PHYSICAL DATA STORAGE

Ongole Campus

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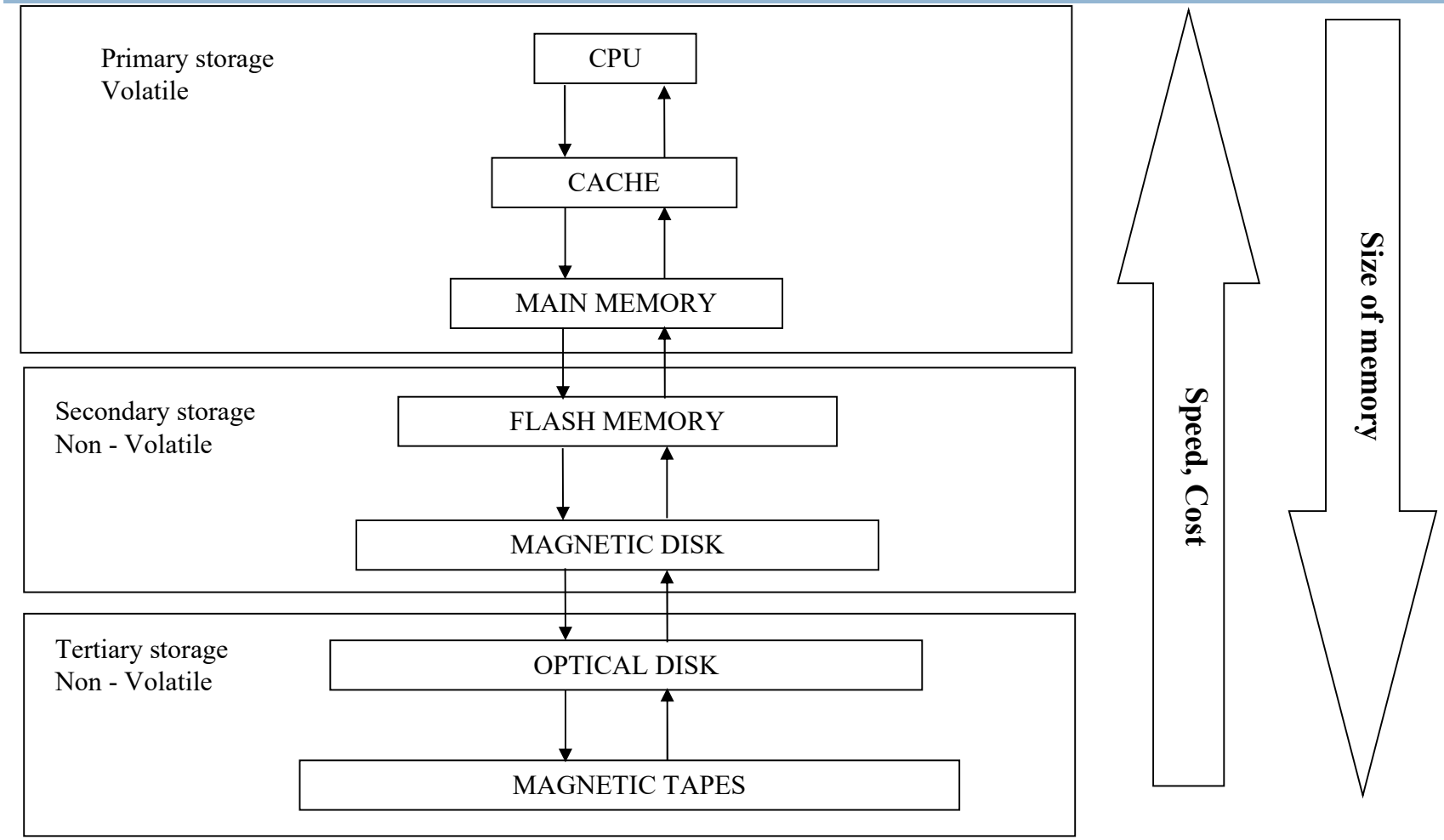
Memory hierarchy



RAID

- Introduced by David Patterson, Garth A. Gibson and Randy Katz at University of California, Berkeley in 1987.
- RAID - Redundant Array of Independent / Inexpensive Disks.
- Connect multiple secondary storage devices to increase –
  - Performance.
  - Data redundancy.
  - Reliability of the system.

RAID

- It contains array of disks in which multiple disks are connected to achieve different goals.
- Goals
  - Performance.
  - Error control.
  - Failure tolerance.

RAID

Advantages:

- Availability.
- Reliability - Consistency well.
- Capacity - Large amount of data store.
- High performance.
- Data loss prevention.

RAID

Disadvantages:

- Expensive – Controller cost.
- Data recovery becomes time consuming if multiple disk failures occur.

RAID

RAID (LEVEL – 0):

- Uses data striping to increase the performance.
- No redundancy.
- Enhances the speed.
- Effective utilization space is 100%.

RAID

RAID (LEVEL – 0):

- The data is broken into blocks and blocks are distributes among disks. each disks receive a block of data to read/write in parallel.

RAID

RAID (LEVEL – 0):

Pros –

- Throughput is multiple of no. of devices.
- Full disk space utilization.
- High performance.
- Minimum number of disk required is 2.

RAID

RAID (LEVEL – 0):

Cons –

- No error detection mechanism.
- No fault tolerance.
- Failure of one disk results in control loss of respective devices.

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RAID

RAID (LEVEL – 1):

- Mirroring.
- Instead of having one copy of the data, two identical copies of the data on two in different disks are maintained. This type of redundancy is known as “Mirroring”.

RAID

RAID (LEVEL – 1):

- Every write of a disk block involves write on both disks.
- This level uses mirror techniques.
- When data sent to RAID Controller, it sends to a copy of data to all the disks in array.
- Combines striping and mirroring.

RAID

RAID (LEVEL – 1):

- It provides 100% redundancy.
- 50% of space utilization.
- half space of drive is used to store the data.
- The other half of drive is just mirror to the already stored data.

RAID

RAID (LEVEL – 1):

Pros:

- Fault tolerance.
- The array will function even if any one of the drive fails.

Cons:

- Expensive.
- Requires extra space for mirroring.

RAID

RAID (LEVEL – 2):

- Error Correction Code (ECC).
- Bit level striping with dedicated Hamming code parity.
- Highly expensive and Complex structure.
- Cannot used for commercial purpose.

RAID

RAID (LEVEL – 2):

- Bit level striping.
- Each data bit in a word is related on separate disk and ECC of data word is stored on different set disks.
- No. of check disks increases logarithmically with no. of data disks.

RAID

RAID (LEVEL – 2):

Pros:

- Hamming code for error detection.
- Uses one partial drive to store parity.

Cons:

- Extra drives for error detection.
- No check disk will available for failure disk.

RAID

RAID (LEVEL – 3):

- Bit interleaved parity.
- Overcomes the draws backs of RAID level-2.
- Byte level striping with dedicated parity.
- Keeps redundant information that is necessary.

RAID

RAID (LEVEL – 3):

- Able to identify which disk has failed.
- Failed disk can be identified by using check disk.
- With the help of parity drive, the failure drive data can be reconstructed.

RAID

RAID (LEVEL – 3):

Pros:

- Lost data can be reconstructed using parity drive.
- Contains high data transfer rates.
- Parallel data accessing.

Cons:

- Slow performance.
- Extra drive for parity.
- Requires at least three disks for implementation.

RAID

RAID (LEVEL – 4):

- Block -interleaved parity.
- Block-level striping with distributed parity.
- Require at least three disks for implementation.
- One disk dedicated to parity.

RAID

RAID (LEVEL – 4):

- Parity can be calculated using an XOR function.

New Parity = (Old data XOR New data) XOR old parity

- Effective space utilization is 80%.
- Check disk is required.
- Recovery of disk failure.

RAID

RAID (LEVEL – 5):

- Block -interleaved distributed parity.
- Distributes the parity blocks uniformly over all disks instead of storing in single check disk.
- Allow recovery of at most one disk failure.

RAID

RAID (LEVEL – 5):

Pros:

- Cost effective and high performance.
- Parity distributed across all disks in an array.

Cons:

- Disks failure recovery take longer time as parity has to be calculated from all available drives.

RAID

RAID (LEVEL – 6):

- Block level striping with double distributed parity.
- Fault tolerance up to two failed drives.
- Requires minimum 4 disks and multiples of 2.

RAID

RAID (LEVEL – 6):

- Single drive failure results in reduced performance of the entire array until the failed drive has been replaced.

RAID

RAID (LEVEL – 6):

Pros:

- More practical.
- High availability.

Cons:

- Large capacity drives requires longer time to restore.
- Limited scalability.
- Cannot use total disk capacity.

Disk space manager

- The software which manages the disk space is known as disk manager.
- Disk manger is responsible for allocation and de-allocation of the space in the disk for read and write operations.
- It uses paging technique.

Disk space manager

As Database grows and Shrinks while records are inserted and deleted over time.

Therefore, the Disk Space Manager Keeps track of which disk blocks are in use, in addition to keeping track of which pages are on which disk blocks.

Disk space manager

Methods to track memory blocks availability:

- Maintaining the list of free blocks –
  - As blocks are de-allocated, add them to the free list.
- Bitmap –
  - Use one bit for each disk block to indicate whether the block is in use (or) not.
  - It very fast method to identify and allocate contiguous area of disk.

Buffer manager

- The buffer manager is a software that is responsible for bringing pages from physical disk to main memory as needed.

Buffer manager

- The goal of the buffer manager is to ensure that the data requests made by programs are satisfied by copying data from secondary storage devices into buffer.

Buffer manager

- Buffer manager uses pin_count and dirty variable to keep track of frame use information.
- For each page request pint_count get incremented.
- After page releasing pin_count get decremented.
- If the page is modified then the Boolean variable dirty is set as “on”. Otherwise “off” .

File organization and indexes

- Disk space management:

  Should Operating System services be used ?

  Should RDBMS manage the disk space by itself ?

  - RDBMS requires complete control over when a block or page in main memory buffer is written to the disk.

  This is important for recovering data when system crash occurs

File organization and indexes

- File is a Sequence of records stored in binary format.
- A Disk drive formatted into several blocks that can store records.
- File organization defines how file records are mapped on the disk blocks. It is logical relationships among various records.
- In simple terms, Storing the files in certain order is known as “File organization”.

References

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Thank You