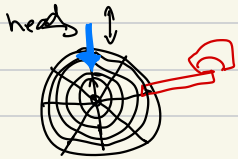
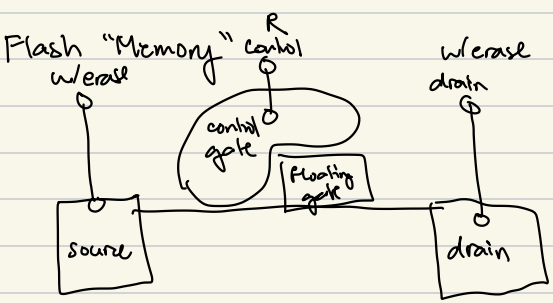
- tapes => cheap but slow
- magnetic disks
- flash memory
- NVM




- seek for next sector

- Disk Response Latency = queue time + access time
- LDR/STR
  - ↳ disk may be busy
  - ↳ at disk controller
  - ↳ IO bus controller
- delay is in milliseconds

Disk Bandwidth: Sequential v. Random
(throughput OR data transfer rate)
↳ sequential is faster than random




- array of blocks
1. write/read page (2-4KB)
   - 50-100 usec
2. writes must be to "clean" cells

- write amplification => one small overwrite causes machine to erase large block

- Flash Translation Layer (FTL)
  - firmware

- Nonvolatile Memory
  - memory is volatile; by bytes
  - storage is block oriented

NVM => non-volatile

- Linux Storage Stack
  - implementor

- Page Table Implementation
  - use Radix Tree

- most virtual regions backed by disk
- mmap(): bind one virtual memory region
  <-> a file (as the backing store)
    - byte-for-byte correlation

- mmap => no syscalls on each file read/write
  ↳ except initial
  ↳ requires VM

- file io: more universal

- most files are small but large files take the most storage

- FAT – File Allocation Table
  ↳ works for all filesystems