Secondary Storage

Secondary Storage

Floppy disks

Flash Drives

Hard Drives
- HDD: Hard Disk Drive
- SSD: Solid State Drive

RAID

Cool, someone 3D printed the Save icon.

Floppy disks

8”, 5.25”, 3.5” (200mm, 133mm, 90mm)

IBM PC: 2 floppy drives

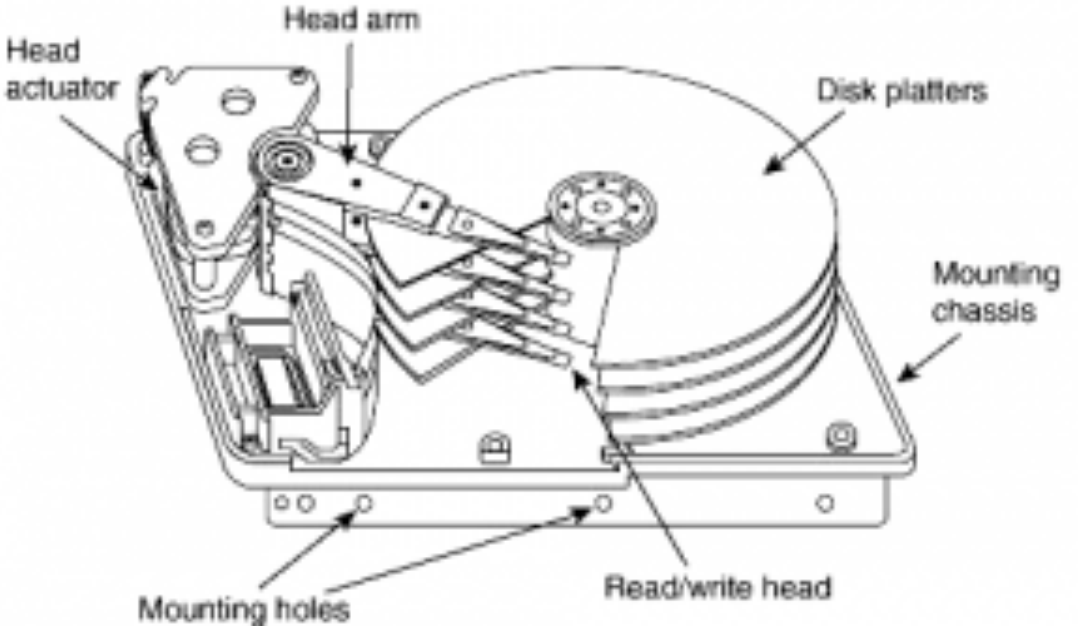
Hard Disk Drive (HDD)

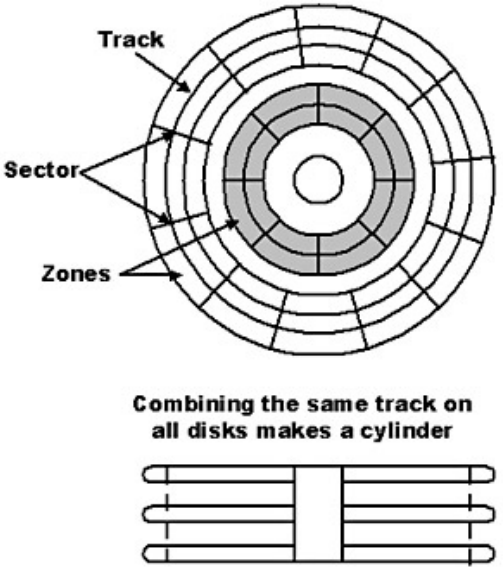
8TB & 10TB HDD available

Secondary Storage

Magnetic - non-volatile

Classic iPod





HDD

I think Silicon Valley was misnamed. If you look back at the dollars shipped in products in the last decade, there has been more revenue from magnetic disks than from silicon. They ought to rename the place Iron Oxide Valley.

Al Hoagland A pioneer of magnetic disks (1982)

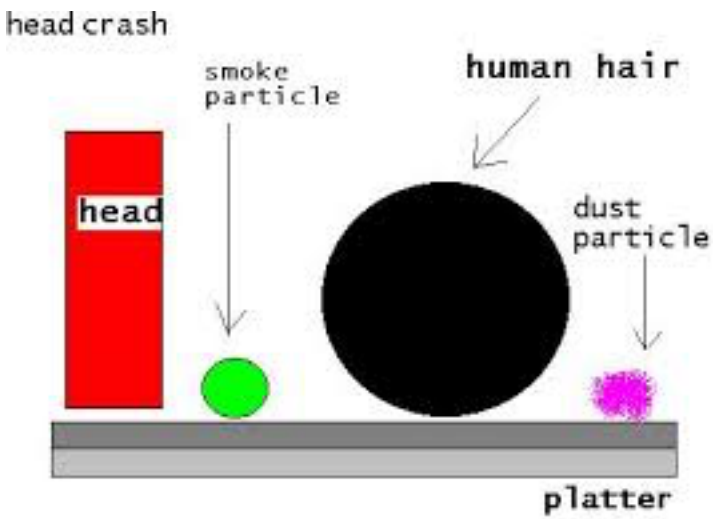
HDD Performance

Time to access data
- Seek time
  - how long it takes the head assembly to travel to the track of the disk that contains data
- Rotational latency
  - desired disk sector may not be directly under the head when data transfer is requested

Rpm – revolutions per minute (eg 7200 rpm)
- Seek time & Rotational latency ~ 4ms

Bit rate – data transfer rate
- ~1Gbit/s

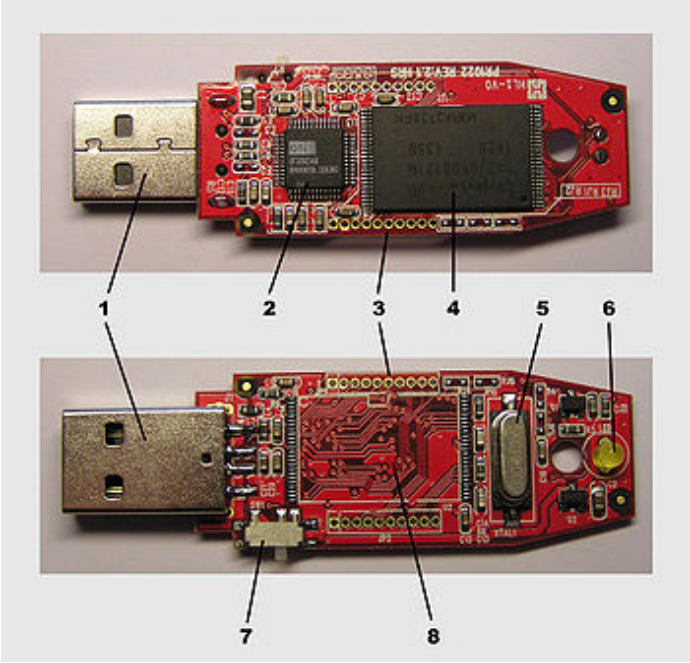
Fragile
- Head crash



Flash Drives

AKA
- Pen Drive
- Thumb Drive
- USB Drive, etc

Flash Memory
- Non volatile
- typically NAND
- 8MB — 1TB



1 USB Standard-A, "male" plug
2 USB mass storage controller device
3 Test point
4 Flash memory chip
5 Crystal oscillator
6 LED (Optional)
7 Write-protect switch (Optional)
8 Space for second flash memory chip

https://en.wikipedia.org/wiki/USB_flash_drive

SSD - Solid State Drive

SSD

Secondary Storage
- Replacement for HDD
  - HDD form factors (3.5” & 2.5”)

No moving parts – more durable, shock resistant
- ~100 times faster than HDD


HDD

NAND-based flash
- Same as in USB flash drives and memory cards

Consumes less power, cooler, quieter
- But of course – more expensive

1TB HDD €50 for an HDD, SSD is Was €250, Now €150

Rumours that SDDs will ‘wear out’
- Probably strictly true but not something to worry about

Quick Quiz

Like conventional hard drives, solid-state drives are electromechanical devices.

True
False

Because they have no moving parts SSDs have an indefinite lifespan.

True
False

Which of these is NOT a benefit of SSDs?

a. Faster startup
b. Shorter seek times
c. Lower cost
d. More Durable

Rank SRAM, DRAM and Flash in order fastest to slowest?

a. DRAM, SRAM, Flash
b. SRAM, DRAM, Flash
c. SRAM, Flash, DRAM

Disk Partitions

Disks can be formatted for different file systems
- e.g. MS-DOS (FAT), NTFS

Divide physical disk into ‘logical’ disks

Why?
- Security
  - Different access levels (OS & User partitions)
  - A temp/scratch disk (partition)
- Some Unix systems put swap in a separate partition
- Different File System formats
- Different OS boot partitions

Boot partition
- Special partition containing the OS Kernel

Disk arrays - RAID

Redundant Array of Inexpensive (Independent) Disks

Multiple physical disk is a single logical (virtual) unit

Redundancy

- improves dependability and performance
- many disk drives and many disk arms, rather than fewer large drives
- However, with more drives, dependability decreases – based on reliability of a single device
- Therefore – adding redundant disks, and if a single disk fails, reconstruct lost information from redundant information

https://en.wikipedia.org/wiki/RAID

RAID techniques

Striping
- Stripe data evenly across multiple drives

Mirroring/shadowing
- 2 copies of every piece of data

Parity information
- Eg XOR data from drive 1 with drive 2 and store on drive 3; if 1 or 2 fails, xor back to get original

RAID Levels

RAID 0 - striping

RAID 1 – full mirroring

RAID 2 – Hamming code for error correction
Redundancy allows error correction
Hamming code Wikipedia page (not on syllabus)

RAID 3 – striping/parity

RAID 4 – striping/parity

RAID 5 – striping/parity

RAID 6 – striping/parity

Dell Products <link>

Standard RAID Levels

RAID 0, Raid 1 and RAID 5 most widely used

Differ in levels of fault tolerance (0-2 drive failures), read/write performance etc

You need to notice that a drive has failed!

Secondary Storage

Floppy disks

Flash Drives

Hard Drives
- HDD: Hard Disk Drive
- SSD: Solid State Drive

RAID

Cool, someone 3D printed the Save icon.