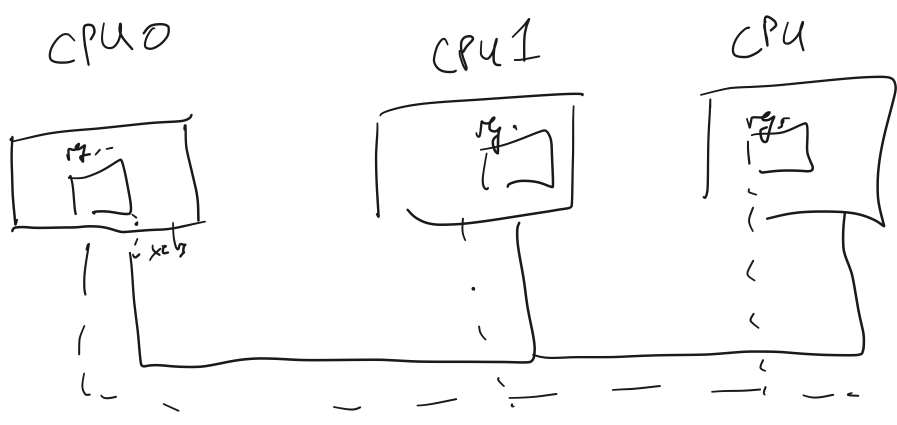
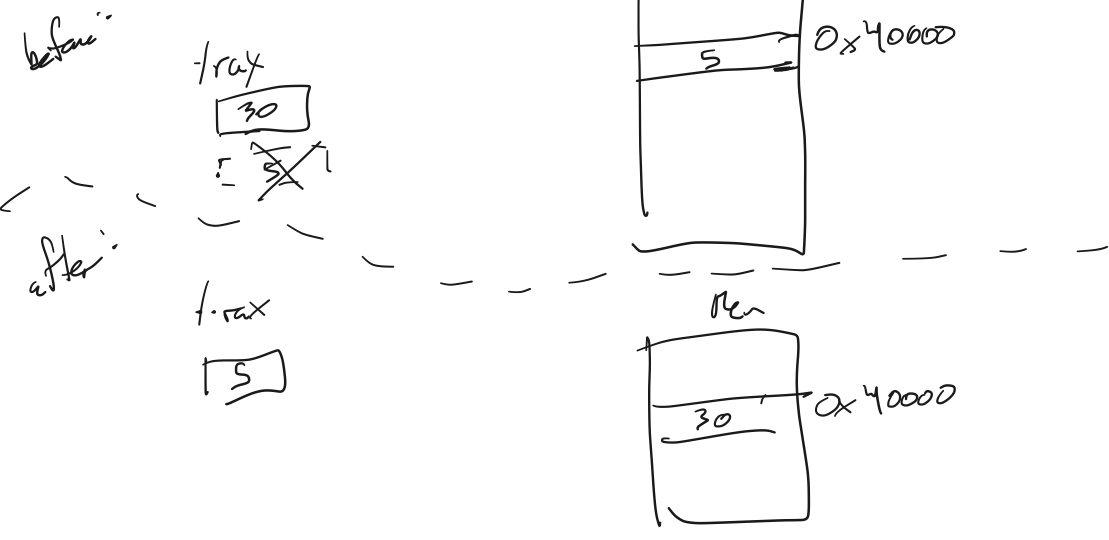


- page faults

- mechanics
- costs
- uses

- Page replacement policies (FIFO, LRU, CLOCK, etc)
- Thrashing

x chg / rax, 0x40000

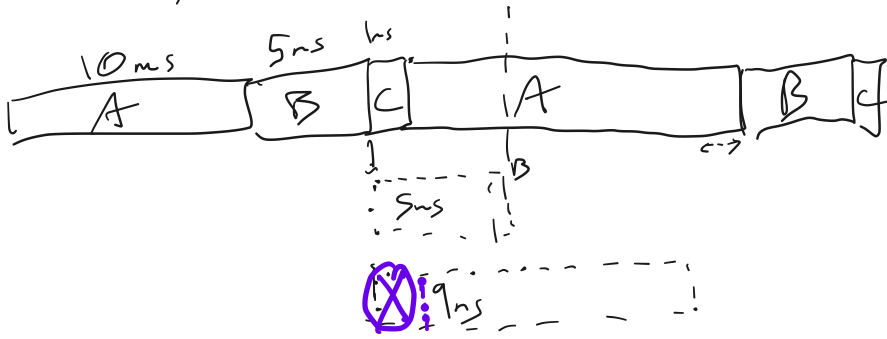


A, B, C

A: CPU-bound

B: 5ms of computation, disk: 5ms

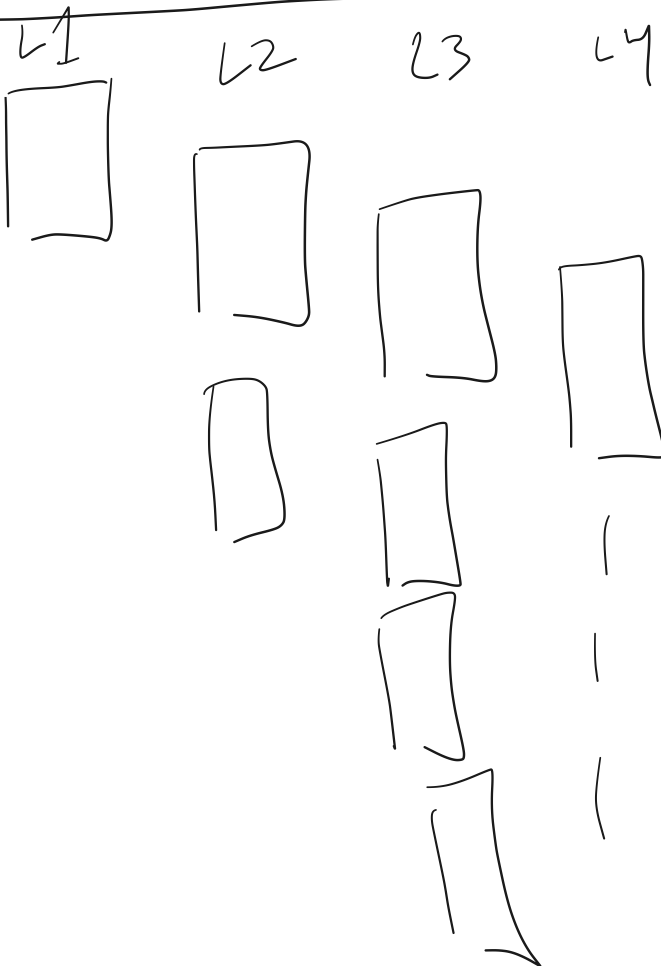
C: 1ms, sleeps for 1ms



$$A: \frac{10}{16} = \frac{5}{8} \quad 9$$

$$B: \frac{5}{16}$$

$$C: \frac{1}{16}$$



MMU:

✓

TLB miss

< VPN, PPN, perms >

store? R/O pg

⇒ pg fault

pg fault

- pg not present

→ disk

→ invalid

- perms: R/O, kernel-only, execute disabled

→ bring pg in

→ set pg table entry (including "Present" bit)

→ restart the process

↳ TLB miss

VPN	PPN	perms
36	40	

