

Why do we study DBMS?



GATE: only gate?

DBMS:

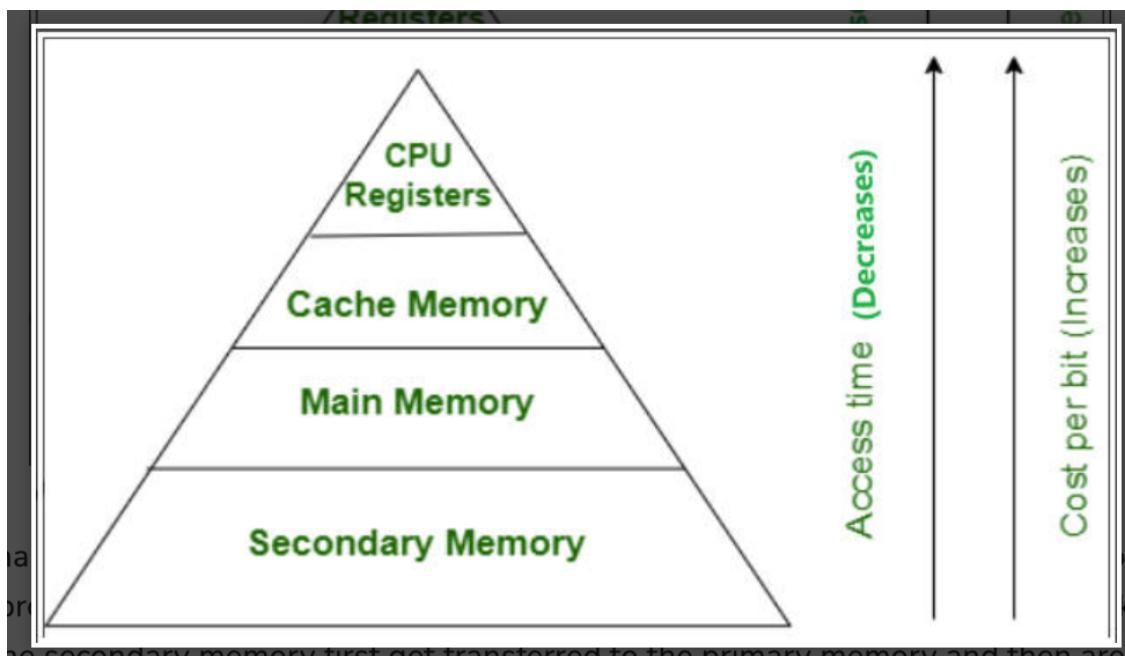
Data:

Database Management System:

Primary Memory:

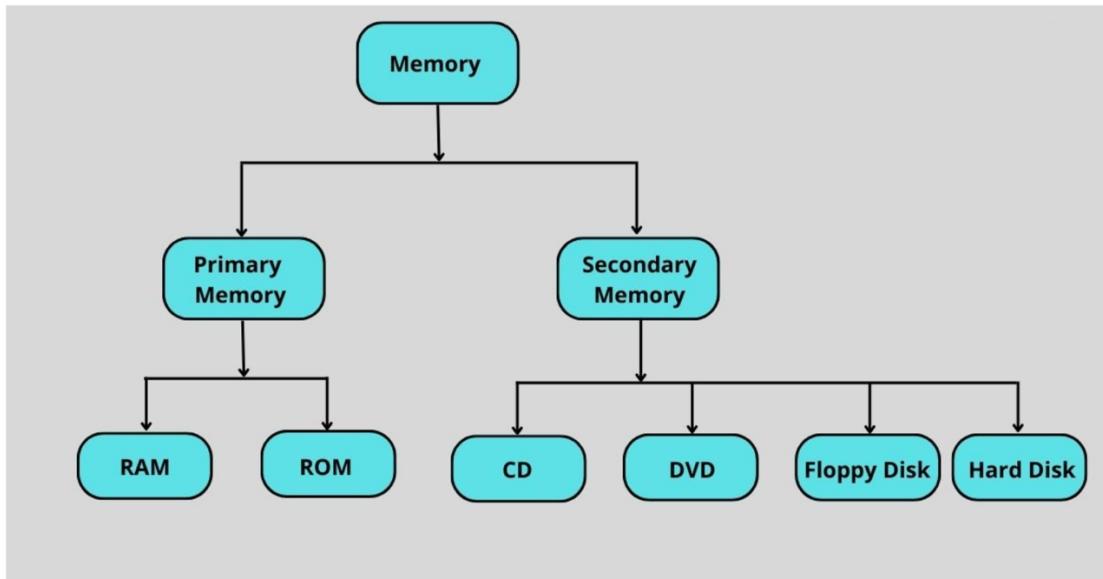
Secondary Memory:

E-R vs Relational Model:

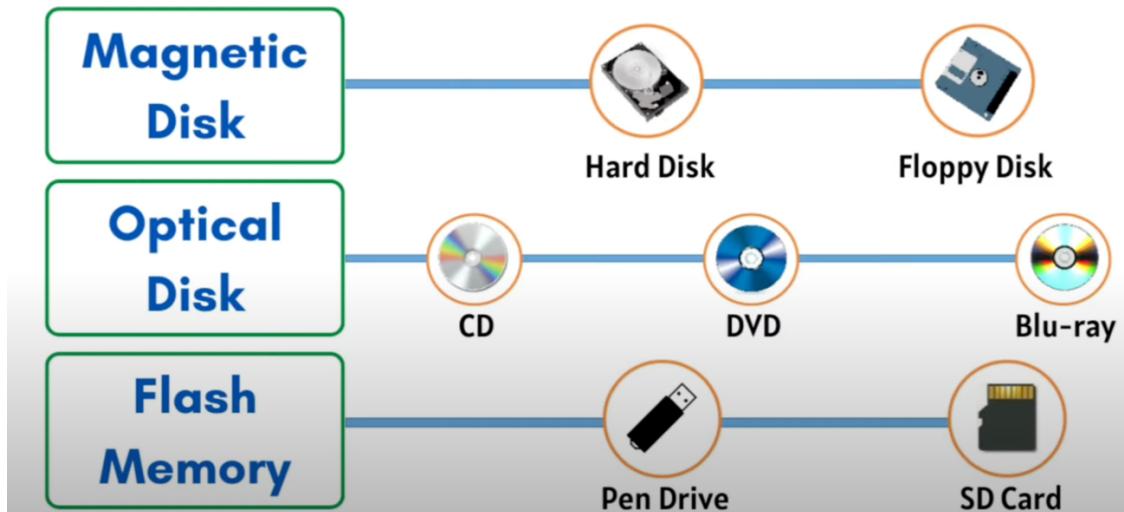


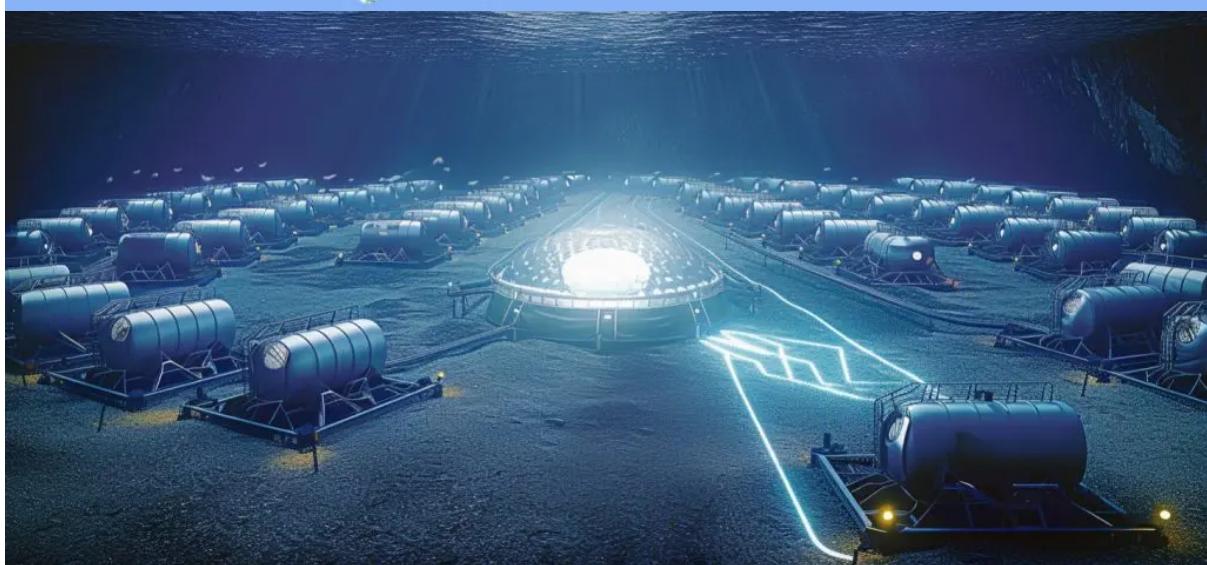
1. Primary Memory (RAM - Random Access Memory): This is the memory directly accessible by the CPU for storing and retrieving data that is actively being used by programs or processes. It is volatile, meaning it loses its contents when the power is turned off. RAM is much faster than secondary memory but also more expensive.

2. Secondary Memory (Storage): This includes devices like hard disk drives (HDDs), solid-state drives (SSDs), optical drives, and magnetic tape systems. Secondary memory stores data for long-term use, even when the power is turned off. It is non-volatile. SSDs, despite their speed and similarities with RAM in terms of access times, are considered part of secondary memory because they store data persistently, like traditional hard drives, and are used for long-term storage rather than temporary data storage.



Secondary Memory





From Wikipedia, the free encyclopedia

Google data centers are the large [data center facilities](#) Google uses to provide [their services](#), which combine large drives, computer nodes organized in aisles of racks, internal and external networking, environmental controls (mainly cooling and humidification control), and operations software (especially as concerns [load balancing](#) and [fault tolerance](#)).

There is no official data on how many [servers](#) are in Google data centers, but [Gartner](#) estimated in a July 2016 report that Google at the time had 2.5 million servers. This number is changing as the company expands capacity and refreshes its hardware.^[1]



Former Google data center in

Eemshaven, Netherlands

Locations [edit]

The locations of Google's various data centers by continent are as follows:^{[2][3]}

External videos

 YouTube

 Google Data Center 360° Tour

Hardware [edit]

Original hardware [edit]

The original hardware (circa 1998) that was used by Google when it was located at [Stanford University](#) included:^[74]

- Sun Microsystems Ultra II with dual 200 MHz processors, and 256 MB of RAM. This was the main machine for the original Backrub system.
- 2 × 300 MHz dual Pentium II servers donated by Intel, they included 512 MB of RAM and 10 × 9 GB hard drives between the two. It was on these that the main search ran.
- F50 IBM RS/6000 donated by IBM, included 4 processors, 512 MB of memory and 8 × 9 GB hard disk drives.
- Two additional boxes included 3 × 9 GB hard drives and 6 × 4 GB hard disk drives respectively (the original storage for Backrub). These were attached to the Sun Ultra II.
- SSD disk expansion box with another 8 × 9 GB hard disk drives donated by IBM.
- Homemade disk box which contained 10 × 9 GB SCSI hard disk drives.



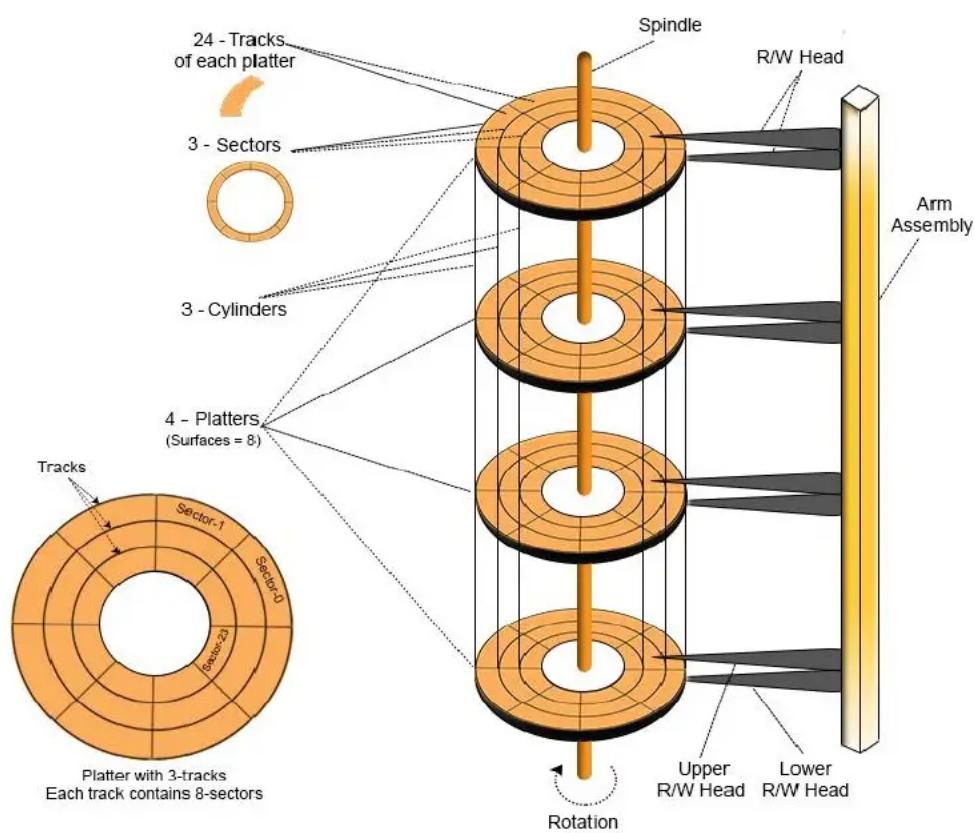
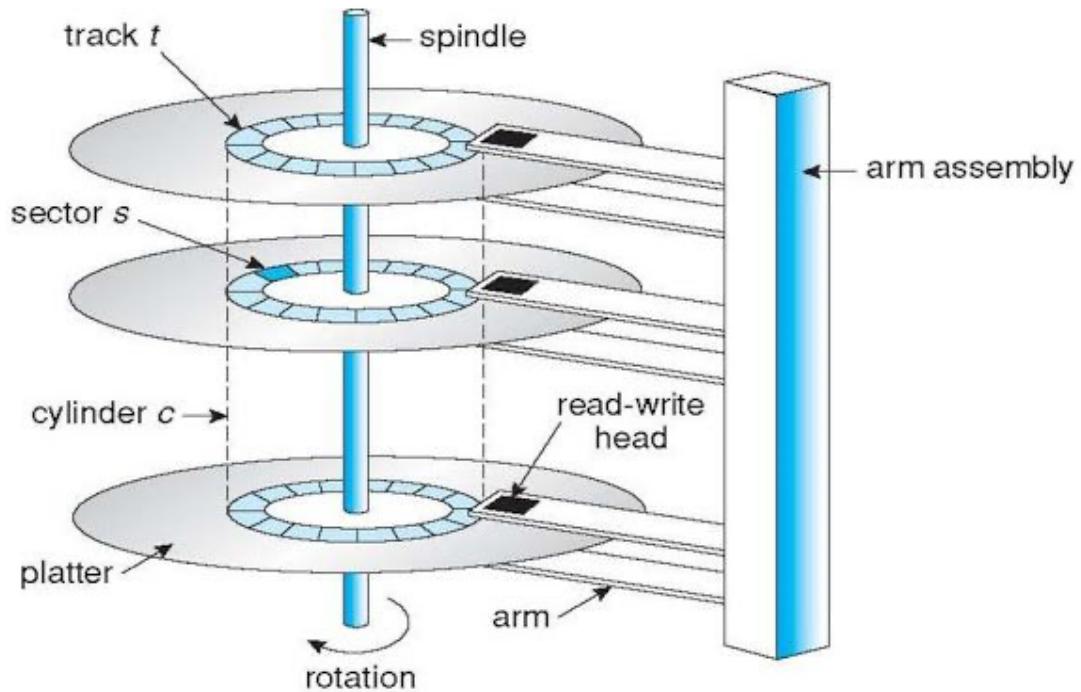
Google's first production server rack, circa 1998

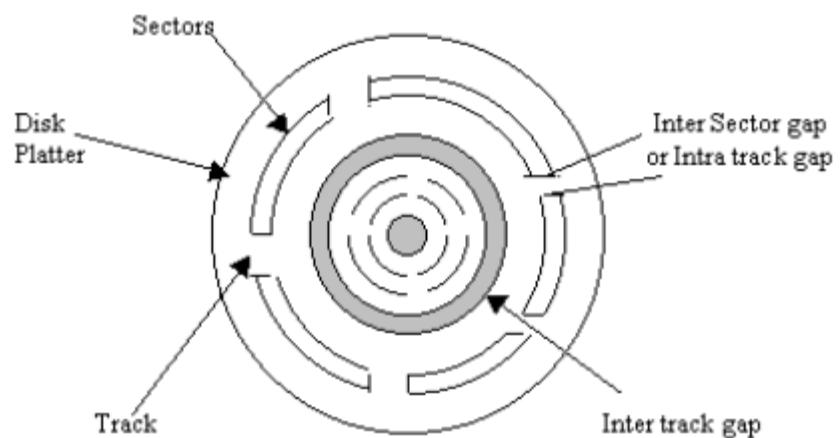
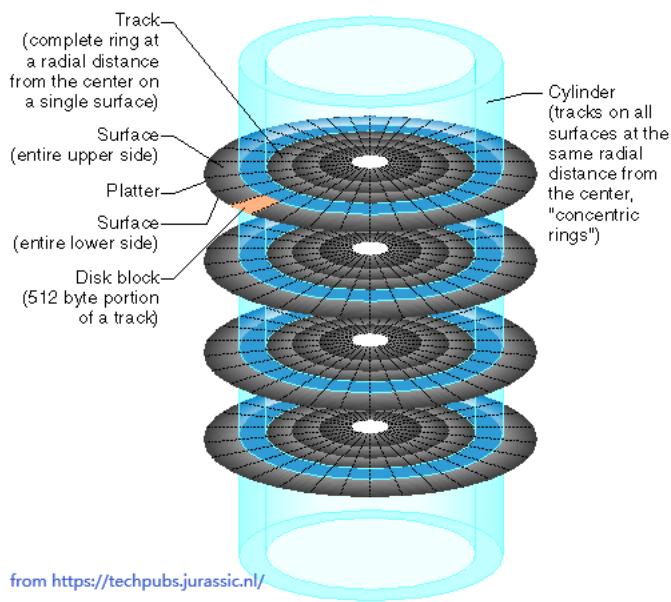
Production hardware [edit]

As of 2014, Google has used a heavily customized version of [Debian Linux](#). They migrated from a Red Hat-based system incrementally in 2013.^[75]

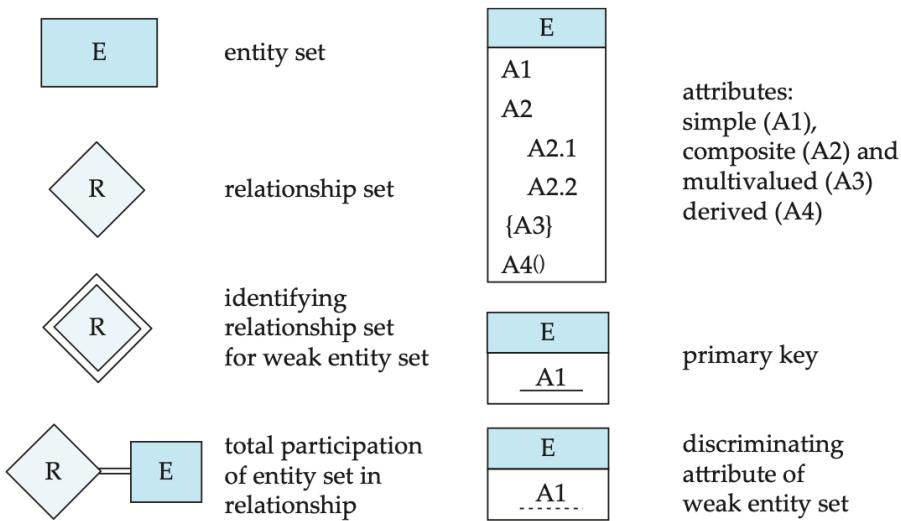
The customization goal is to purchase CPU generations that offer the best performance per dollar, not absolute performance. How this is measured is unclear, but it is likely to incorporate running costs of the entire server, and CPU power consumption could be a significant factor.^[76] Servers as of 2009–2010 consisted of custom-made open-top systems containing two processors (each with several cores^[77]), a considerable amount of RAM spread over 8 DIMM slots housing double-height DIMMs, and at least two SATA hard disk drives connected through a non-standard ATX-sized power supply unit.^[78] The servers were open top so more servers could fit into a rack. According to CNET and a book by [John Hennessy](#), each server had a novel 12-volt battery to reduce costs and improve power efficiency.^{[77][79]}

According to Google, their global data center operation electrical power ranges between 500 and 681 megawatts.^{[80][81]} The combined processing power of these servers might have reached from 20 to 100 petaflops in 2008.^[82]

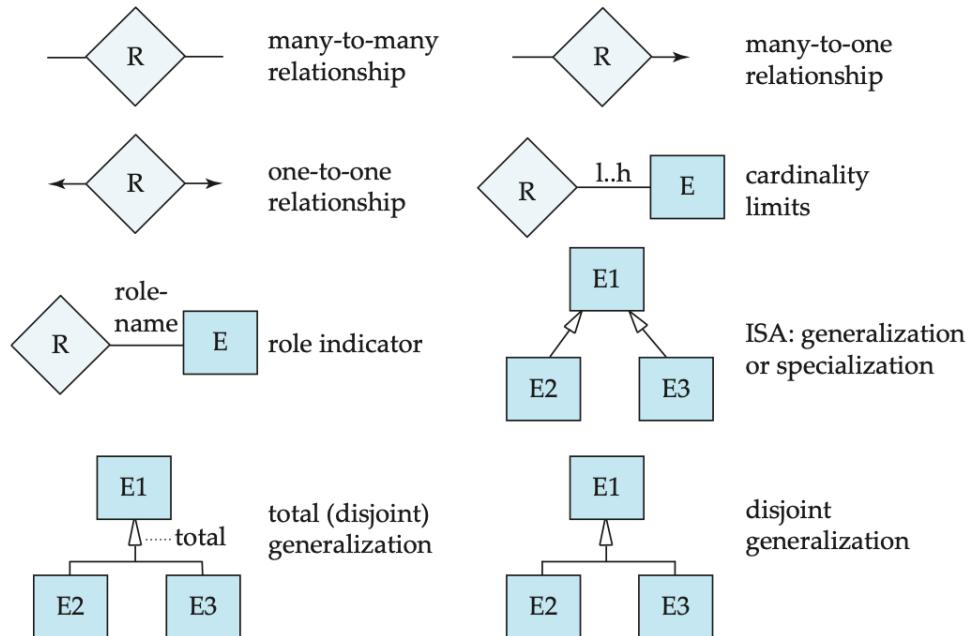




Summary of Symbols Used in E-R Notation



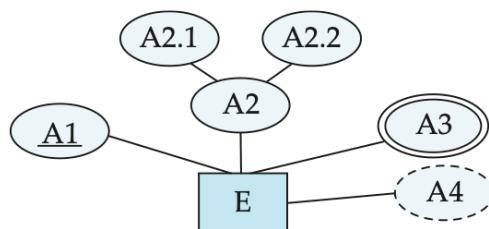
Symbols Used in E-R Notation (Cont.)



Alternative ER Notations

- Chen, IDE1FX, ...

entity set E with
simple attribute A1,
composite attribute A2,
multivalued attribute A3,
derived attribute A4,
and primary key A1



weak entity set



generalization



total
generalization



Alternative ER Notations

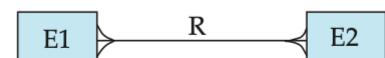
Chen

many-to-many
relationship



IDE1FX (Crows feet notation)

one-to-one
relationship



many-to-one
relationship



participation
in R: total (E1)
and partial (E2)

