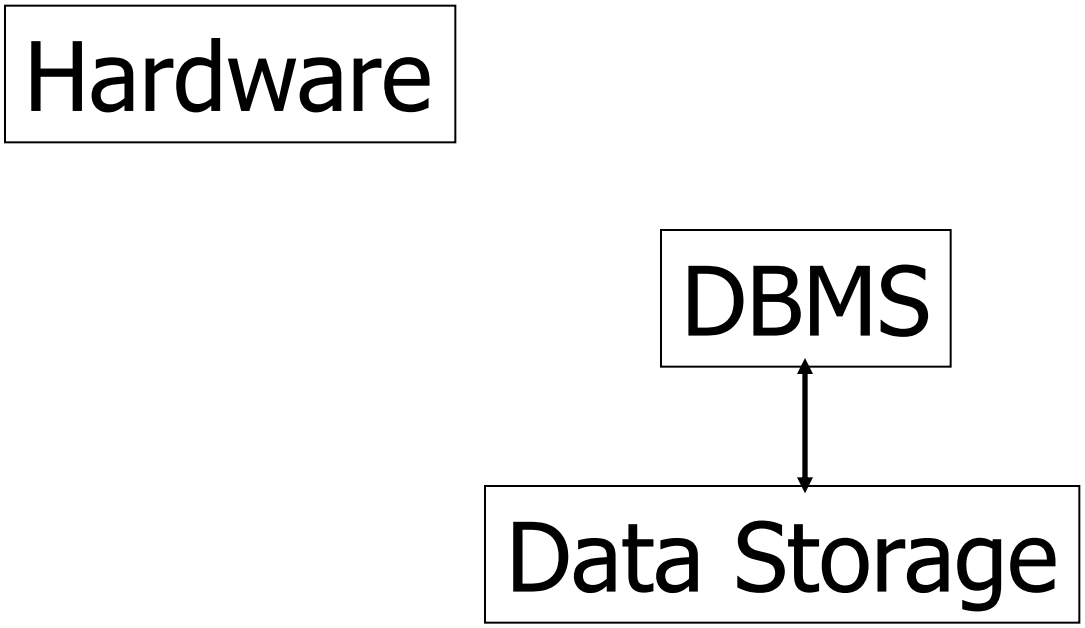
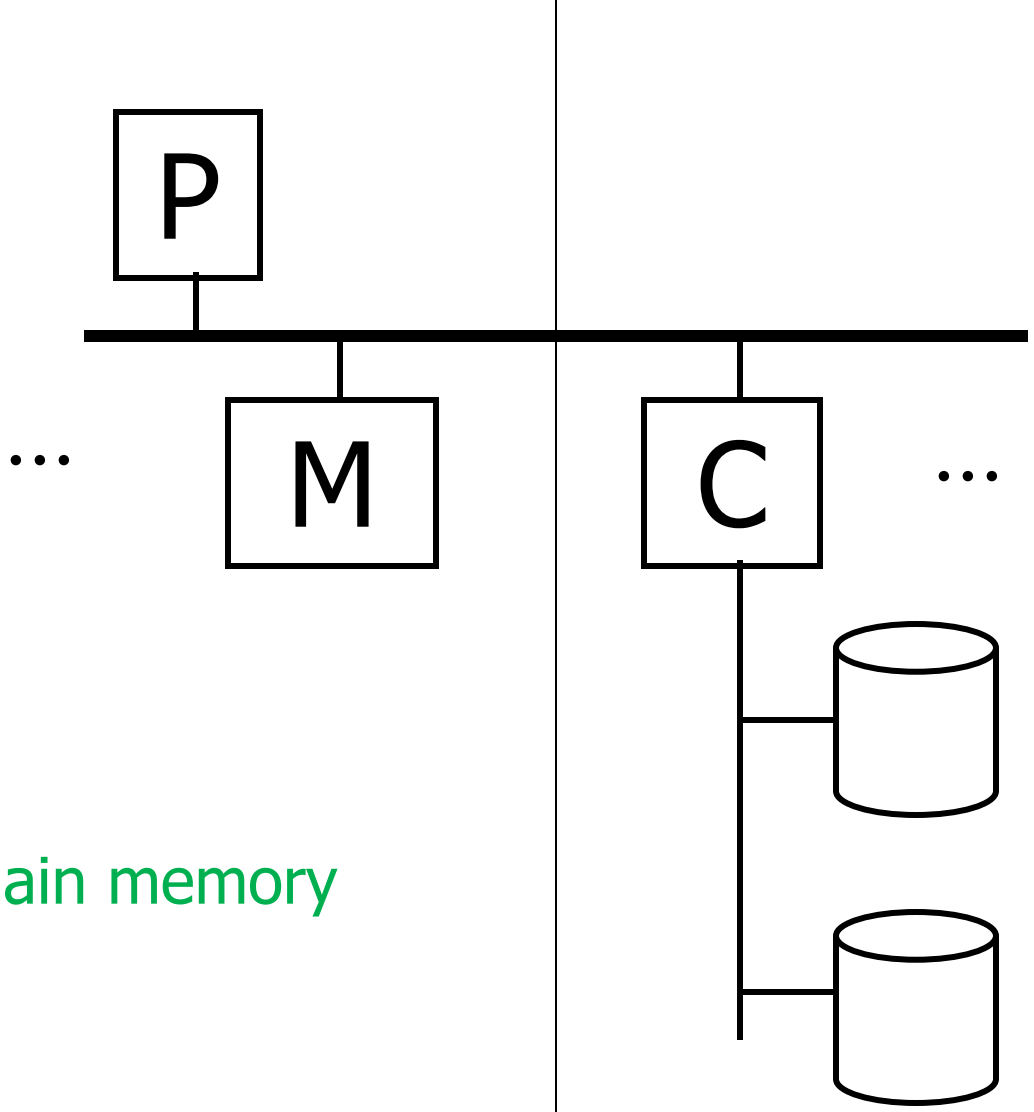
Hardware

Based on Lecture notes by Hector Garcia-Molina

Outline

- Hardware: Disks
- Access Times


Hardware
DBMS
Data Storage



main memory

volatile memory

secondary memory

persistent memory

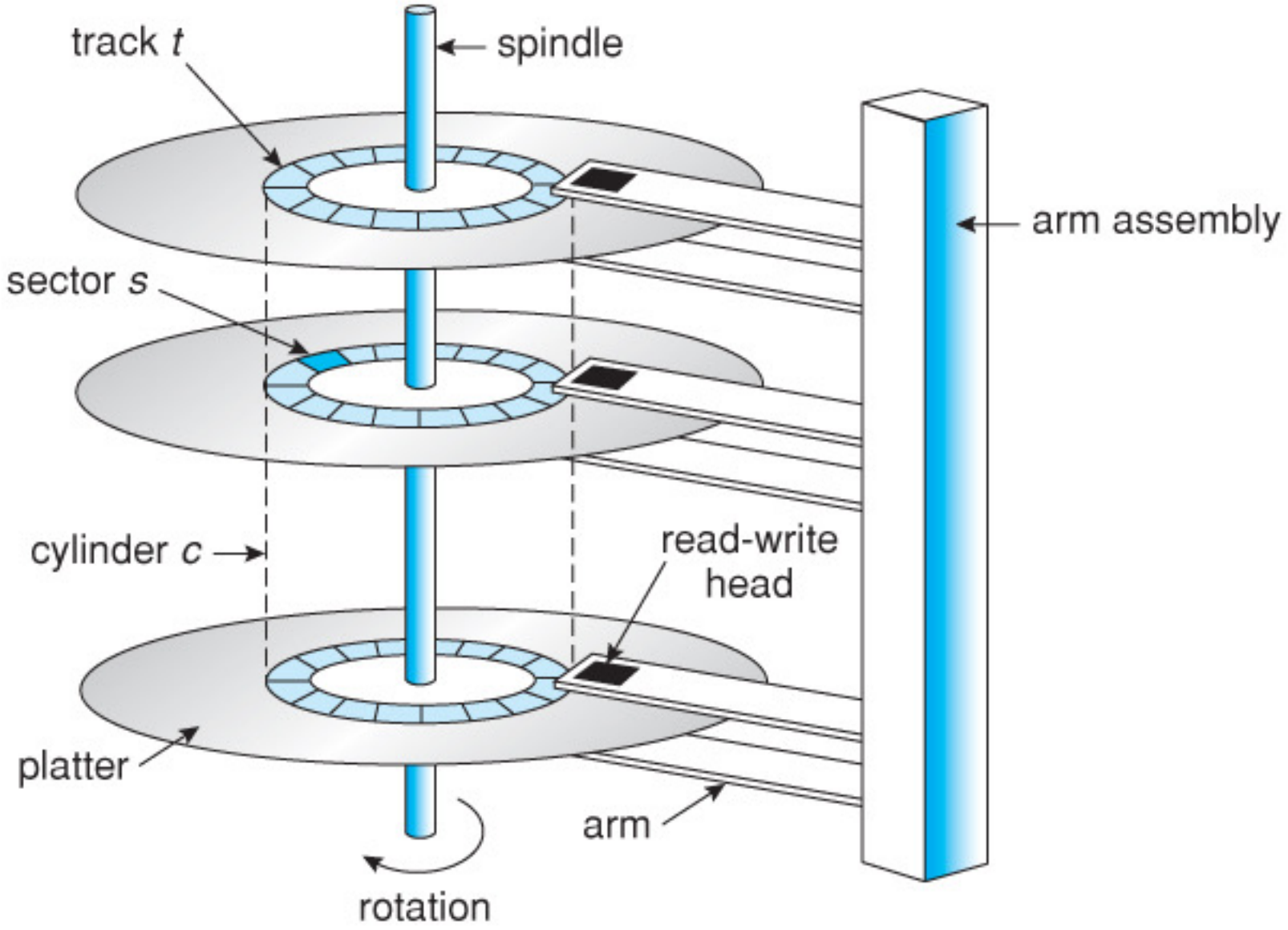
Memory Hierarchy

Typical Computer

Secondary storage

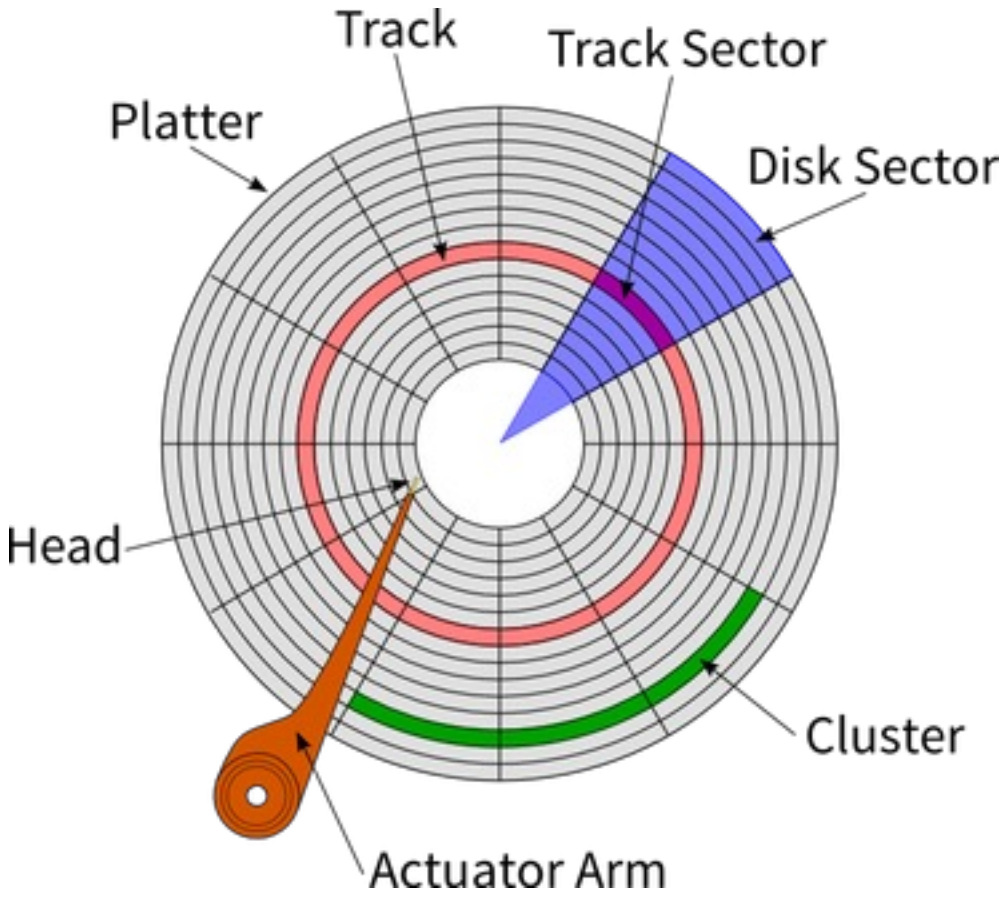
- Hard Disk Drive (HDD): addressable space
- Solid State Drive (SSD): addressable space

- Tape: sequential access


track t
spindle
arm assembly
sector s
cylinder c
read-write
head
platter
arm
rotation

Top View

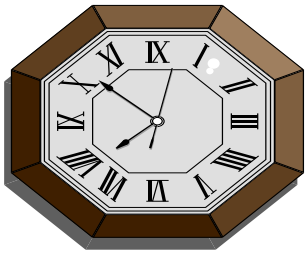
Each block has an address:
(platter#,track#,sector#,block#)



A disk is a random-access memory device

Disk Access Time (Read operation)

I want block X



block x in main memory

?

Time = Seek Time +
Rotational Delay +
Transfer Time

Seek time and rotational delay depend on mechanical components of the disk

Transfer time is electronically determined

- So far: Random Block Access
- What about: Speed for reading “Next” block?
- This is very fast compared to seek time
- Depends on the rotational speed of the disk

Rule of Thumb

Random I/O: Expensive
Sequential I/O: Much less

Cost for Writing similar to Reading

- To Modify a Block?

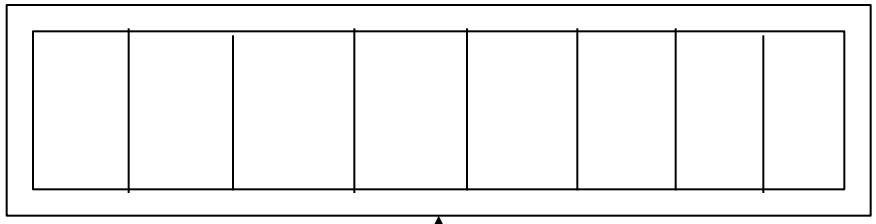
To Modify Block:

(a) Read Block (tens of milliseconds ms)
(b) Modify in main memory (nano seconds ns)
(c) Write Block (tens of milliseconds ms)

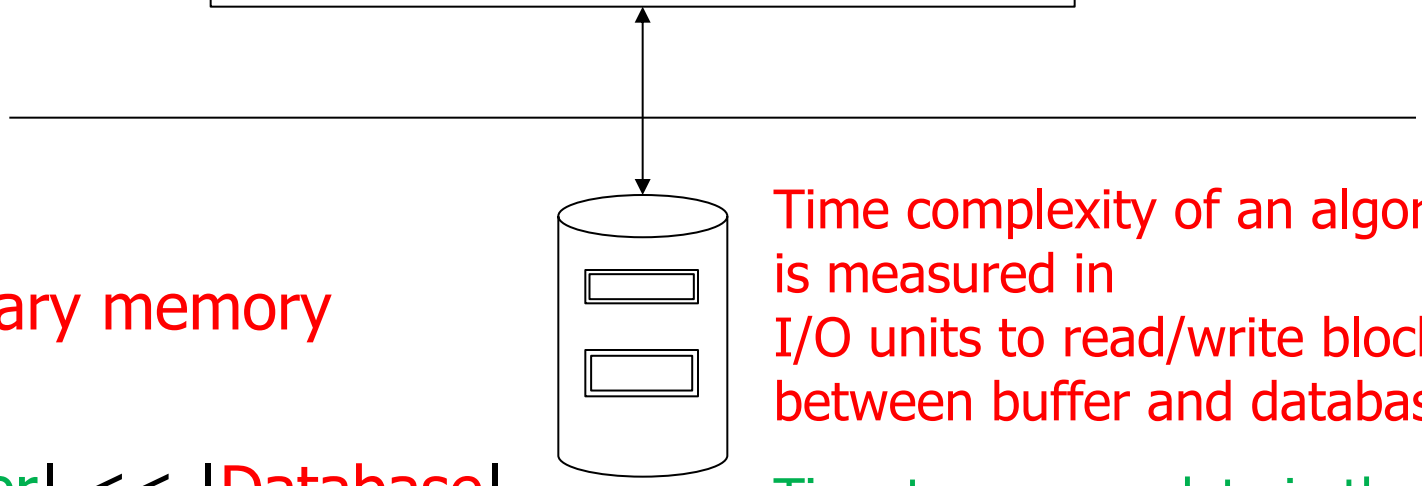
ms = 1/1000 of second
ns = 1/100 000 000 of second

Algorithm Time Complexity Analysis

Main memory



Buffer has # of blocks



Secondary memory

Time complexity of an algorithm is measured in I/O units to read/write blocks between buffer and database

|Buffer| << |Database|

Time to process data in the blocks in the main memory buffer is ignored