

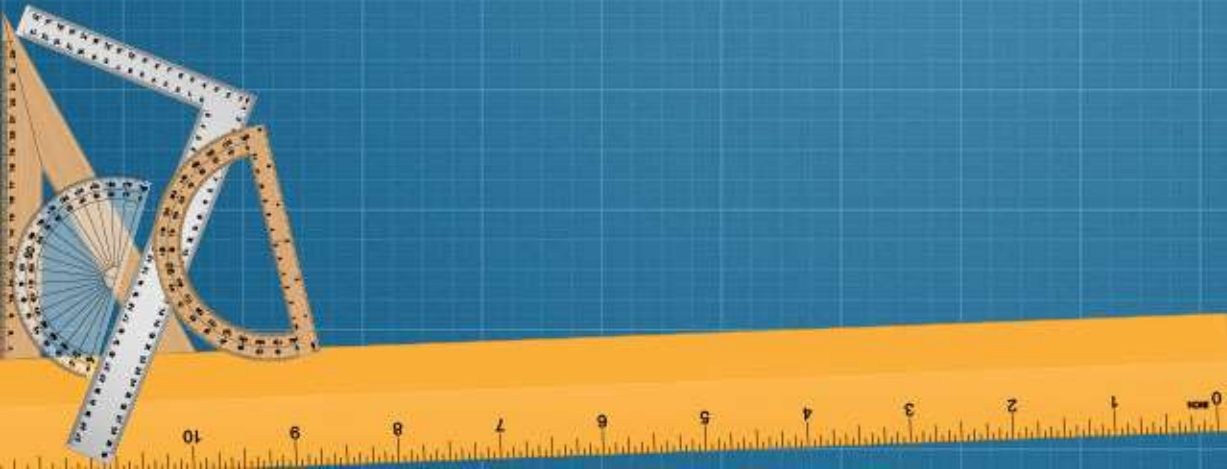
RAID LEVELS

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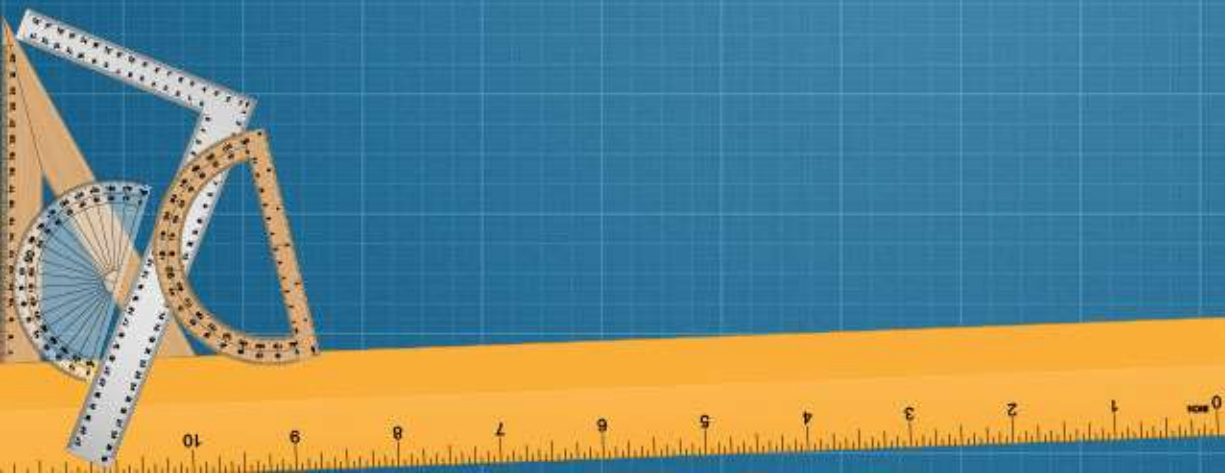
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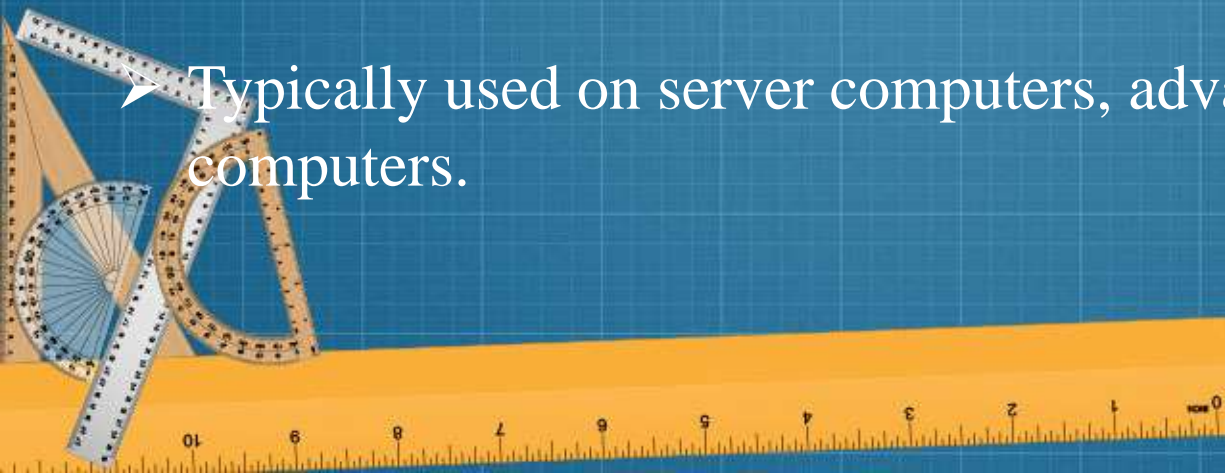
Introduction:

- RAID stands for Redundant Array of Independent Disks or Redundant Array of Inexpensive Disks.
- RAID is an example of storage virtualization and was first defined by David Patterson in 1987.
- RAID is a storage technology that combines multiple disk drive components into a logical unit



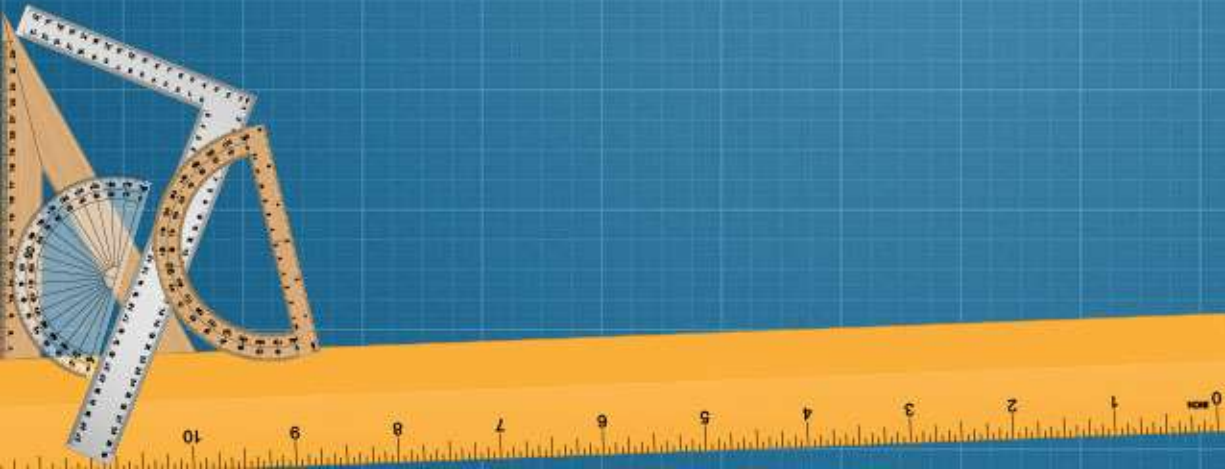
Abstract:

- Storage scheme using multiple hard drives to share or replicate data among the drives.
- It provide data integrity, fault-tolerance, throughput or capacity compared to single drives.
- Instead of seeing several different hard drives, the OS sees only one.
- Typically used on server computers, advanced personal computers.



Major concepts that you should know!

- What is RAID?
- Why RAID?
- How does RAID work?
- Are there any alternatives to RAID?

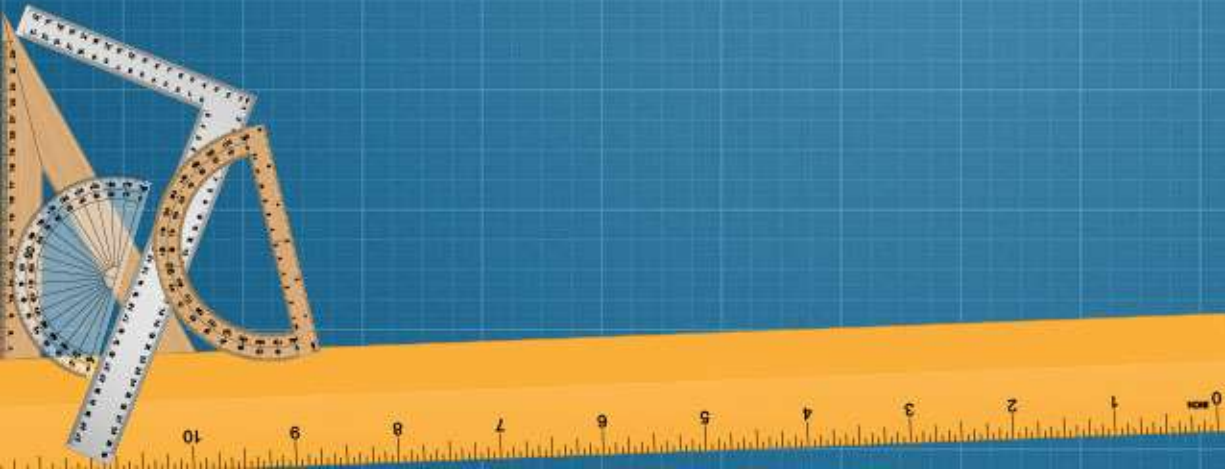


What is RAID?

➤ Redundant Array of Inexpensive Disks.

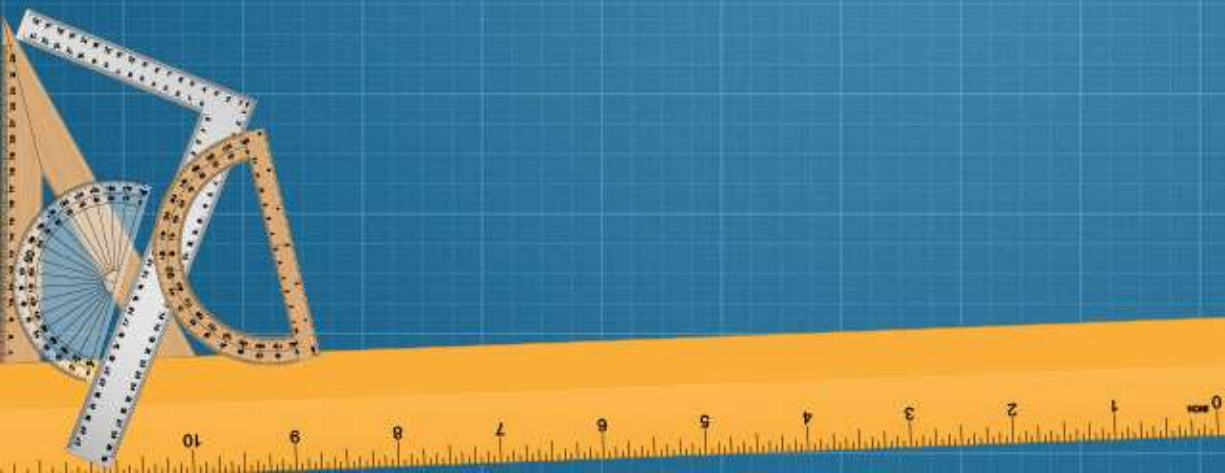
Basic idea is to connect multiple disks together to provide

- Large storage capacity
- Faster access to reading data
- Redundant data



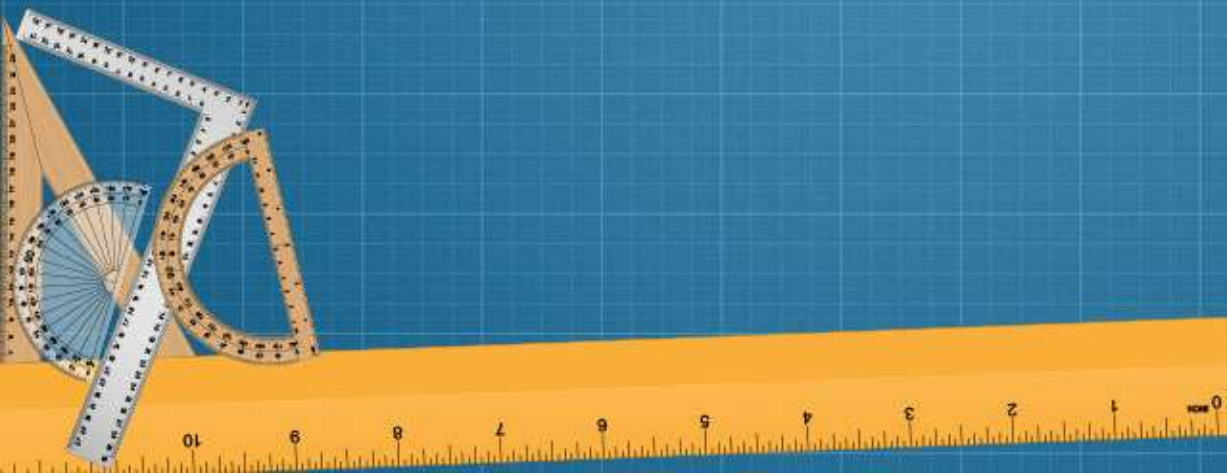
Why RAID?

- RAID system provides data redundancy, fault tolerance, increased capacity and increased performance.
- RAID has for a long time been something that you only find in large server systems, but lately cheaper **RAID controller card** have made it possible to get a RAID system even for small servers and home computers.



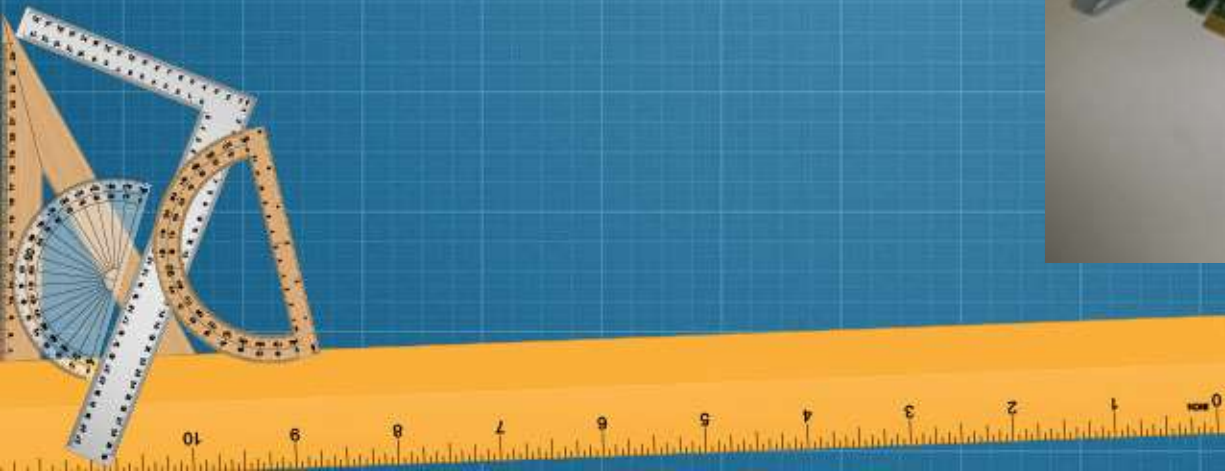
How does RAID works?

- Take some inexpensive disks and group them together, which will make the system see them as one single disk.
- This is done by using a **RAID controller card** that handle all I/O to the disks, and which knows where the stored data can be found.



RAID controller:

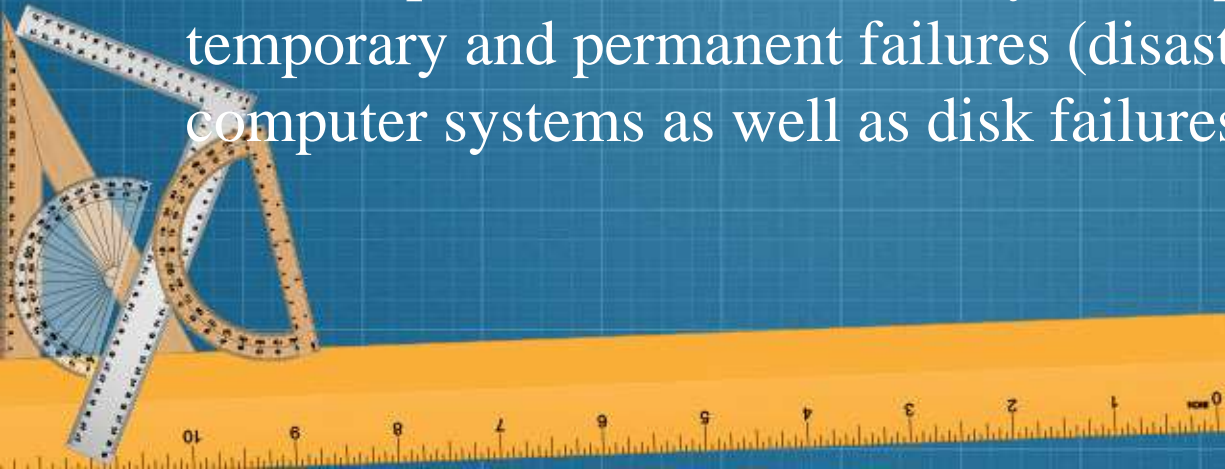
- A RAID controller is a hardware device or software program used to manage hard disk drives (HDDs) or solid-state drives (SSDs) in a computer or storage array so they work as a logical unit.



Are there any alternatives to RAID?

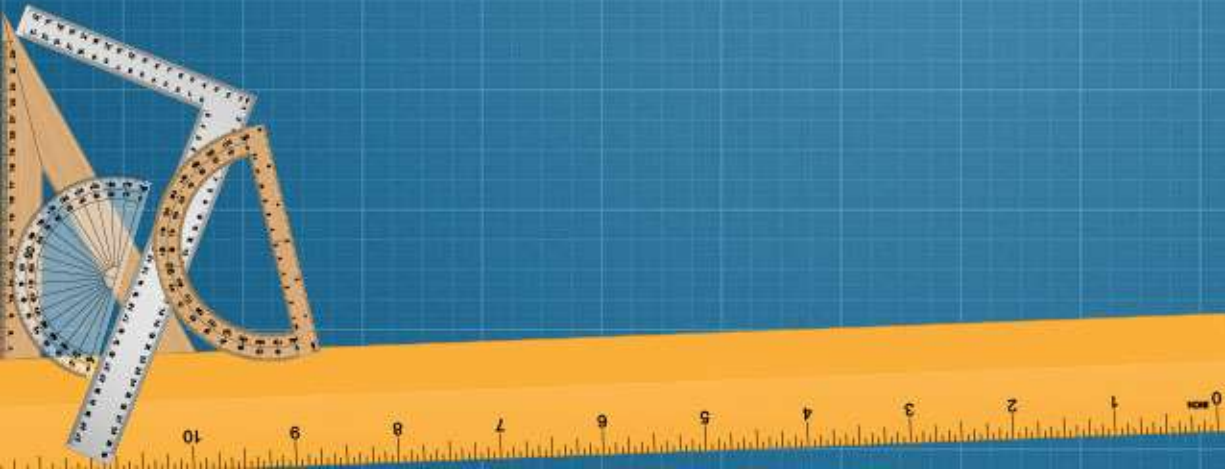
At the **Berkeley University of California** they perform researches about alternative solutions.

- Such a solution is RADD, or Redundant Array of Distributed Disks. RADD: can support redundant copies of data across a computer network at the same space cost as RAID: do for local data.
- Such copies increase availability in the presence of both temporary and permanent failures (disasters) of single site computer systems as well as disk failures.



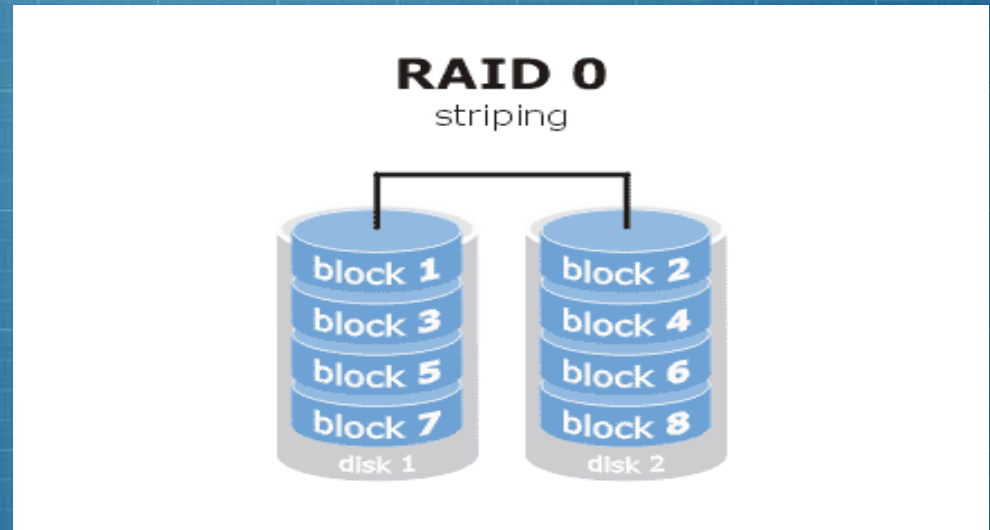
RAID LEVELS:

- **RAID 0** – striping
- **RAID 1** – mirroring
- **RAID 2** – redundancy through Hamming
- **RAID 3** – bit interleaved Parity
- **RAID 4** – block interleaved Parity
- **RAID 5** – striping with parity



LEVEL 0 (striping):

- **Striping** means that each file is split into blocks of a certain size and those are distributed to the various drives.
- Offers superior I/O performance.
- Performance can be enhanced further by using multiple controllers.



Ideal use:

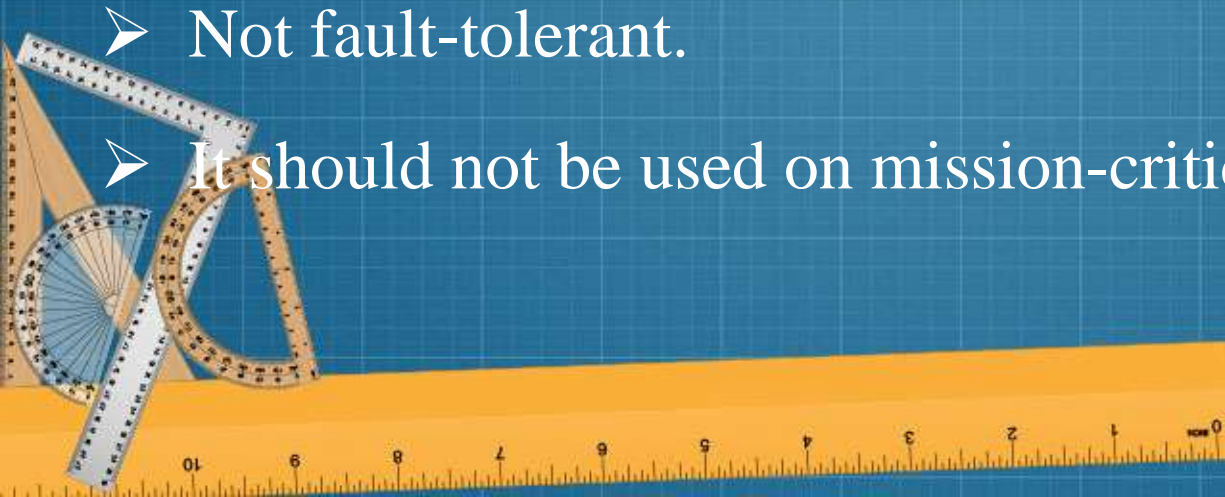
Photoshop image retouching station.

Advantages:

- Offers great performance.
- There is no overhead caused by parity controls.
- Easy to implement.

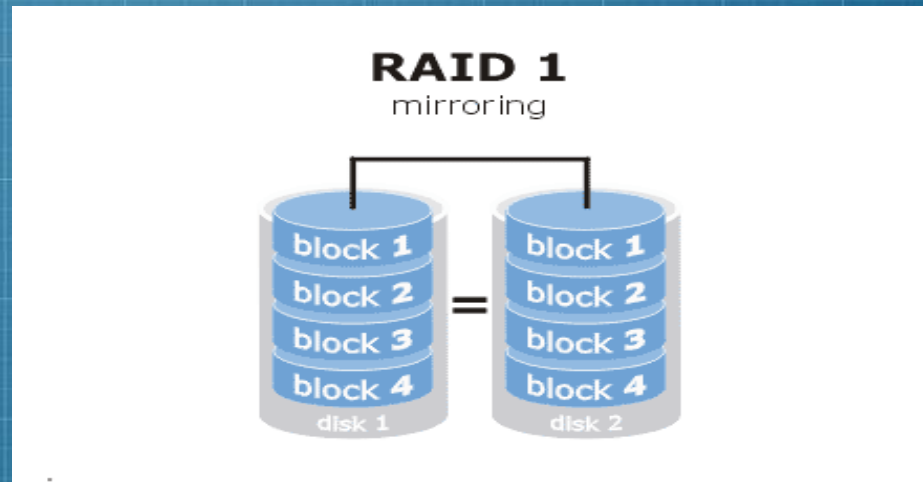
Disadvantages:

- Not fault-tolerant.
- It should not be used on mission-critical systems



LEVEL 1 (mirroring):

- **Mirroring** means duplication of data i.e
- Data are stored twice.
- Writing them to both the data disk and a mirror disk .
- The controller uses either the data drive or the mirror drive for data recovery.



Ideal use:

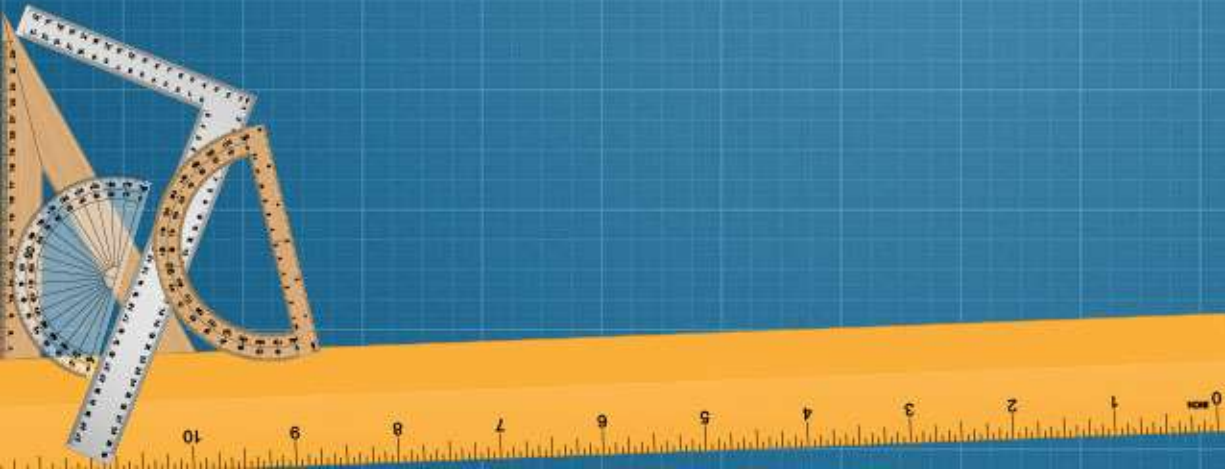
Accounting systems.

Advantages:

Data do not have to be rebuild.

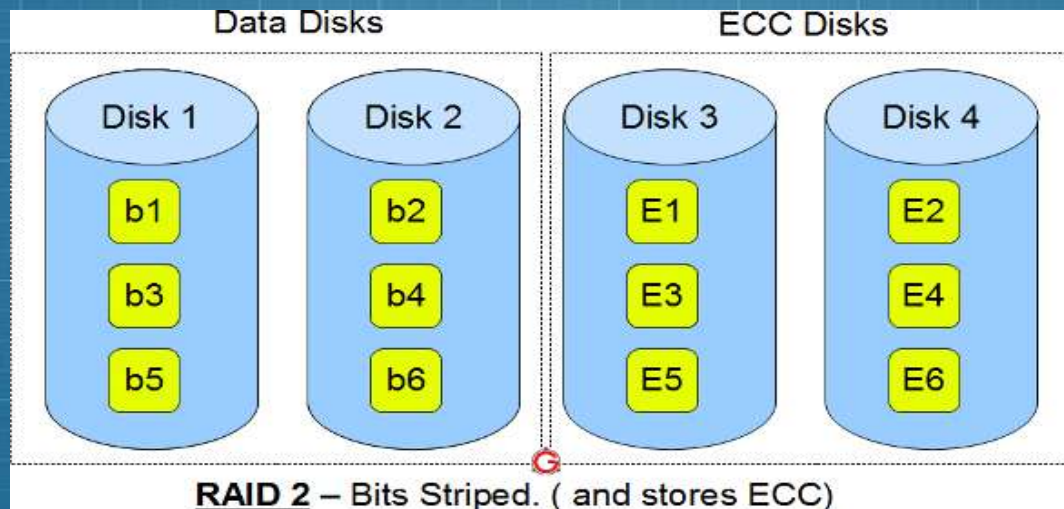
Disadvantages:

Storage capacity is only half of the total disk capacity .



LEVEL 2 (redundancy through Hamming):

- **Bit-level striping** means that the file is broken into “bit-sized pieces”.
- It uses a **Hamming code** for error correction.



Ideal use:

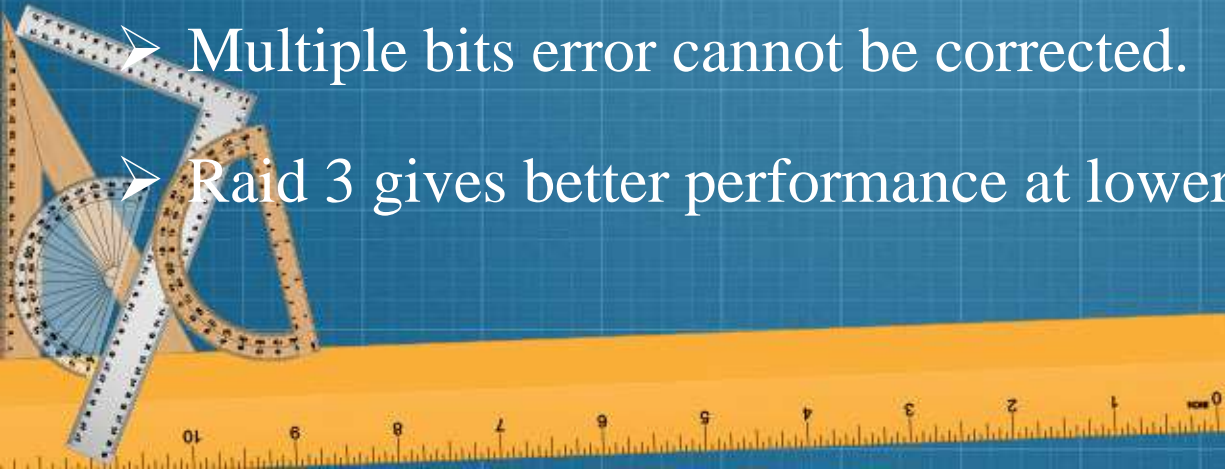
- No commercial use.

Advantages:

- Data transferred rate is very high.
- Single bit errors can be detected and corrected.
- Multiple bit errors can be detected.

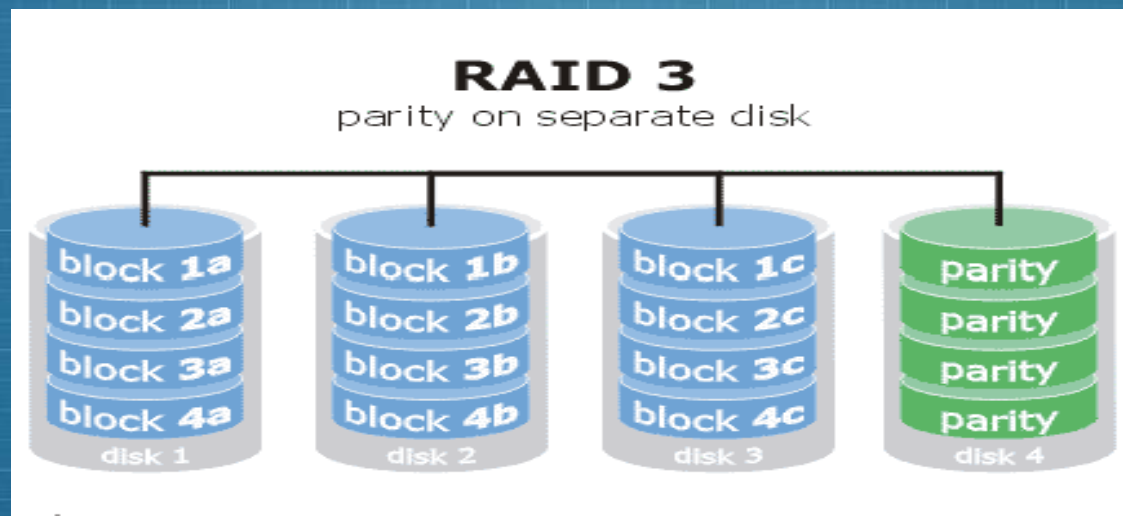
Disadvantages:

- Multiple bits error cannot be corrected.
- Raid 3 gives better performance at lower price.



LEVEL 3 (bit interleaved Parity):

- **Byte-level striping** means that the file is broken into "byte-sized pieces".
- Written in parallel on two or more drives.
- An additional drive stores parity information.



Ideal use:

- Video streaming.

Advantages:

- It provides high throughput for large data transfers.
- Disk failures do not significantly slow down throughput.

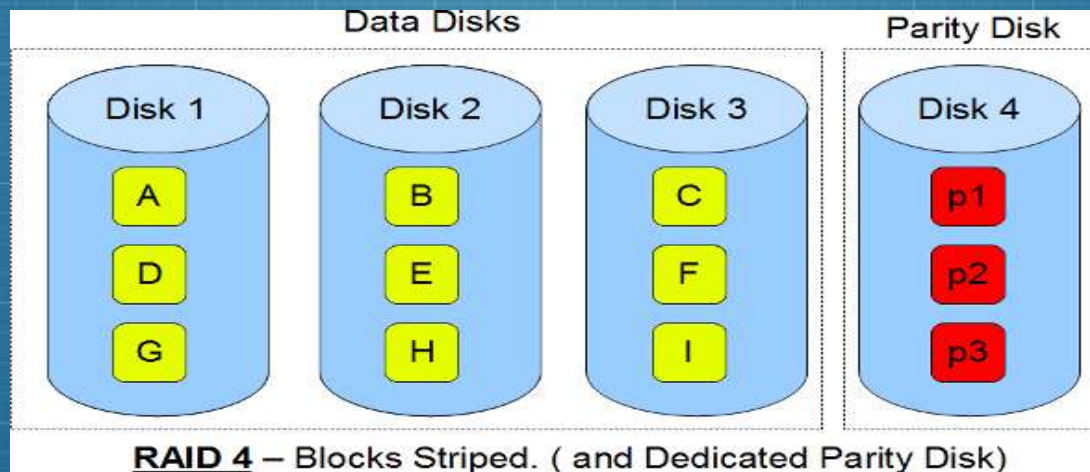
Disadvantages:

- Performance is slower for random, small I/O operations.



LEVEL 4 (block interleaved Parity):

- **Block-level striping** means that each file is split into blocks of a certain size .
- Allows each member to act independently when only a single block is requested.
- Service multiple read requests simultaneously.



Ideal use:

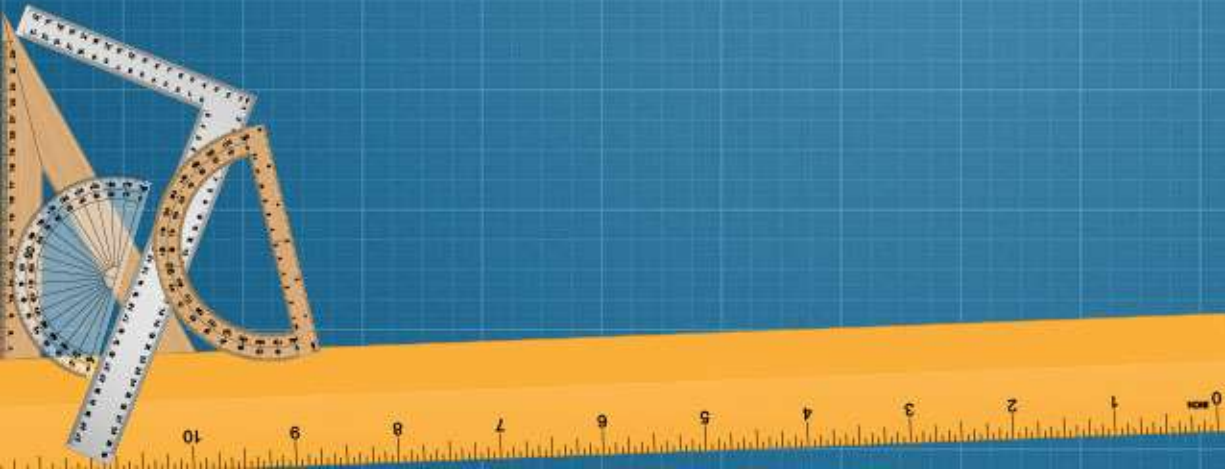
Enterprise level company to use it is Net App.

Advantages:

- Reading operations are very fast.
- Fault tolerance is very high.

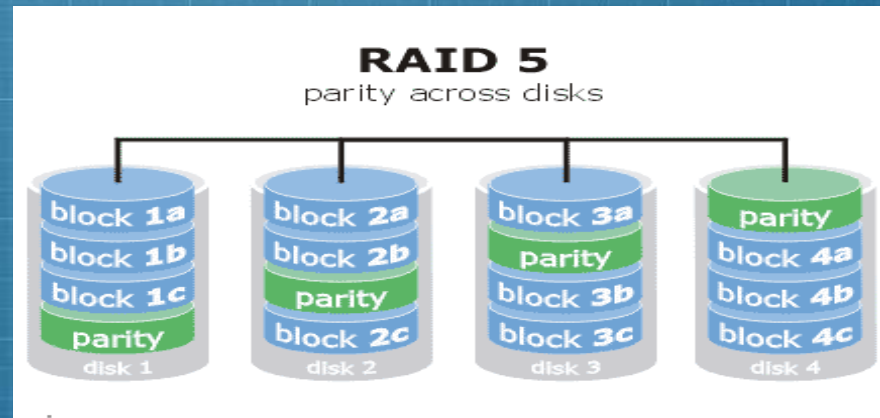
Disadvantages:

- In degraded mode, its reading operation becomes slow.
- Writing operation on disks is extremely slow.



LEVEL 5 (striping with parity):

- Most common secure RAID level.
- Except that data are transferred to disks by independent read and write operations.
- Instead of a dedicated parity disk, parity information is spread across all the drives.



Ideal use:

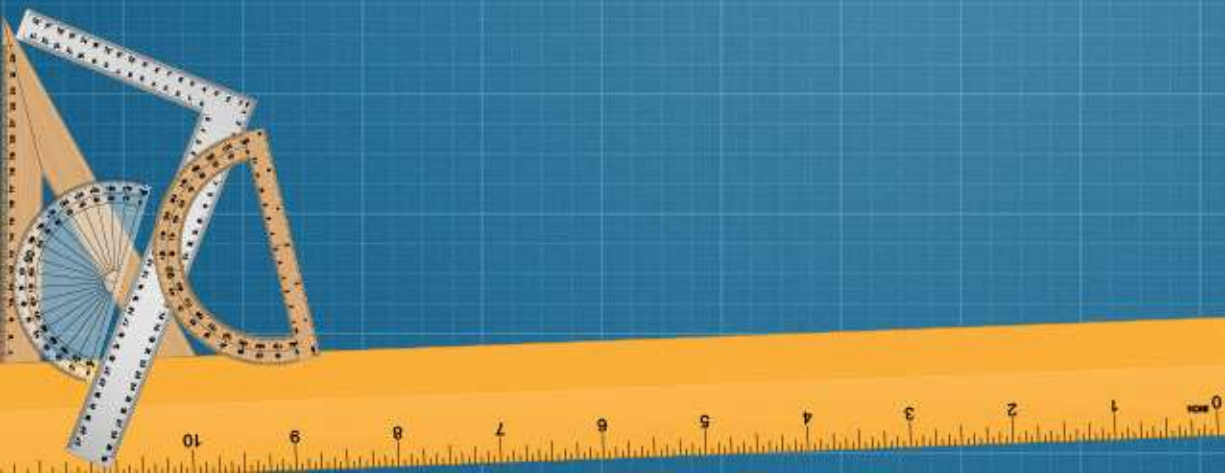
- Application servers.

Advantages:

- Read data transactions are very fast while write data are somewhat slow.

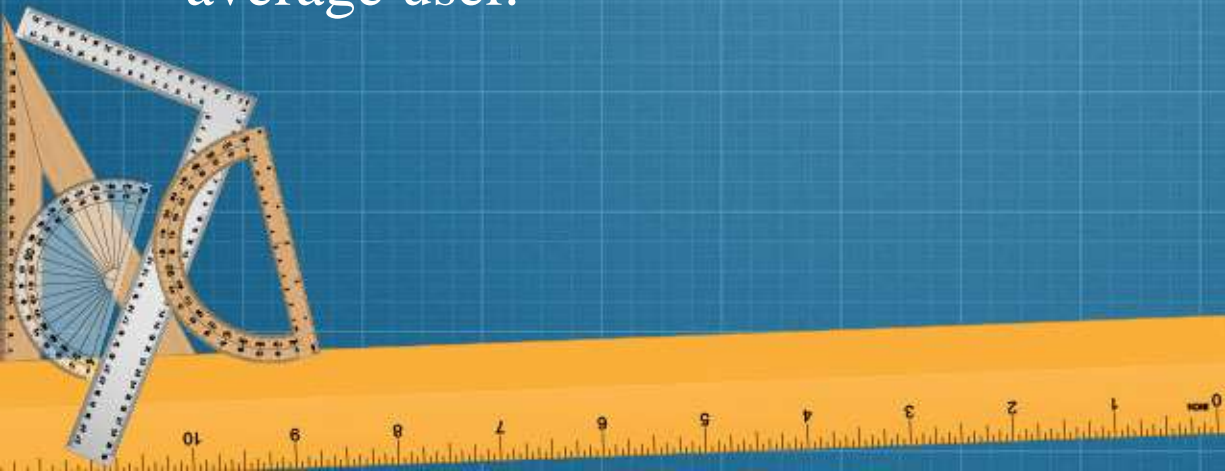
Disadvantages:

- Disk failures have an effect on throughput.
- This is complex technology.



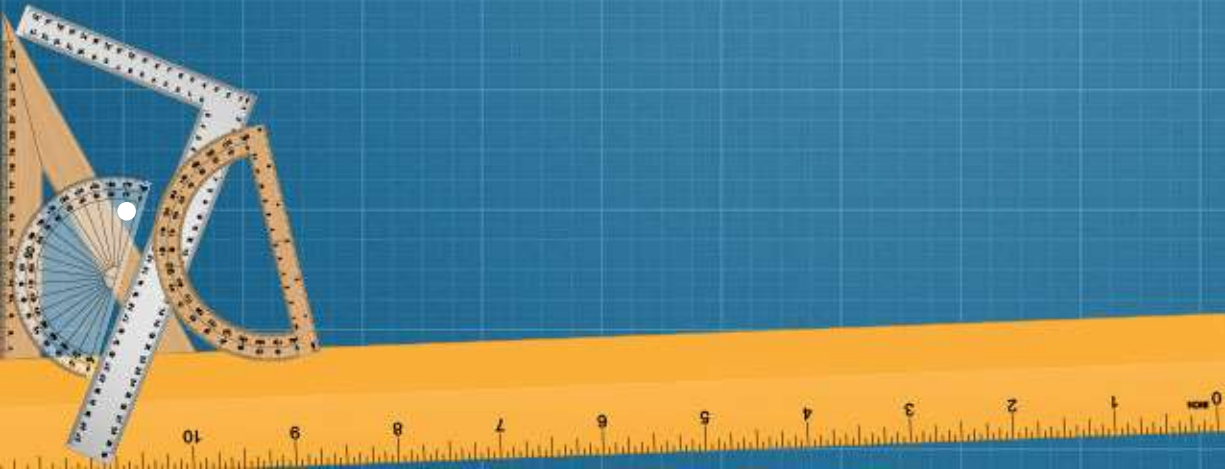
Conclusion:

- Overall it provides systems with a variety of benefits depending upon the version implemented.
- Most users will likely opt to use the RAID 0 for increased performance without the loss of storage space.
- This is primarily because redundancy is not an issue for the average user.

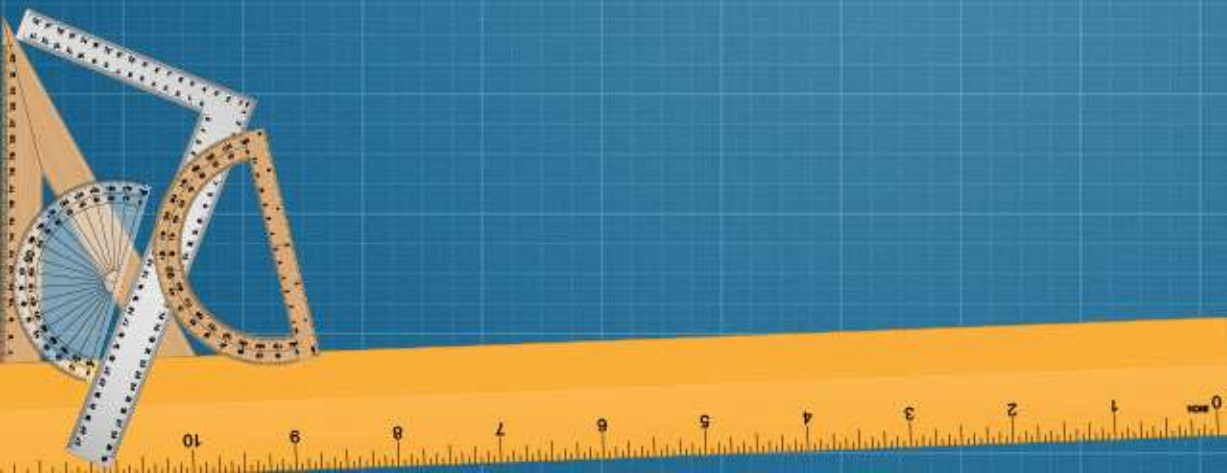


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University of California



ANY QUERY ?



THANKS !

