RAID

(Redundant Arrays of Independent Disks)

What is RAID ?

The full form of RAID is Redundant Arrays of Independent Disks, the meaning of redundant is copy or duplicate, the meaning of independent is that doesn't depend on single theme and disks where we store data. Together we can say RAID is a combination of multiple independent disks. Whether hardware or software, RAID is available in so many ways and that's where come the RAID levels. The most commonly levels that are use is **RAID 0,1,4,5,6 and 10.**

Functionality of RAID

RAID works in a balanced way by improving performance, using multiple disks allowing input/output. The using of multiple disks ensures the increasing of mean time between failures and fault tolerance.

Why we use RAID ?

RAID is specially used for good performance and for fast performance. RAID is a way of storing the same data in different places on multiple hard disks to protect data in case of any kind of system failure. System failure is not that common case but when it comes for a big data storing company like **facebook, whatsapp** or any multinational company where the number of employees is more than thousand, a single error or a system failure on their data storing system can cause tertiary damage. To get protection from those and to store data safely we use RAID.

The reasons of using RAID

It improves the efficiency and it can increase the speed of a computer of huge capacity. Using of multiple disks in parallel can cause a system to slow down but RAID will provide high speed by dividing data into blocks and spreading them across several drives, so the disks can access the files freely, resulting a faster performance. The data in the RAID is linked together to prevent data loss. Having multiple disks at a time gives to apply techniques like **disk striping, disk mirroring** and **parity.**

What is redundancy in RAID ?

Redundancy means a system contains duplicate copies of files of data. If a failure occurs the chances of losing data increases but because of redundancy there will be another available copy of every data which stops the chances of losing data. The RAID level 5 is mainly redundancy.

What is disk striping in RAID ?

Disk striping means multiple small disks having information and those disks acting as a large disk. This is a process to spread large data across multiple storage devices. If a person wants to find out a single query on a huge database, disk striping allows to make that happen very simply without searching the whole disk. Striping is based on RAID level 0.

What is disk mirroring in RAID ?

Disks mirroring is used to protect a computer system from loss of data. Mirroring provides to store data in several duplicate drives and which are connected to one disk controller card. The replication of data to two or more disks. High performance applications mainly use disk mirroring. Disk mirroring is based on RAID level 1.

What is parity in RAID ?

Parity is a calculated value that's used to restore data from other drives if a drive fails. RAID 5 is disk striping with parity.

RAID levels

RAID LEVEL 0

The RAID level 0 is mainly the process of dividing a body of data into blocks and spreading the data blocks across multiple storage devices which is called RAID striping. The devices can be hard disks or solid state drives (SSDs). The **diagram 1.1** shows how RAID level 0 works, as there shown the data which are dividing into two disks at a time.

Advantages and disadvantages of using RAID level 0.

- The first advantage of RAID level 0 is that it have higher number of input and output operations per second compared to single drives (HDD)
- The second advantage of RAID level 0 is improved performance, striping data across three hard disks provide three times the bandwidth of a single drive.
- The first disadvantage of RAID level 0 is it has a lack of redundancy which means the data may be lost in the event of a defective disk.
- The second disadvantage of RAID level 0 is the storage capacity of the individual drives are limited.

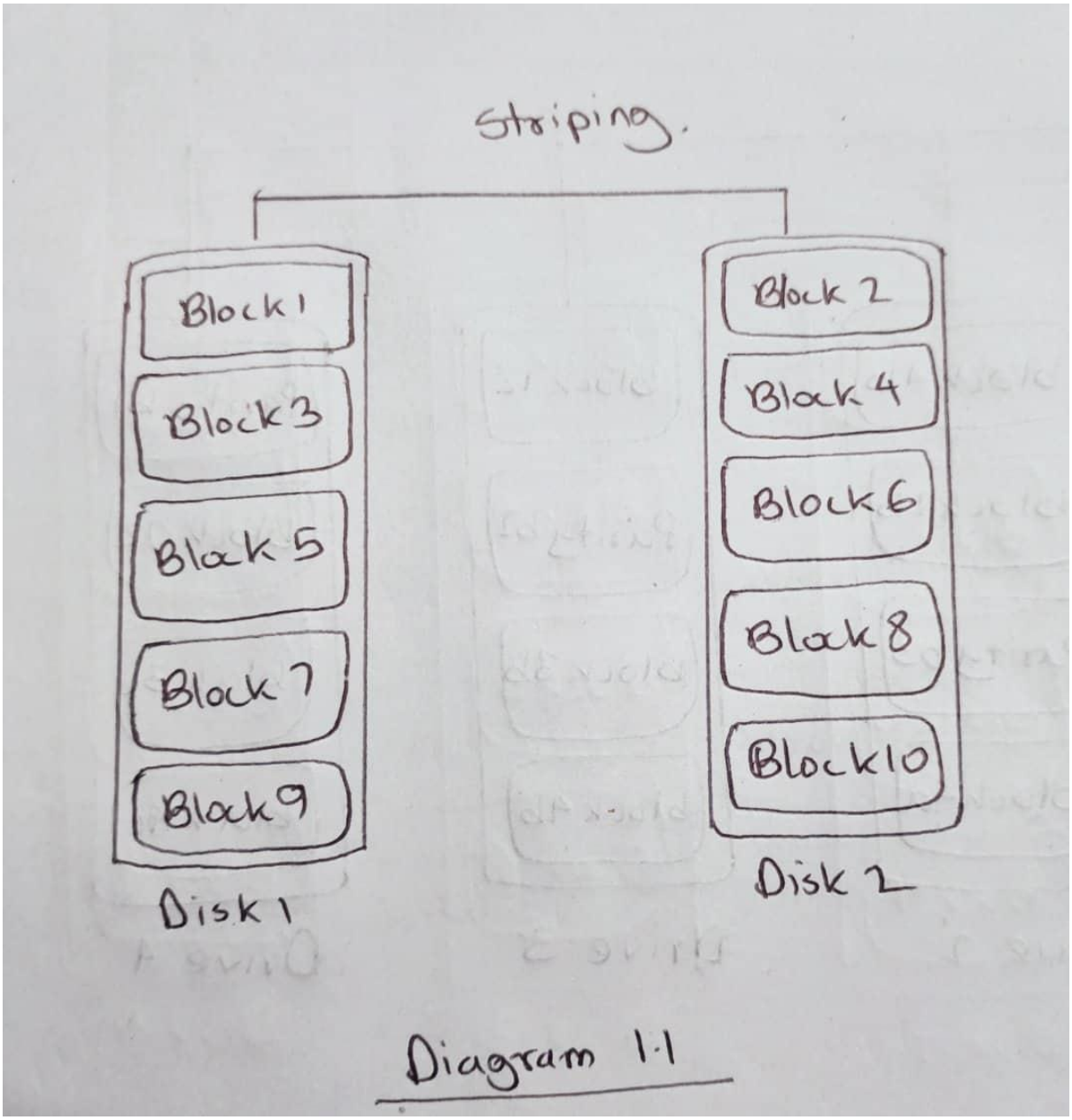
Striping.
Block 1
Block 3
Block 5
Block 7
Block 9
Disk 1
Block 2
Block 4
Block 6
Block 8
Block 10
Disk 2

Diagram 1.1

RAID LEVEL 1

Disk mirroring is mainly the RAID level 1 which is replication of data to two or more disks. The RAID level 1 is ideal for mission critical storage, for instance for accounting systems. The two data drive used system is very suitable for RAID level 1. The **diagram 1.2** shows how the RAID level 1 works. The diagram shows two drives of same blocks. Drive 1 and drive 2 gathering same information which indicates the formation of mirroring.

Advantages and disadvantages of using RAID level 1.

- The first advantage of RAID level 1 is that it has an increased read performance.
- The second advantage of using of RAID level 1 is that it is simple and easy to use.
- The first disadvantage of RAID level 1 is that it uses only half of the storage capacity.
- The second disadvantage of RAID level 1 is that it is an expensive method.

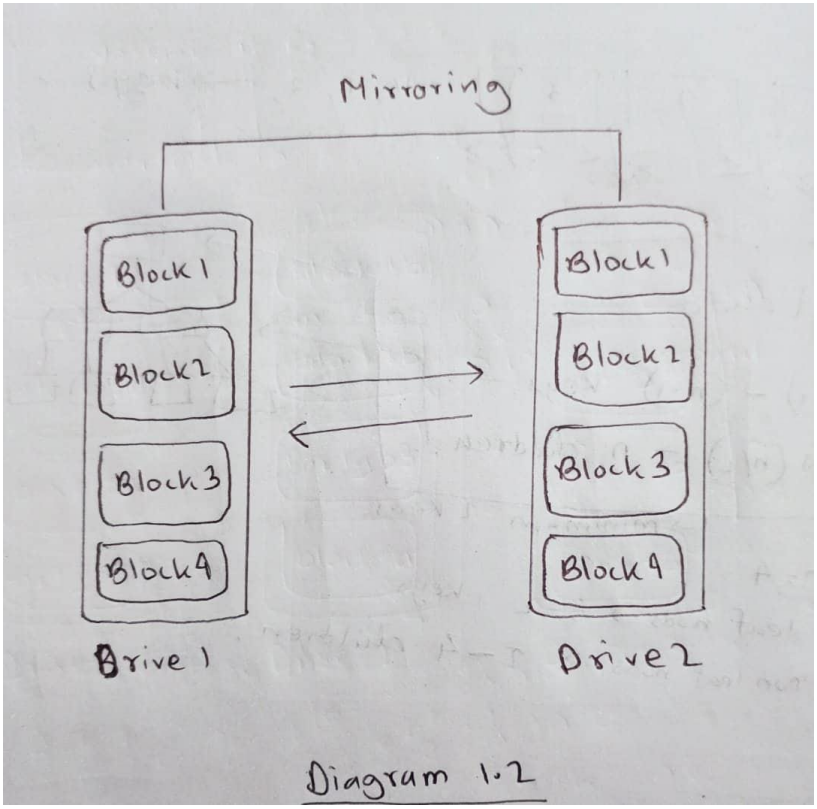

Diagram 1.2

RAID LEVEL 4

It is a standard configuration that uses block level data striping and a dedicated disk for storing parity bits. The disks in RAID 4 functions independently when single data blocks are required. RAID 4 doesn't distribute parity bits but it is almost similar to RAID 5. The **diagram 1.6** shows the RAID 4. The recovery from failure is mainly similar to the method of **XOR gate.**

Advantages and disadvantages of using RAID level 4.

- The first advantage of using RAID level 4 is, it has data blocking striping which gives a unique facility of doing several times input/output request.
- The second advantage of RAID level 4 is, it does not requires synchronized spindles or controller.
- The first disadvantage of RAID level 4 is the parity drives may lead to bottlenecks

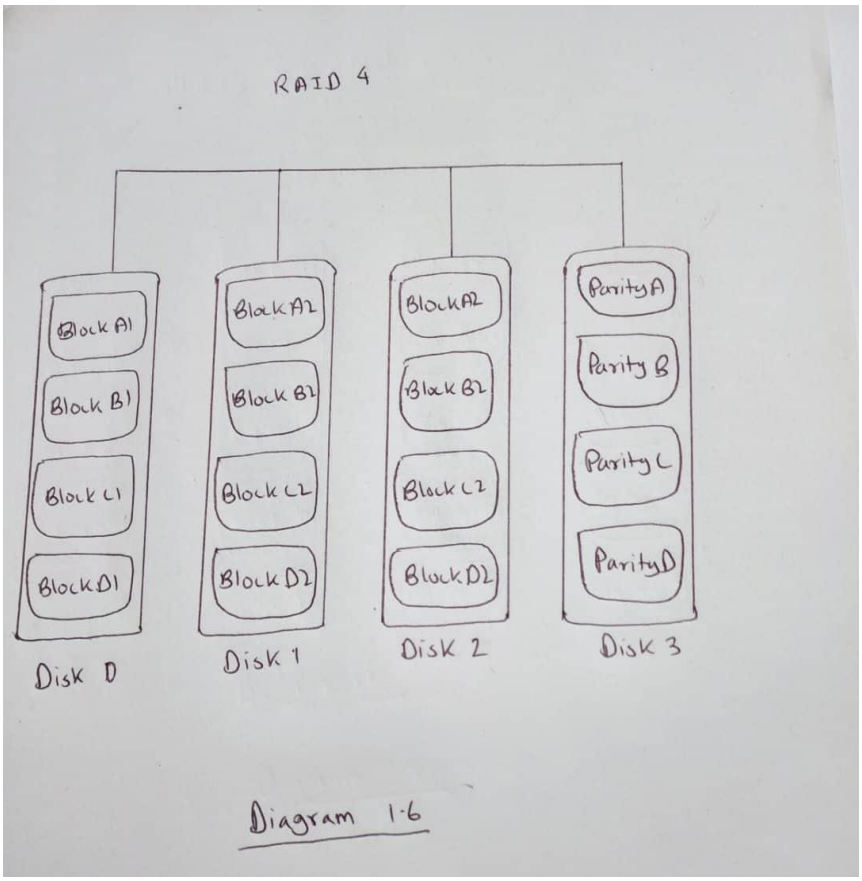

Diagram 1.6

RAID LEVEL 5

The RAID level 5 is usually the disk striping with parity. The data and parity are striped all over the disks or drives and no single disk is a bottleneck. So this kind of striping ensure the reconstruction data in case of any kind of failure. The **diagram 1.3** shows how RAID level 5 works. 4 drives having 4 block each where a parity block is present to distribute information among the drives.

Advantages and disadvantages of using RAID level 5.

- The first advantage of RAID level 5 is, it has increased reliability through parity.
- The second advantage of using of RAID level 5 is that it has good price performance ratio In terms of redundancy and storage optimization.
- The first disadvantage of RAID level 5 is, its write speed reduced compared to single drives.
- The second disadvantage of RAID level 5 is its storage capacity is limited which is similar to RAID level 0.

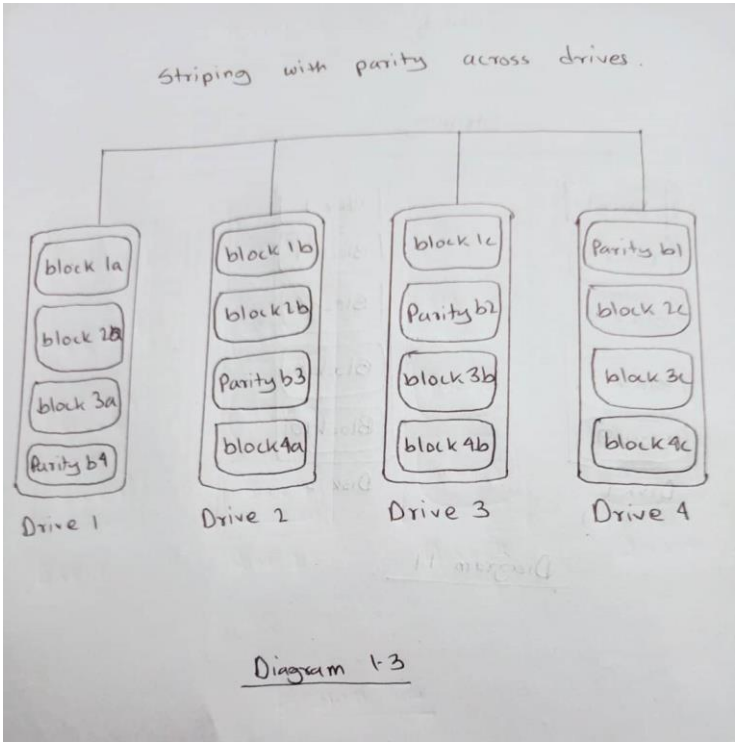

Diagram 1.3

RAID LEVEL 6

The benefits of using the RAID level 6 is for the parity protection. The lost data can be reconstructed by the IOA after any failure. The system will run if there is minimum failure of 2 disks. The RAID level 6 is the upper version of RAID level 5. RAID level 6 is also known as double parity RAID. The **diagram 1.4** shows how RAID level 6 works. 4 drives having 4 blocks each in which 2 parity blocks are present.

Advantages and disadvantages of using RAID level 6.

- The first advantage of RAID level 6 is, it has slightly improved throughput rate in the reading process compared to single drives.
- The second advantage of using of RAID level 6 is that it has excellent data accessibility.
- The third advantage of RAID level 6 is, it is highly secured.
- The first disadvantage of RAID level 6 is, it has significant restricted storage capacity.
- The second disadvantage of RAID level 6 is that it has slightly little chances of data lost.

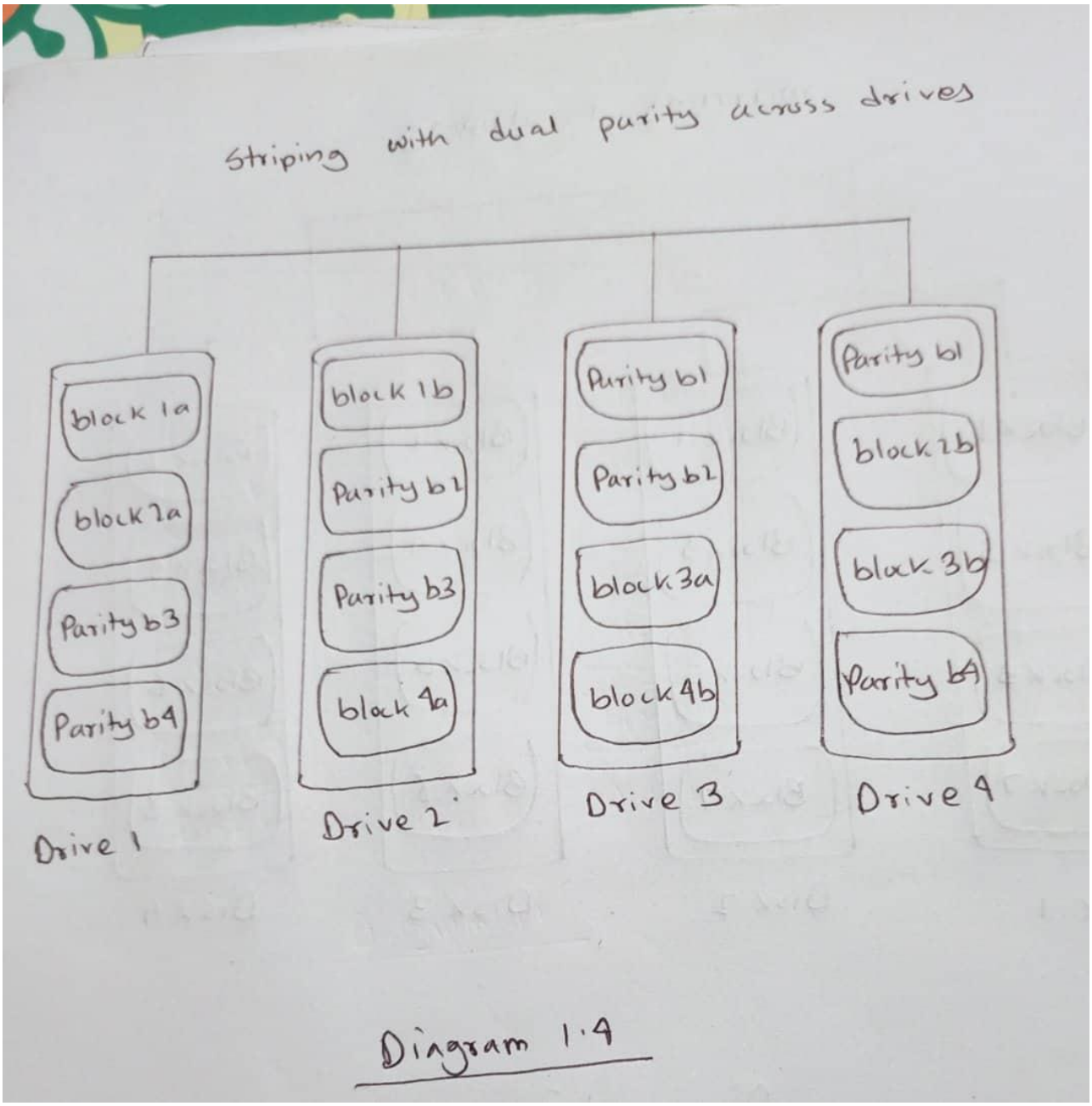
Striping with dual parity across drives
block 1a
block 2a
Parity b3
Parity b4
Drive 1
block 1b
Parity b2
Parity b3
block 4a
Drive 2
Parity b1
Parity b2
block 3a
block 4b
Drive 3
Parity b1
block 2b
block 3b
Parity b4
Drive 4

Diagram 1.4

RAID LEVEL 10

The RAID level 10 is the combination of the disk striping and disk mirroring. The RAID level 10 is also known as RAID level 1+0. The process of RAID level 10 is striping data across mirrored pair disks. 4 disks are required for the function of RAID level 10 because it can recover from multiple drive failure at a time. The **diagram 1.5** shows the RAID level 10.

Advantages and disadvantages of using RAID level 10.

- The first advantage of RAID level 10 is that its read speed is very fast compared to single drives.
- The second advantage of using of RAID level 10 is that it has an increased fail safety of the integrated hard drives.
- The first disadvantage of RAID level 10 is same as RAID level 0 and 5, which is limited storage capacity.
- The second disadvantage of RAID level 10 is, it has chances of whole system crashing.

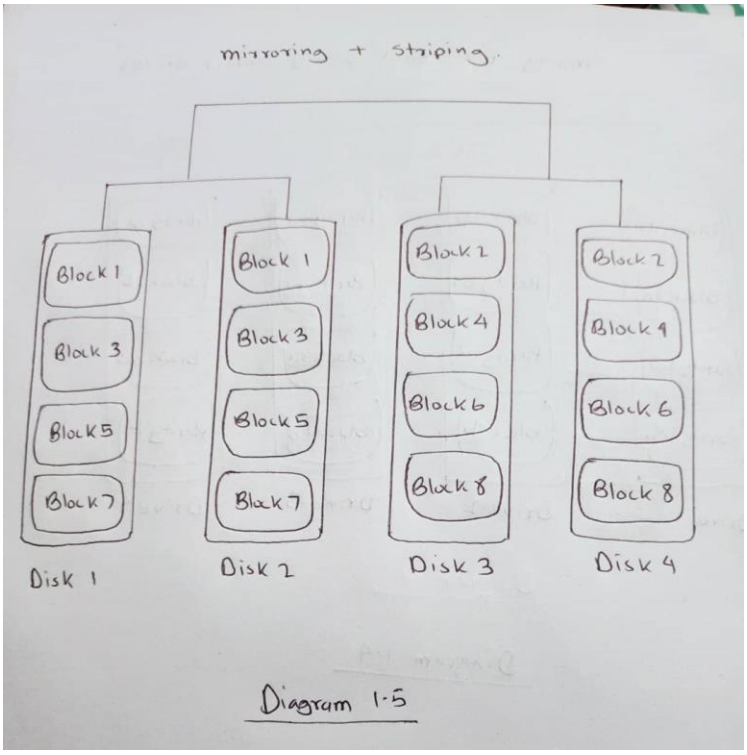

Diagram 1.5

Which RAID level is best for database ?

The RAID level is mainly based on the configuration of the storage system speed and data redundancy. For a good speed of a system RAID 0 have the most common use. For any kind of business severs or enterprise NAS devices RAID 5 is the best. So most of the time a huge database which needs to store so many information at a time, RAID 5 is the better option. RAID 5 ensures the rapid recovery, gives users full redundancy of all the data on the array and disks are easily replaceable.

Thank you

Reference: (https://phoenixnap.com/kb/raid-levels-and-types,

https://www.techopedia.com/definition/4569/disk-striping,

https://www.techtarget.com/searchstorage/definition/RAID-10-redundant-array-of-independent-disks,

https://www.lucidti.com/raid-4-level-4-raid-raid-level-4/,
https://www.stellarinfo.co.in/blog/advantages-and-disadvantages-popular-raid-systems/)