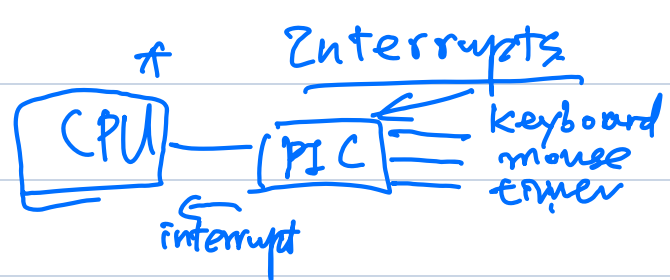
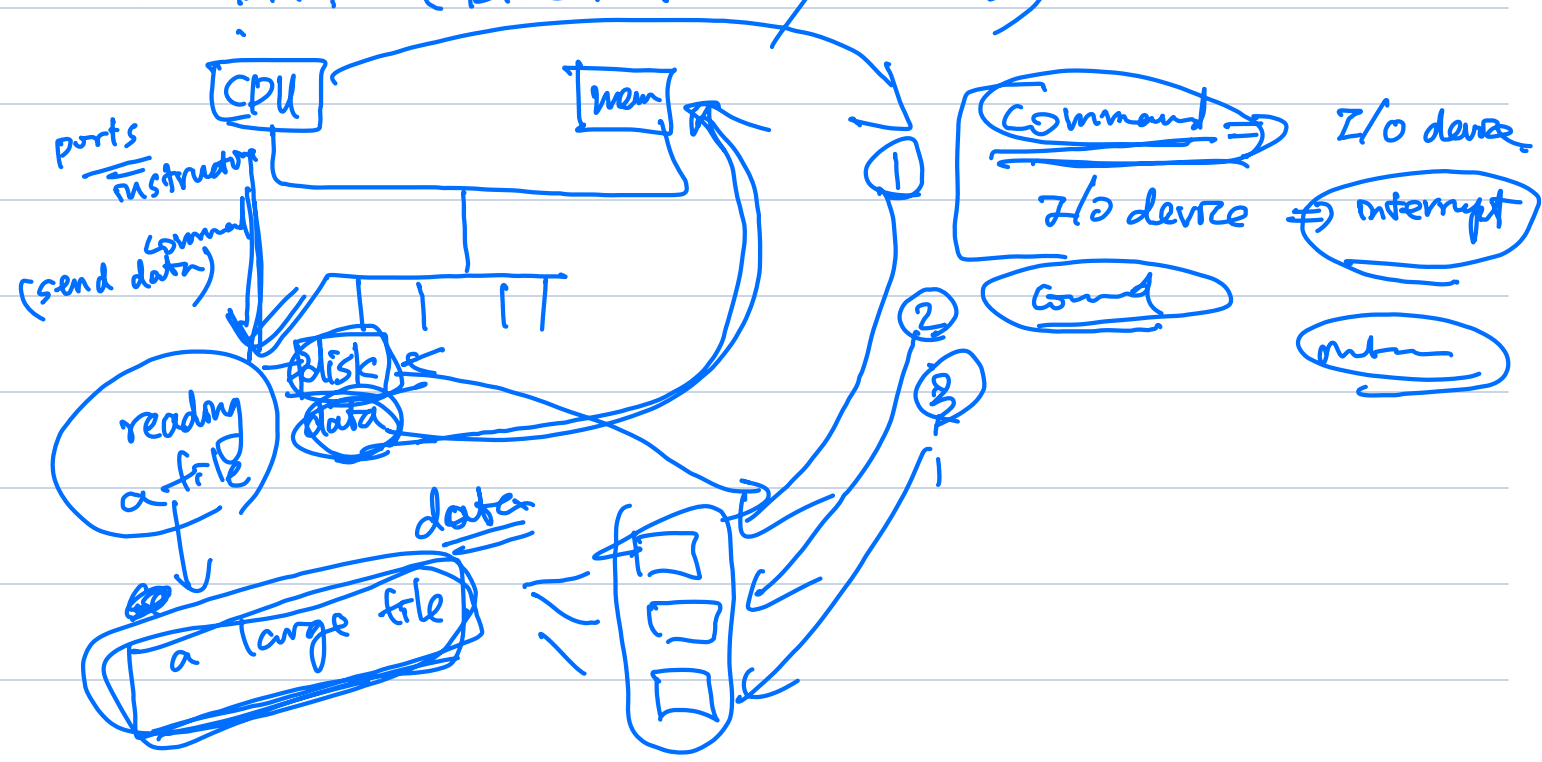


* memory-mapped I/O
ports I/O.

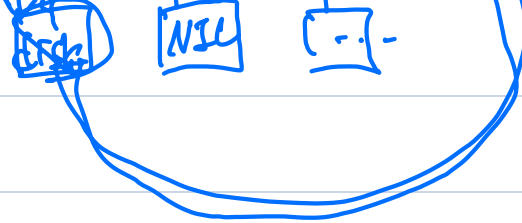


* DMA (Direct Memory Access)



DMA. (Direct Memory Access)





* Disk

* Hard drive (HDD) : mechanical parts

* Solid state (SSD) : non-mechanical.

- last longer

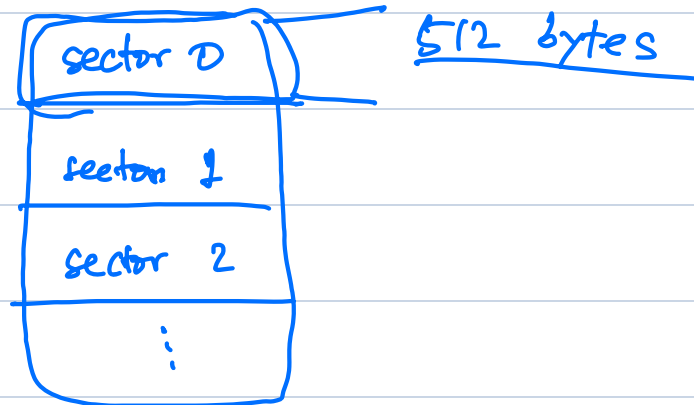
cheaper. slower

expensive faster

- shorter lifetime.

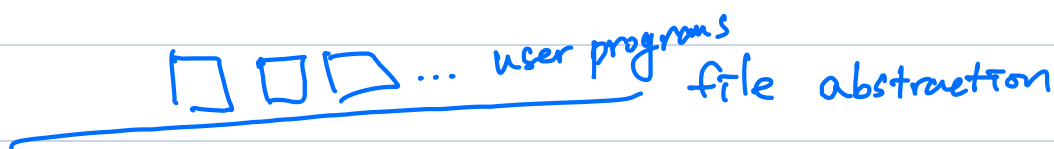
* Kernel uses an abstraction of a disk.

* sector



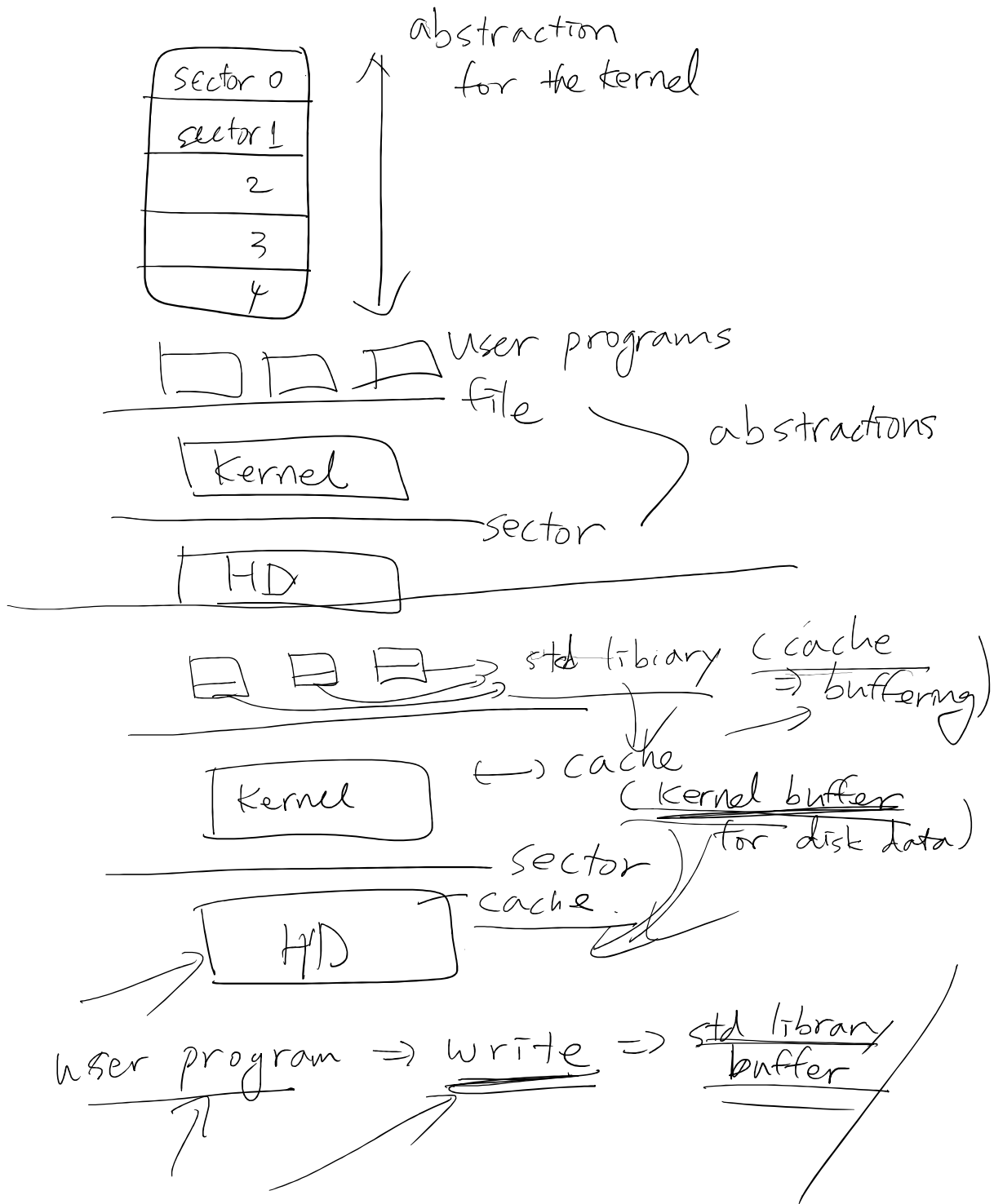
* User programs use an abstraction

* file



sector abstraction.



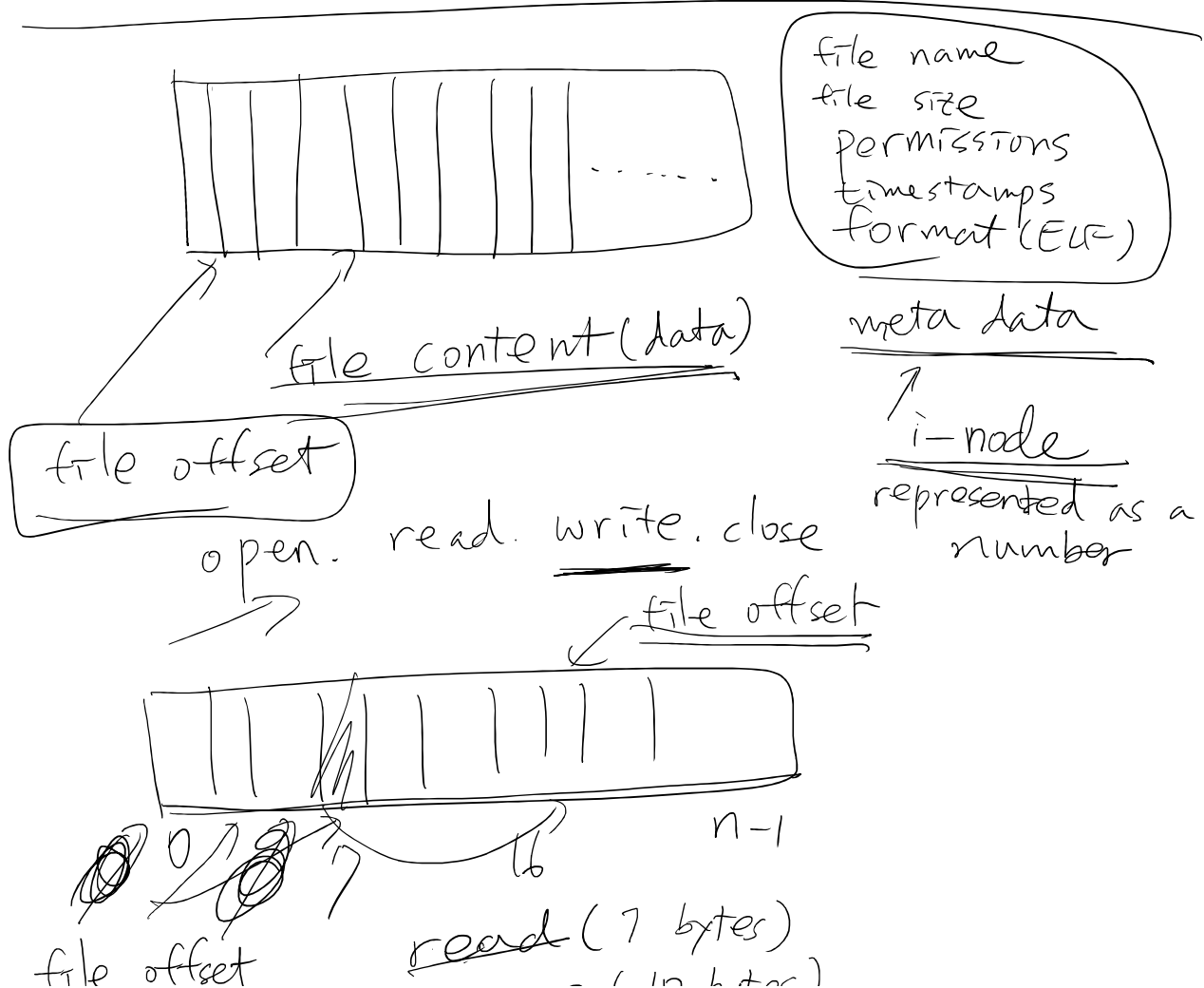
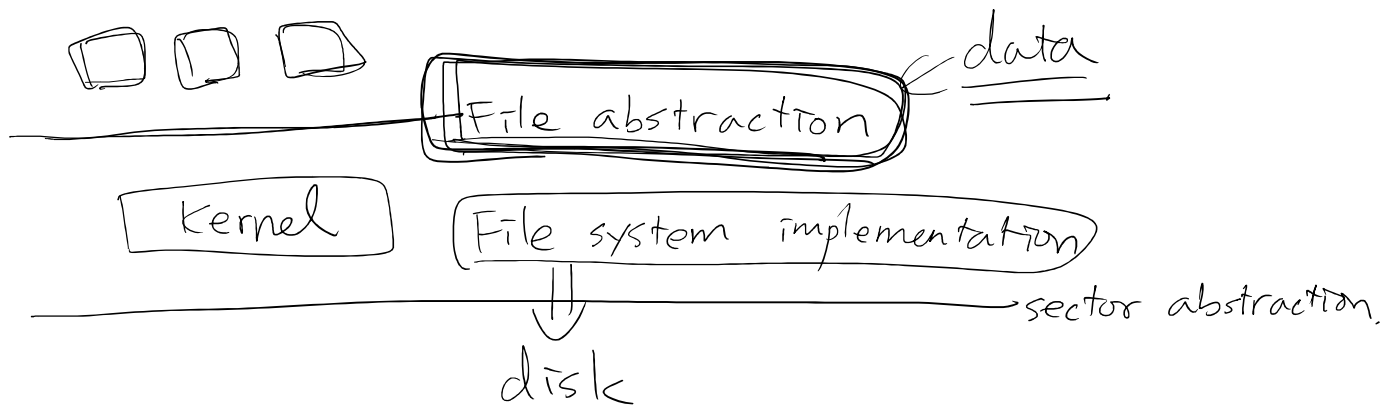
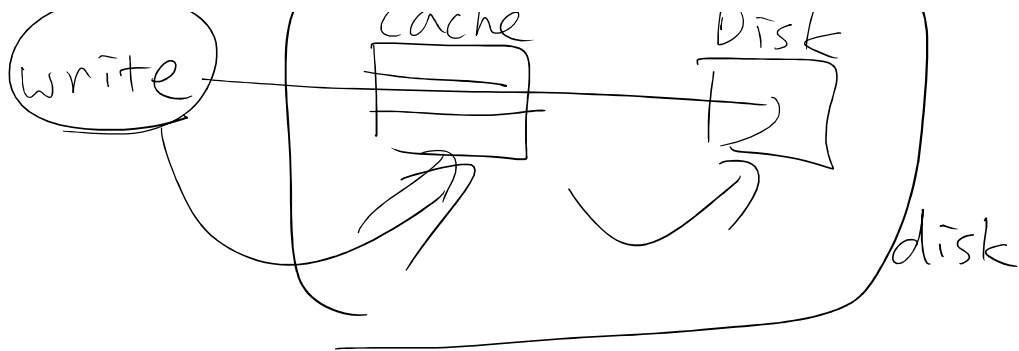


* ~~write-back~~ write-back : write to cache
 write-through : write to memory & cache

write

cache

Disk



file offset

read (7 bytes)

write (10 bytes)

lseek : move file offset.

Linux : everything is a file.

~~/dev~~ /dev / (serial)
 devices
 CPU info
 mem info

/dev / proc /
 process info

(process id
- running time,
- memory consumption)

/dev / serial

fd = open ("/dev/serial");
 write (fd, "string");

/dev / keyboard

read ()

network card (NIC)
 write / read.
