

Storage

Chapter 3

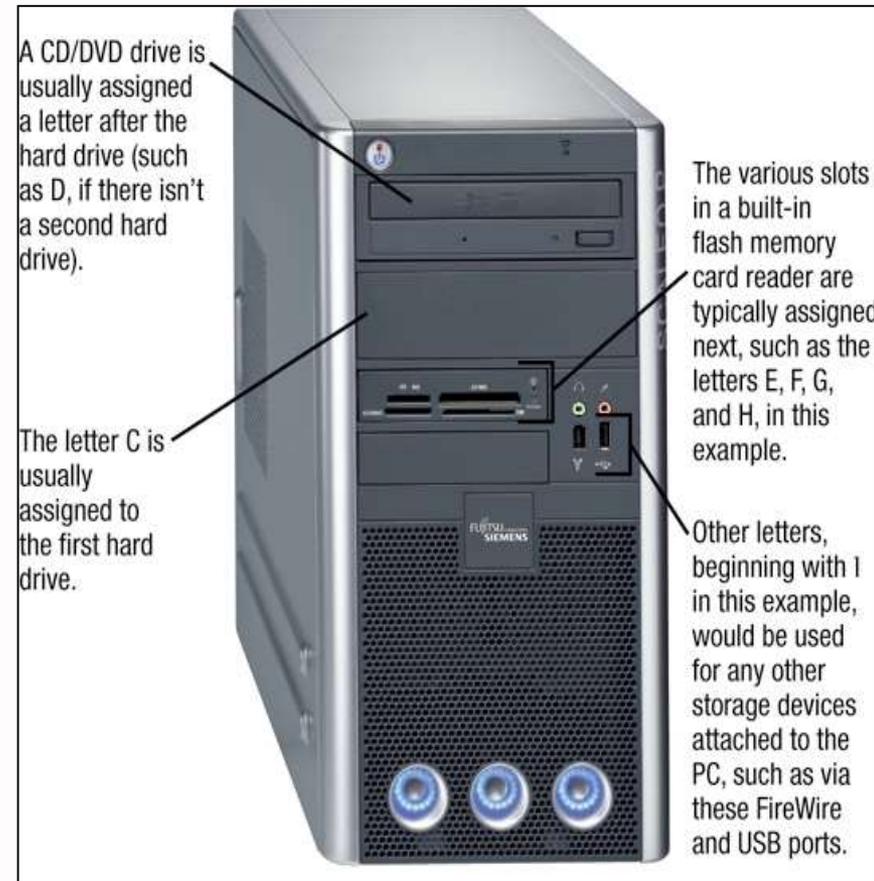
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Storage System Characteristics



- Consist of a storage device and a storage medium
 - Device: DVD drive, flash memory card reader, etc.
 - Media: DVD disk, flash memory card, etc.
 - Media is inserted into device to be used
 - Storage devices are typically identified by letter

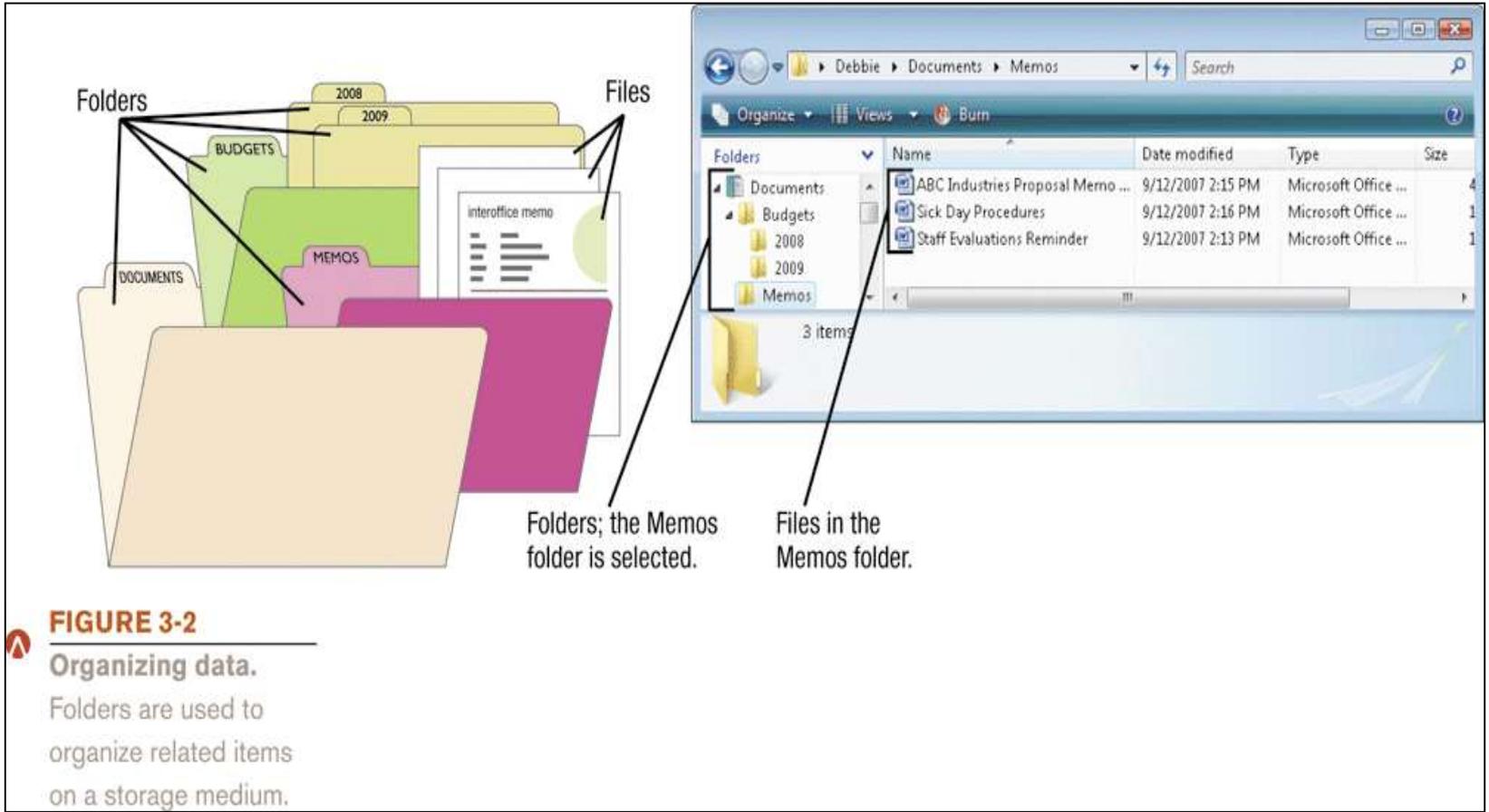


Storage System Characteristics



- Can be internal, external, or remote
- Are nonvolatile
- Usually use random access; can be sequential
- Logical file representation: The user's view of the way data is stored
 - File: something stored on a storage medium, such as a program, document, or image
 - Filename: name given to a file by the user
 - Folder: named place on a storage medium into which files can be stored
- Physical file representation: The actual physical way the data is stored on the storage media as viewed by the computer

Logical vs. Physical Representation



Magnetic Disks vs. Optical Discs



- With magnetic media, such as floppy discs, data is stored magnetically
 - The data (0s and 1s) is represented using different magnetic alignments
- Optical media (such as CDs and DVDs) store data optically using laser beams
 - Data can be permanently burned on the disc
 - Rewritable optical media can be erased and rewritten
- Some storage systems combine magnetic and optical technology
- Others like flash memory represent data using electrons

Magnetic Disk Systems

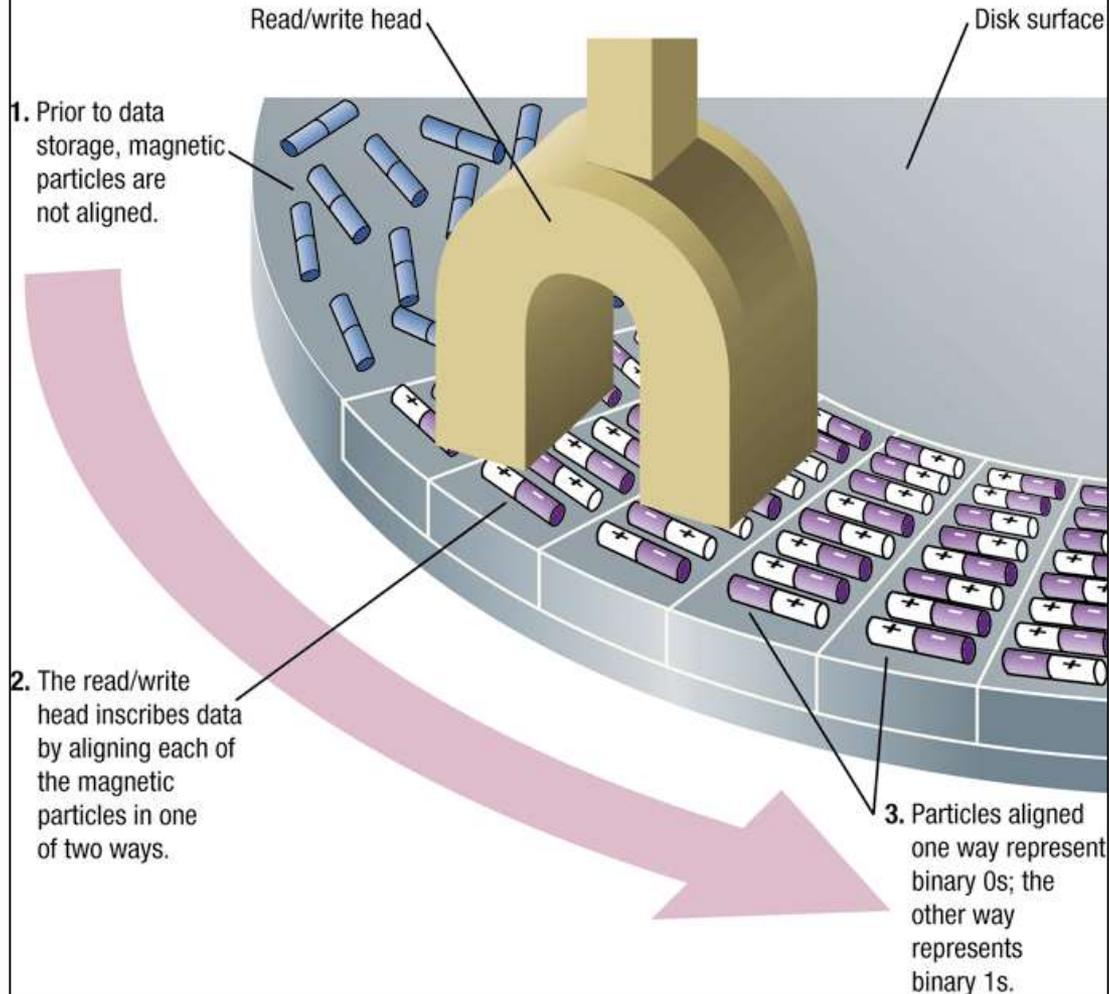


- Magnetic disks: Record data using magnetic spots on disks made of flexible plastic or rigid metal
 - Most widely used storage medium on today's computers (hard drives)
 - Disks are divided into tracks, sectors, and clusters
 - Data written and read using read/write heads
- Common types
 - Floppy disks (common removable storage medium in the past; not widely used today)
 - Hard disks (included on nearly all PCs today)
 - Zip disks (high-capacity magnetic discs that are proprietary)

Magnetic Disk Systems



FIGURE 3-3
Storing data on magnetic disks.

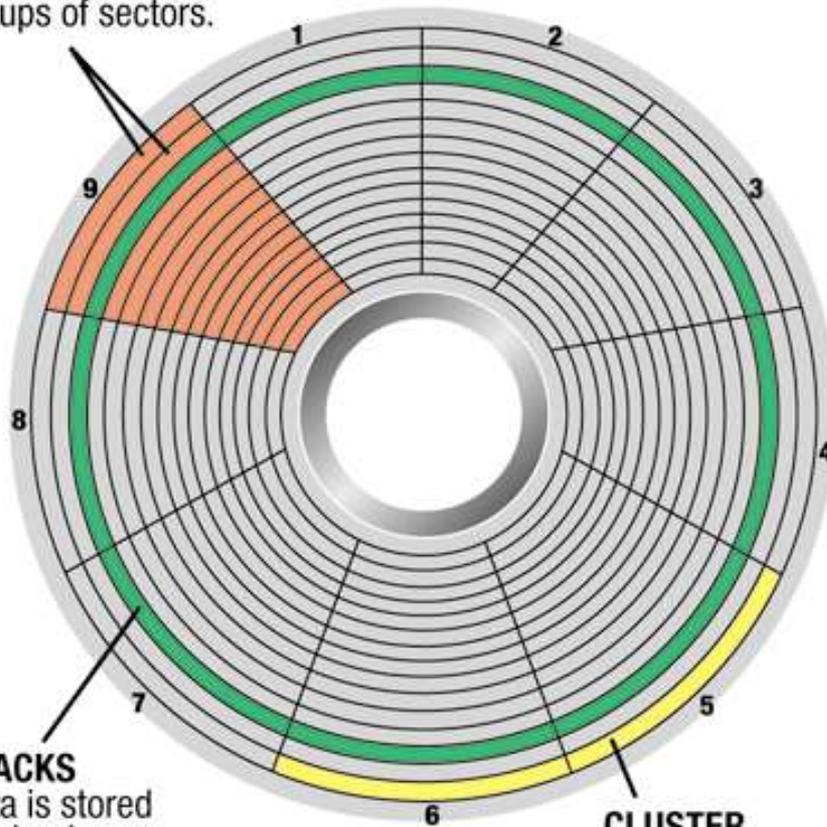


Magnetic Disk Systems



SECTORS

Each track is divided into pie-shaped groups of sectors.



TRACKS

Data is stored on circular tracks; the 0s and 1s are represented magnetically.

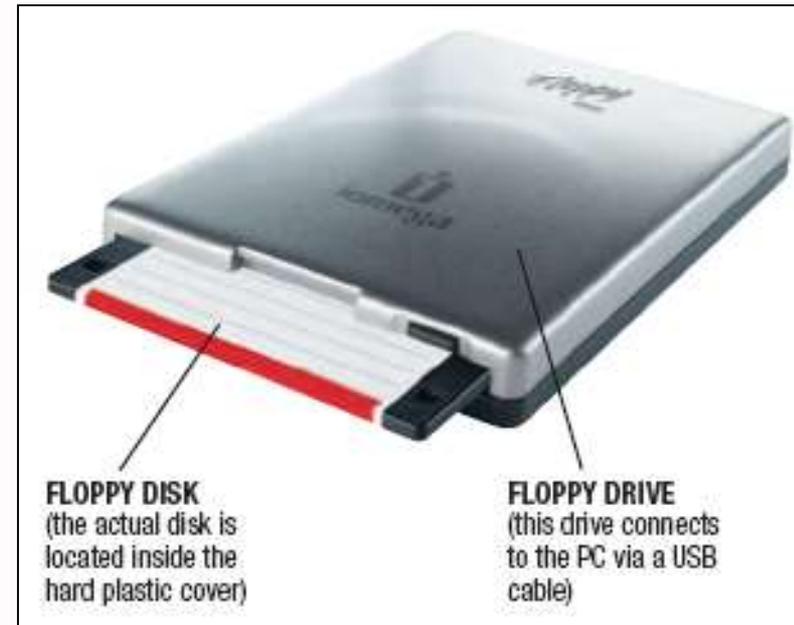
CLUSTER

One or more sectors form a cluster, the smallest storage area on a disk.

Floppy Disks and Drives



- Floppy disk: Low capacity, removable magnetic disk
 - Made of flexible plastic, permanently sealed inside a hard plastic cover
 - Typically hold 1.44 MB each
 - Not widely used today
 - Read by floppy drives; sometimes referred to as a legacy drive



Hard Disk Drives (HDDs)



- Hard drive: Storage system consisting of one or more metal magnetic discs permanently sealed with an access mechanism inside its drive
 - Can be internal or external
 - Found in most computers
 - Also used in many consumer devices, such as DVRs, gaming consoles, etc.
 - Use one or more metal disks
 - Data is stored magnetically
 - Disks are permanently sealed inside the hard drive to avoid contamination and to enable the discs to spin faster

Hard Disk Drives (HDDs)



MOUNTING SHAFT
The mounting shaft spins the disks at a speed of several thousand revolutions per minute while the computer is turned on.

SEALED DRIVE
The hard disks and the drive mechanism are hermetically sealed inside a case to keep them free from contamination.

READ/WRITE HEADS
There is a read/write head for each disk surface. On most systems, the heads are positioned on the same track and sector on each disk so they can move in and out together.

HARD DISKS
There are usually several hard disk surfaces on which to store data. Most hard drives store data on both sides of each disk.

ACCESS MECHANISM
The access mechanism moves the read/write heads in and out together between the hard disk surfaces to access required data.

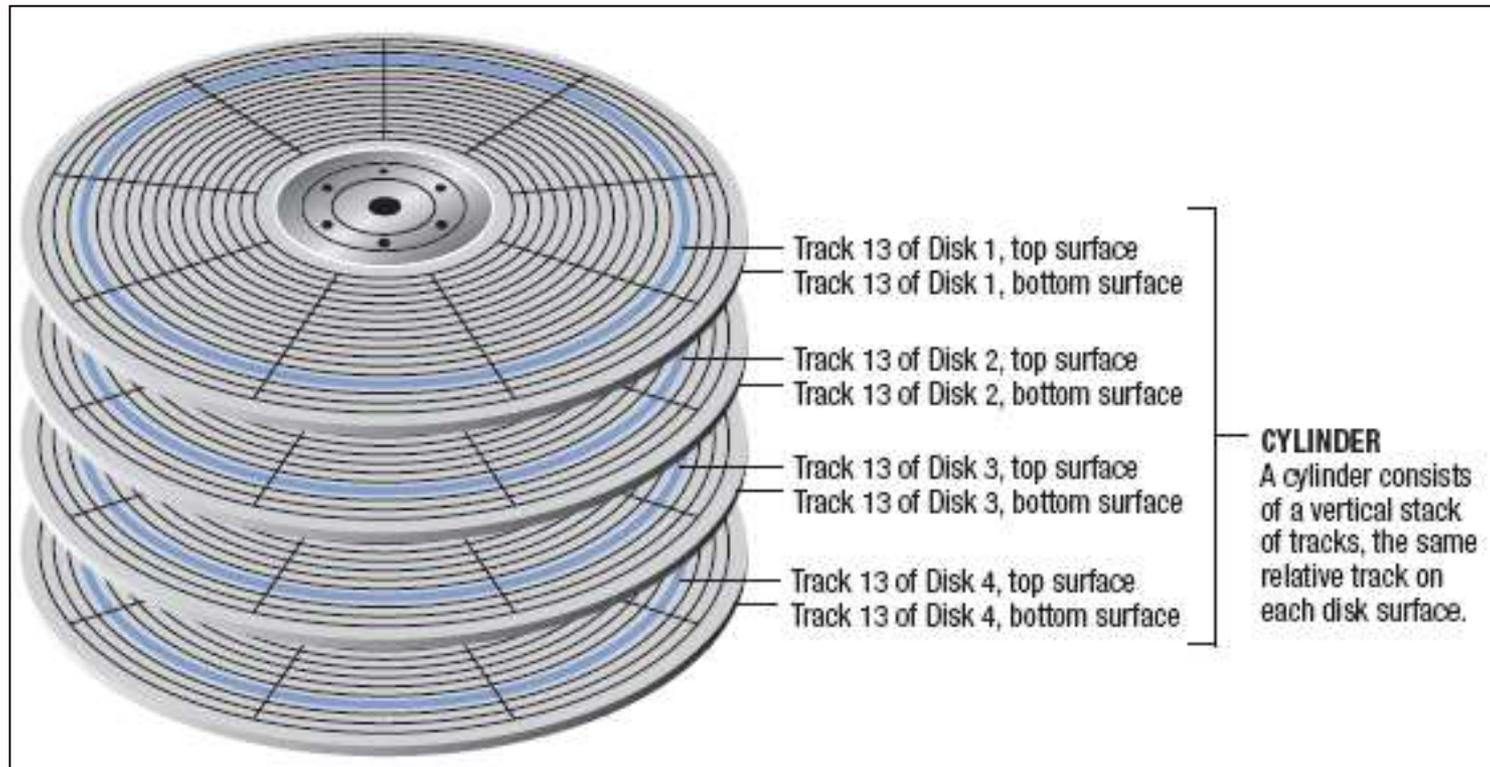
INSIDE A 3.5-INCH HARD DRIVE

2.5-INCH HARD DRIVE LOCATED INSIDE A NOTEBOOK PC

Hard Disk Drives (HDDs)



- Organized into tracks, sectors, and clusters like floppy disks
- Also use cylinders (the collection of tracks located in the same location on a set of hard disc surfaces)



Hard Disk Drives (HDDs)



- Read/write head doesn't touch the surface of the disc
 - Head crashes can occur
 - Backing up is important
- Most hard disks are sealed inside the drive
 - Some hard drive systems use hard disk cartridges
- HDDs can be:
 - Internal: Permanently located inside the system
 - External: Connected via a USB or FireWire port
 - Portable: Designed to transport large amounts of data from one PC to another
 - Pocket: Very small and portable

Internal, External, and Portable Hard Drive Systems



EXTERNAL HARD DRIVE
Holds 750 GB.



PORTABLE HARD DRIVE
Holds 250 GB.



POCKET HARD DRIVE
Holds 60 GB.



HARD DISK CARTRIDGE SYSTEM
Each cartridge holds 70 GB.

Internal, External, and Portable Hard Drive Systems



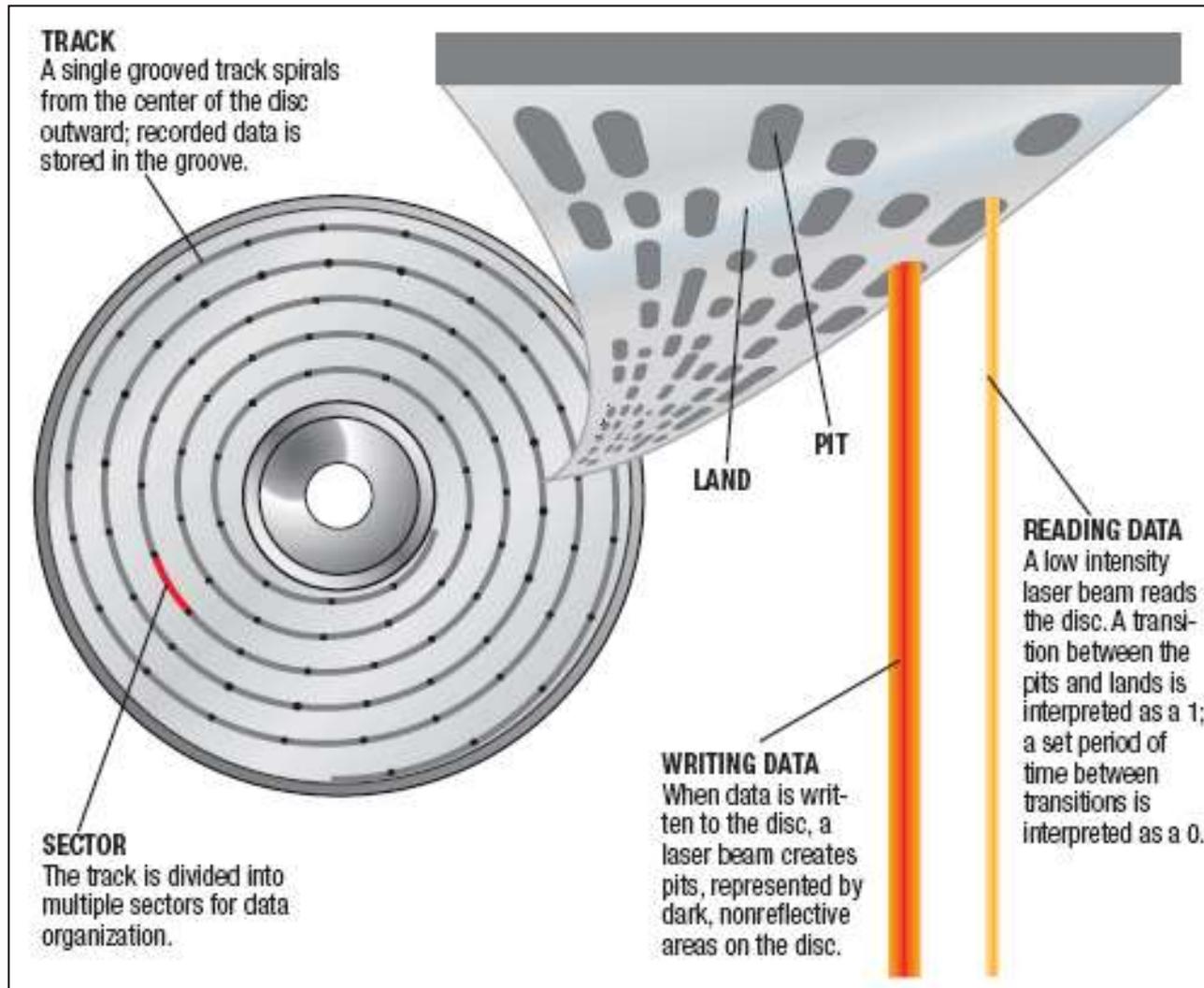
- Internal and external hard drives today typically hold between 80 GB and 2 TB
 - Portable and pocket hard drives hold less
- Longitudinal recording: Magnetic particles are aligned horizontally
- Perpendicular recording: Flips bits upright to fit them closer together to increase capacity
- Other technologies may be used to increase capacity in the future
- Security: Some hard drives used fingerprint readers or encryption to protect the data on the drive.

Optical Disc Systems



- Optical discs: store data optically (using laser beams) instead of magnetically
 - Divided into tracks and sectors like magnetic discs but use a single grooved spiral track
 - Can be read-only, recordable, or rewritable
 - Conventional CD discs use infrared lasers
 - DVDs use red lasers
 - High-definition DVDs use blue-violet lasers to store data more compactly
- Burning: Recording data onto an optical disc
 - Pits and lands are used to represent 1s and 0s
 - Pits can be molded into the disc surface or created by changing the reflectivity of the disc
 - The transition between a pit and a land represents a 1; no transition represents a 0

Optical Disc Systems



Optical Disc Size and Capacity



- Standard sized disc is 120 mm
 - Smaller (80 mm) discs, called minis, also exist
- Optical discs can be made in a variety of sizes and shapes
 - Business card CDs
 - Custom shapes are more expensive to produce
- Flexible DVDs: Can be bent and rolled up.



Optical Disc Size and Capacity



- CDs and DVDs have a large capacity
 - Multiple layers and multiple sides can be used to increase capacity
 - Standard CD discs hold 650 MB to 700 MB
 - Standard DVD discs hold 4.7 GB (single-layer disc) or 8.5 GB (double-layer disc)
 - High definition DVDs hold up to 50 GB
- Optical discs also have great durability
 - Do not degrade with use, but should be handled carefully

Read-Only Discs



- Can be read from, but not written to, by the user
- CD-ROM (compact disc read-only memory)
 - Usually holds about 650 MB
- DVD-ROM (digital versatile disc read-only memory)
 - Holds 4.7 GB (single-sided); 8.5 GB (double-sided)
- BD-ROM and HD DVD-ROM
 - Both hold more content, but are currently in strong competition
- Read-only disc formats also exist for gaming systems (UMD discs)
- Are read by an appropriate drive
- Hybrid drives can read multiple formats

Recordable Discs



- Can be written to, but cannot be erased and reused
- Used for back up, sending large files to others, creating custom music CDs, storing home movies, etc.
- Are written to using an appropriate optical drive
- CD-R discs: Recordable CDs
- DVD-R/DVD+R discs: Recordable DVDs
 - DVD+R DL and DVD-R DL discs use two recording layers (8.5 GB capacity)
- BD-R/HD DVD-R discs: high-definition



REWITABLE CD-RW DISC
Single-layer disc—holds 650 MB.



RECORDABLE DVD+R DL DISC
Dual-layer disc—holds 8.5 GB.



RECORDABLE BD-R DL DISC
Dual-layer disc—holds 50 GB.

Rewritable Discs



- Can be recorded on, erased, and overwritten just like magnetic discs
- Most common formats: CD-RW, DVD-RW, BD-RE and DVD+RW discs
 - HD DVD-RW discs are expected to be available soon
- Phase-change technology: Used to record and erase rewritable optical discs
 - Heating and cooling process is used to change the reflectivity of the disc
- Ultra Density Optical (UDO) discs
 - Expected on the market in about 5 years
 - Optimized for data storage rather than home entertainment applications

Flash Memory Systems



- Use flash memory media
 - No moving parts so more resistant to shock and vibration, require less power, makes no sound
 - Solid-state storage system
- Most often found in the form of:
 - Flash memory cards
 - USB flash drives
 - Solid-state drives
 - Hybrid hard drives
- Very small and so are very appropriate for use with digital cameras, digital music players, handheld PCs, notebook computers, smart phones, etc.

Flash Memory Systems



EMBEDDED FLASH MEMORY

These sunglasses contain a built-in MP3 player with 1 GB of embedded flash memory for storing MP3 files.



Flash memory card

FLASH MEMORY CARDS AND READERS

Flash memory cards are often used to store data for a digital camera or other device; that data can be transferred to a PC via a flash memory card reader.



USB FLASH DRIVES

USB flash drives are often used to store data and transfer files from one PC to another.



SOLID-STATE DRIVES

This solid-state drive fits into an ExpressCard slot and holds 32 GB of data.

Flash Memory Cards



- Flash memory card: A small card containing flash memory chips and metal contacts to connect the card to the device or reader that it is being used with
 - CompactFlash
 - Secure Digital (SD)
 - Secure Digital High Capacity (SDHC)
 - MultiMedia Card (MMC)
 - xD Picture Card
 - Memory Stick
 - SmartMedia (SM)
- Read by flash memory card reader.

Flash Memory Cards



FLASH MEMORY CARD READER

This reader connects to a USB port and can be used with several different types of flash memory media.



COMPACTFLASH (CF) CARD



MEMORY STICK



SECURE DIGITAL (SD) CARDS



XD PICTURE CARD

USB Flash Drives



- Flash memory drives: Consist of flash memory media and a reader in a single self-contained unit
 - Typically portable drives that connect via a USB port
 - Also called USB flash memory drives, thumb drives, jump drives
 - Come in a variety of appearances.

