

Chapter Seven

Storage

**Discovering
Computers 2012**

**Your Interactive Guide
to the Digital World**



Objectives Overview

Differentiate between storage devices and storage media

Describe the characteristics of an internal hard disk including capacity, platters, read/write heads, cylinders, sectors and tracks, revolutions per minute, transfer rate, and access time

Discuss the purpose of network attached storage devices, external and removable hard disks, and hard disk controllers

Describe the various types of flash memory storage

Objectives Overview

Describe cloud storage
and explain its
advantages

Describe the
characteristics of optical
discs

Differentiate among
various types of optical
discs: CDs, archive discs
and Picture CDs, DVDs,
and Blu-ray Discs

Identify the uses of tape,
magnetic stripe cards,
smart cards, microfilm
and microfiche, and
enterprise storage

Storage

Storage holds data, instructions, and information for future use

A **storage medium** is the physical material on which a computer keeps data, instructions, and information

Storage



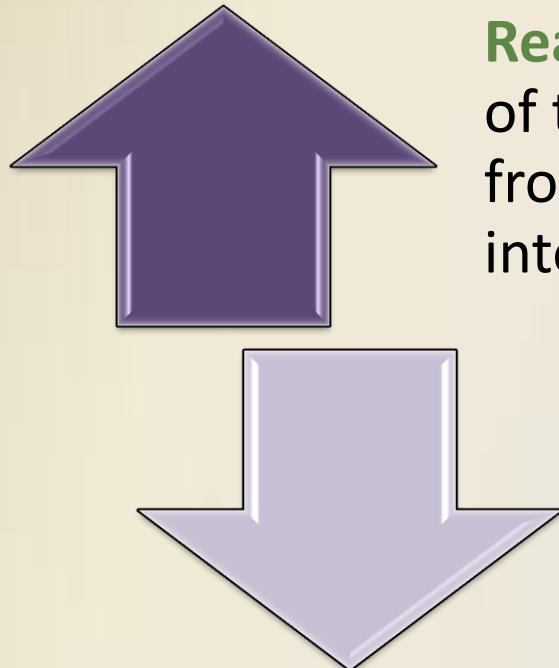
Storage

- **Capacity** is the number of bytes a storage medium can hold

Storage Terms		
Storage Term	Approximate Number of Bytes	Exact Number of Bytes
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176

Storage

- A **storage device** is the computer hardware that records and/or retrieves items to and from storage media

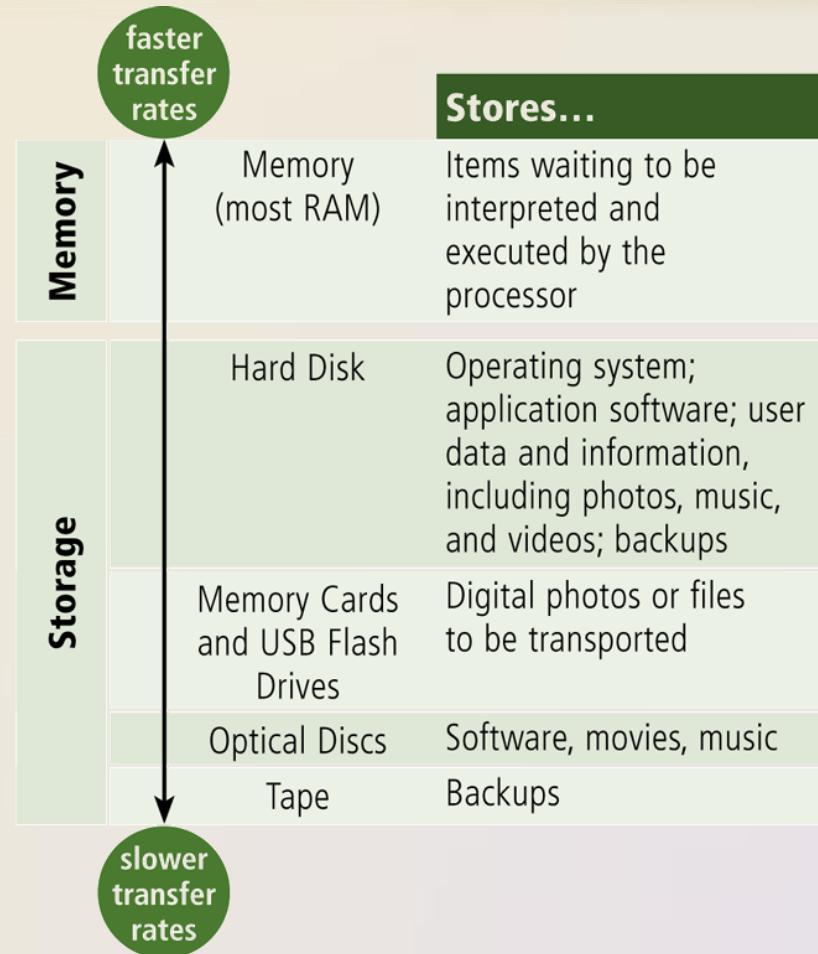


Reading is the process of transferring items from a storage medium into memory

Writing is the process of transferring items from memory to a storage medium

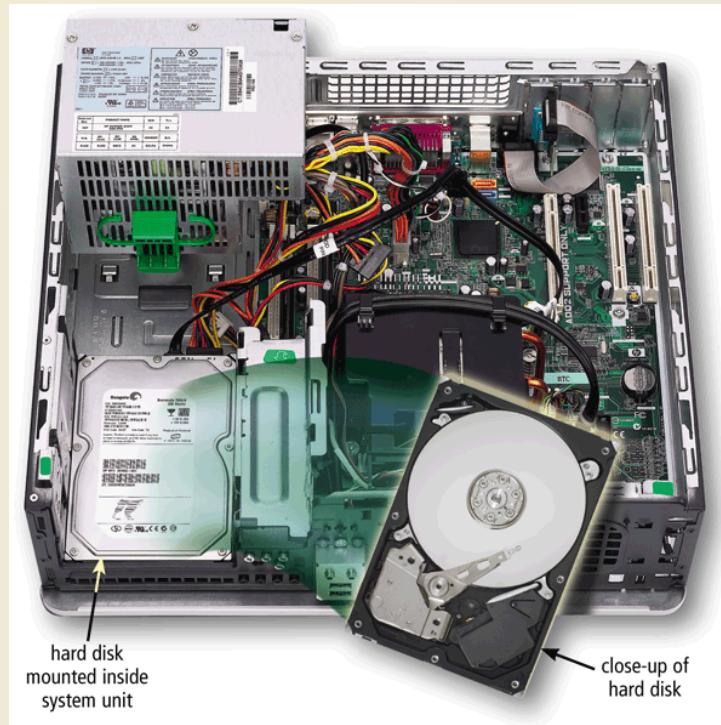
Storage

- **Access time measures:**
 - The amount of time it takes a storage device to locate an item on a storage medium
 - The time required to deliver an item from memory to the processor



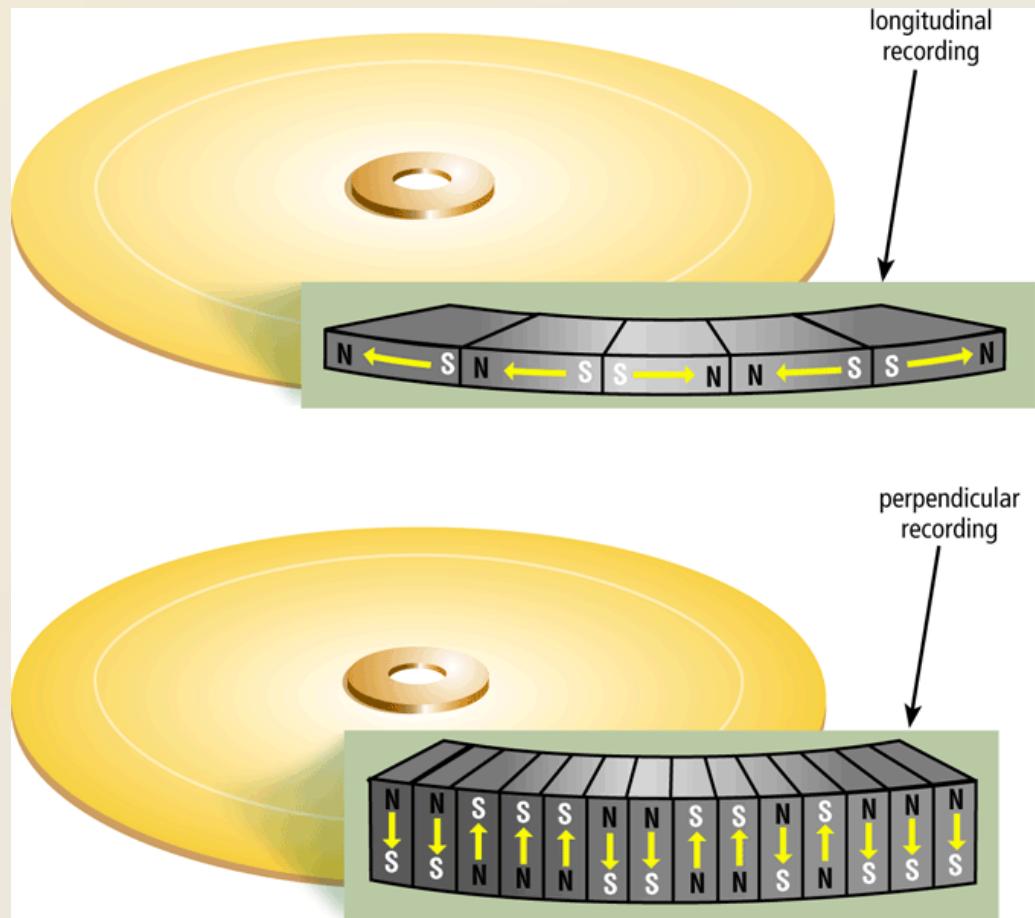
Hard Disks

- A **hard disk** contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information



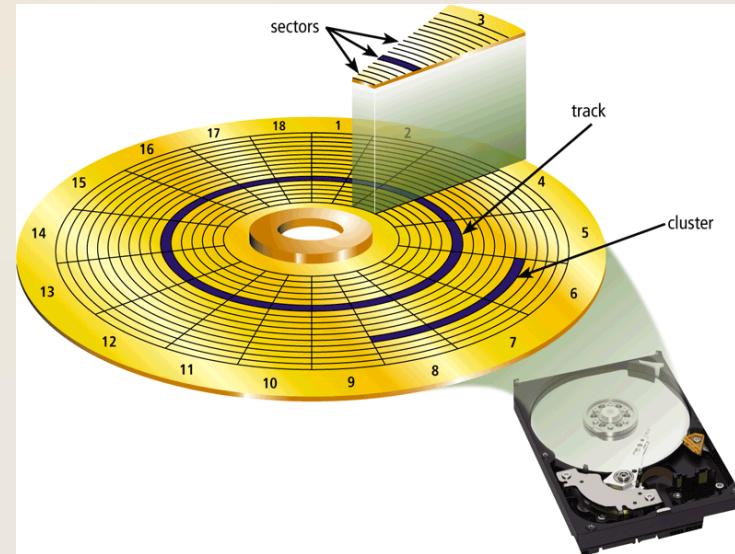
Hard Disks

- Hard disks can store data using longitudinal recording or perpendicular recording



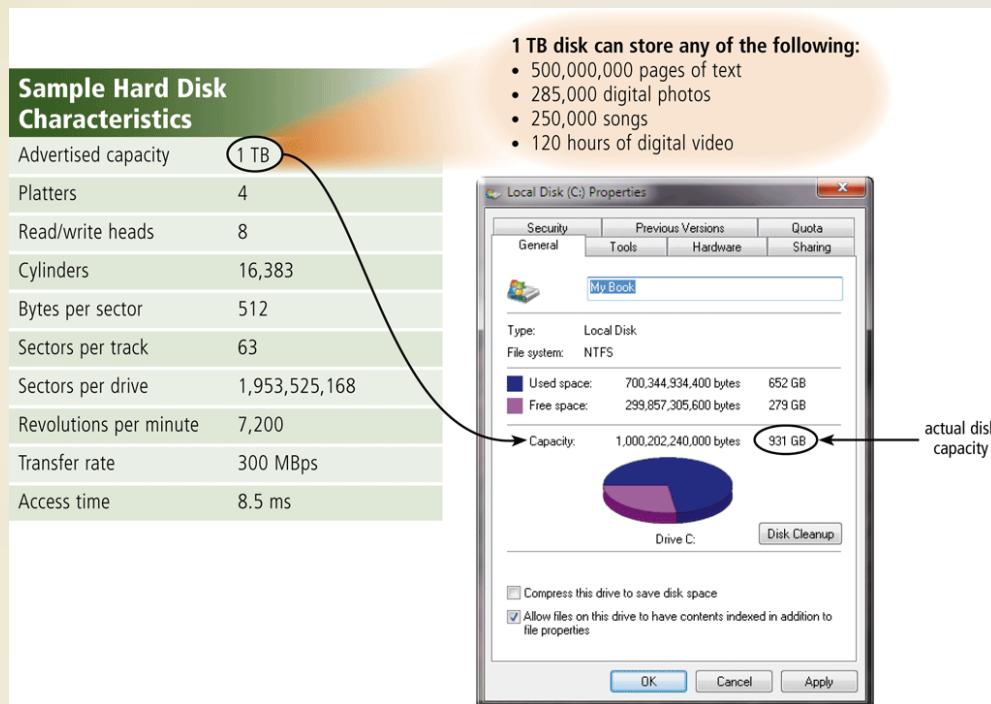
Hard Disks

- Characteristics of a hard disk include:



Hard Disks

- **Formatting** is the process of dividing the disk into tracks and sectors so that the operating system can store and locate data and information on the disk

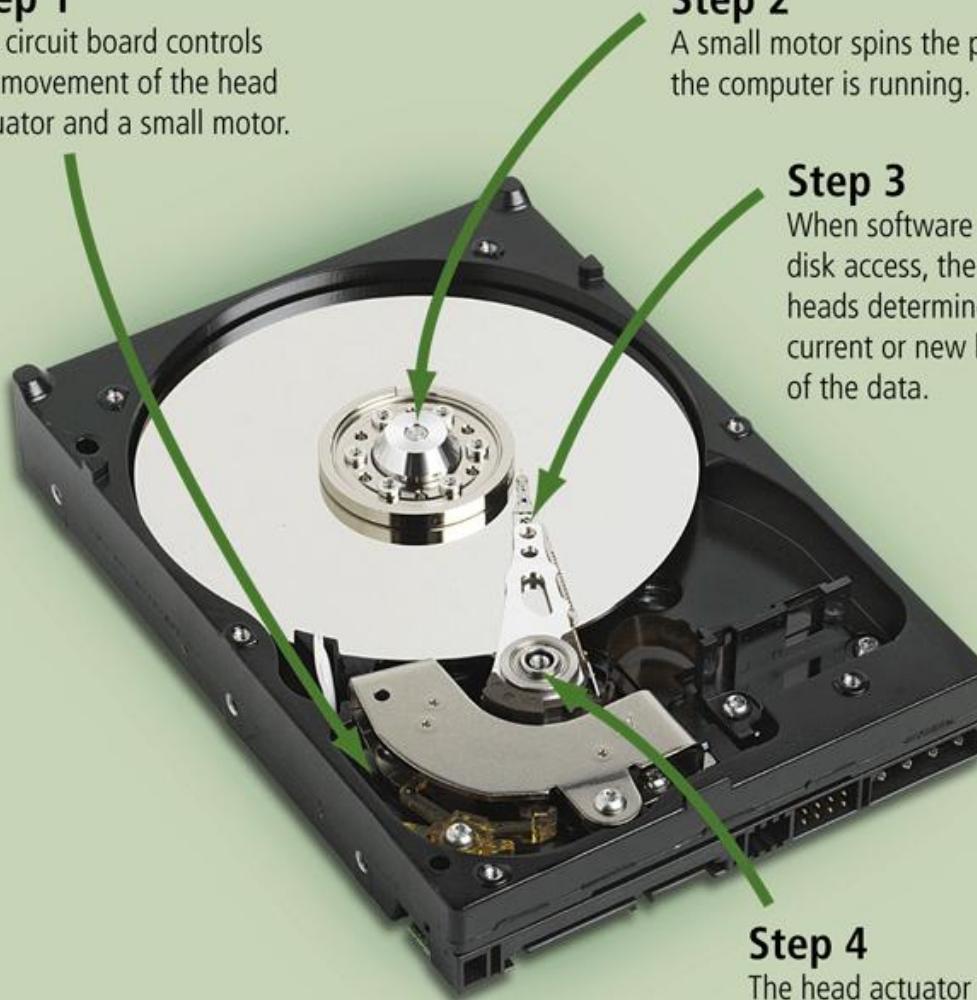


Hard Disks

How a Hard Disk Works

Step 1

The circuit board controls the movement of the head actuator and a small motor.



Step 2

A small motor spins the platters while the computer is running.

Step 3

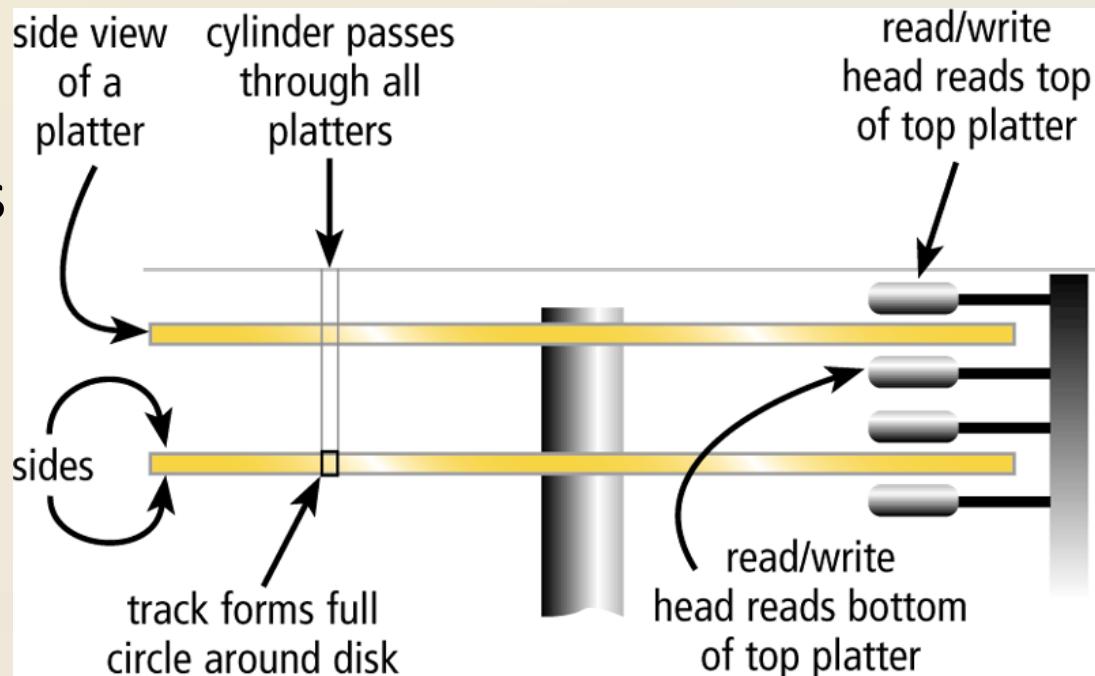
When software requests a disk access, the read/write heads determine the current or new location of the data.

Step 4

The head actuator positions the read/write head arms over the correct location on the platters to read or write data.

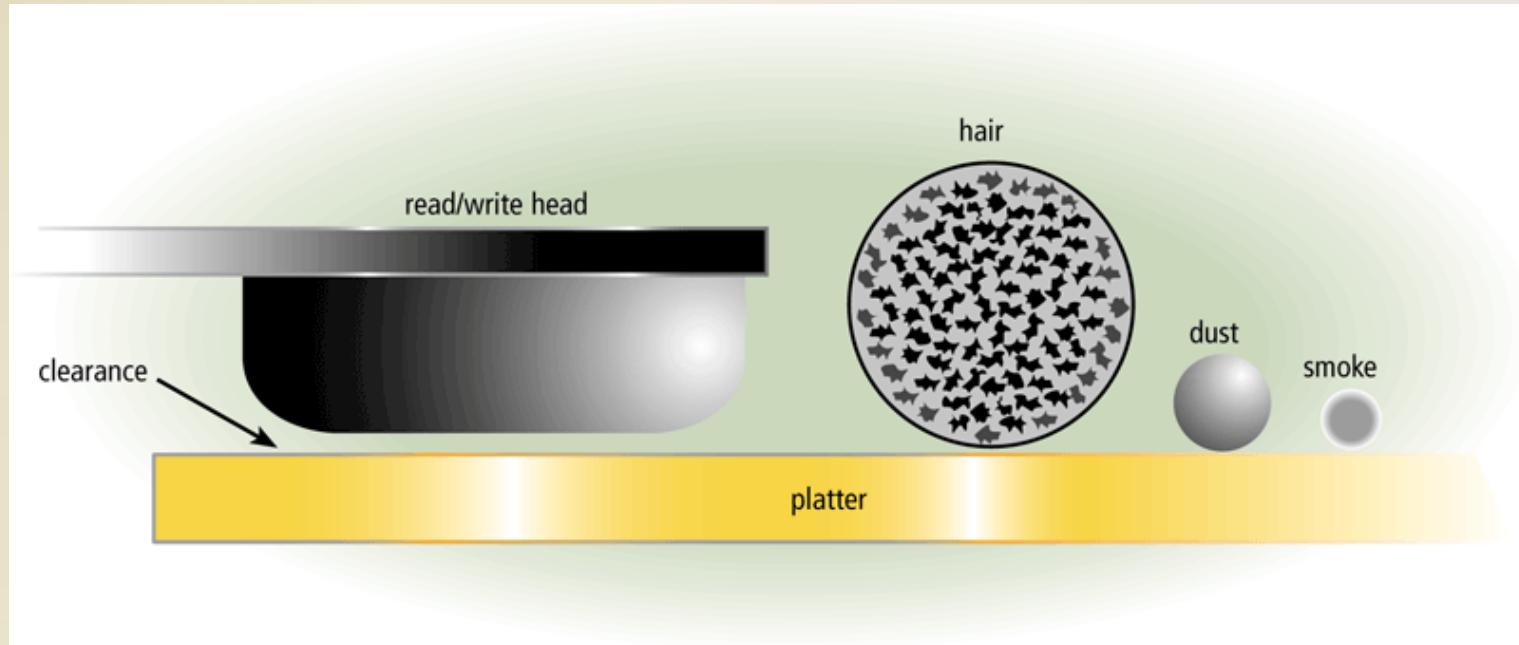
Hard Disks

- The hard disk arms move the read/write head, which reads items and writes items in the drive
 - Location often is referred to by its cylinder



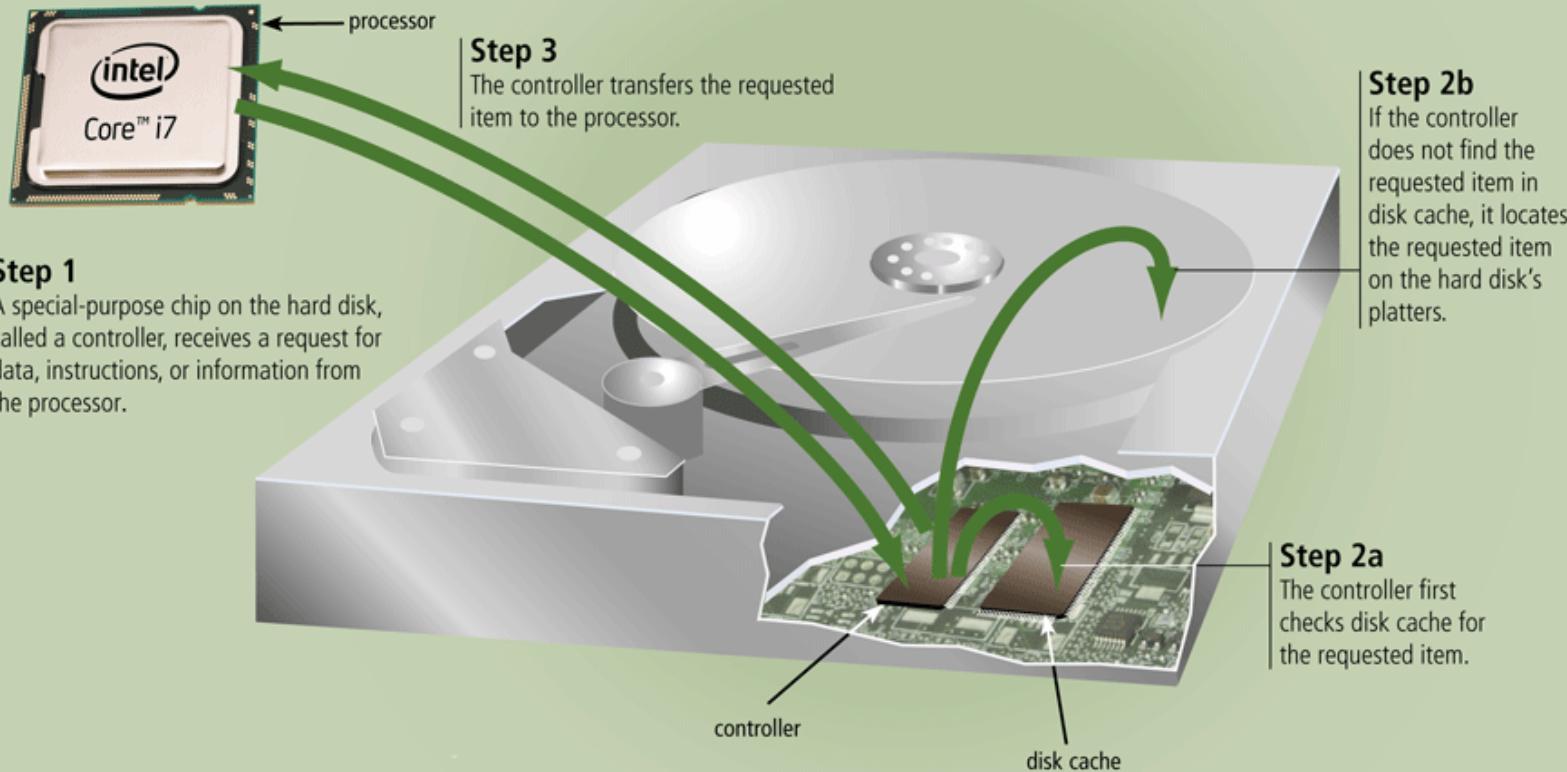
Hard Disks

- A head crash occurs when a read/write head touches the surface of a platter
- Always keep a **backup** of your hard disk



Hard Disks

How Disk Cache Works



Hard Disks

- **RAID** (redundant array of independent disks) is a group of two or more integrated hard disks
- A **network attached storage** (NAS) device is a server connected to a network with the sole purpose of providing storage



Hard Disks



An **external hard disk** is a separate free-standing hard disk that connects to your computer with a cable or wirelessly



A **removable hard disk** is a hard disk that you insert and remove from a drive



Internal and external hard disks are available in miniature sizes (miniature hard disks)

Hard Disks

- A disk controller consists of a special-purpose chip and electronic circuits that control the transfer of data, instructions, and information from a disk to and from the system bus and other components of the computer

SATA

EIDE

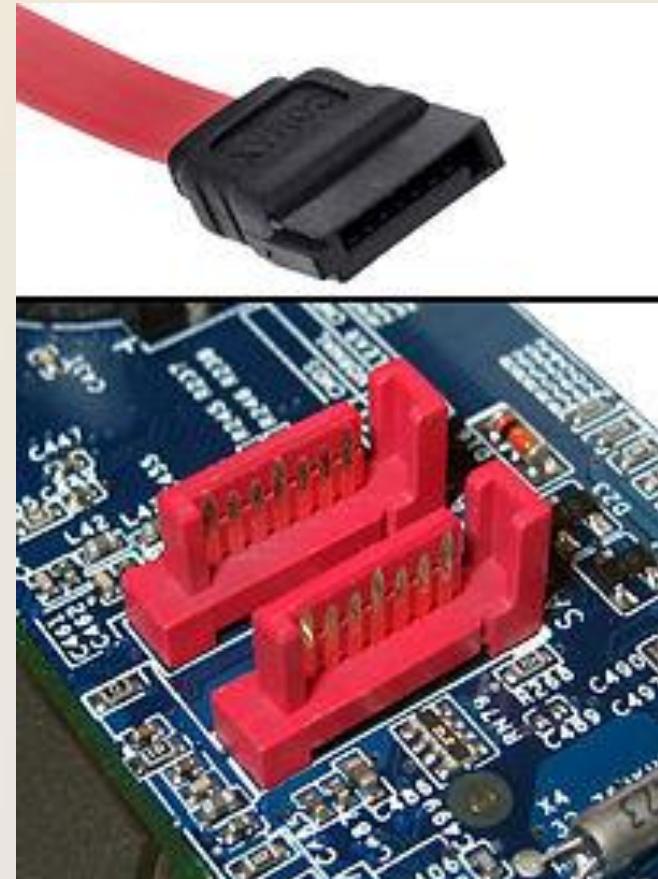
SCSI

SAS

SATA



Abbreviation SATA is “Serial Advance Technology Attachment”



Bus Speed

Technology	Speed
SATA 1.0	1.5Gbit/s (150MB/s)
SATA 2.0	3Gbit/s (300MB/s)
SATA 3.0	6Gbit/s (600MB/s)

SCSI

- Abbreviation of SCSI is “Small Computer System Interface”
- Parallel data interface

Bus Speed

Technology	Speed
Ultra 160	160MB/s
Ultra 320	320MB/s
Ultra 640	640MB/s

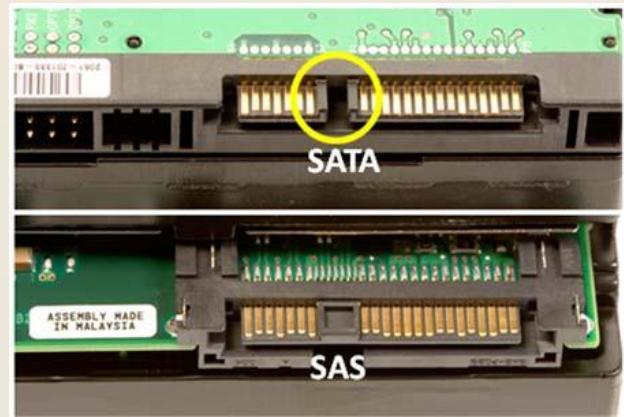


SAS

- Serial Attached SCSI is “Serial Attached SCSI”
- Serial data interface

Bus Speed

Technology	Speed
SAS 1.0	300MB/s
SAS 2.0	600MB/s
SAS 3.0	1200MB/s

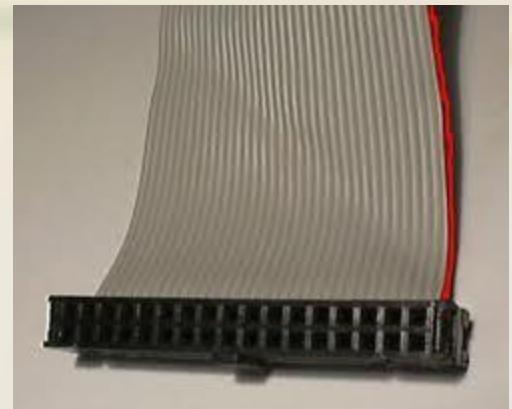


Enhanced IDE

- parallel data interface

Bus Speed

Technology	Speed
Ultra ATA 33 (2)	33.3MB/s
Ultra ATA 66 (4)	66.7MB/s
Ultra ATA 100 (5)	100MB/s
Ultra ATA 133 (6)	133MB/s



Flash Memory Storage

- Flash memory chips are a type of solid state media and contain no moving parts
- **Solid state drives (SSDs)** have several advantages over magnetic hard disks:

Faster access time

Faster transfer rates

Generate less heat and consume less power

Last longer

Flash Memory Storage



Flash Memory Storage

- A **memory card** is a removable flash memory device that you insert and remove from a slot in a computer, mobile device, or card reader/writer

CompactFlash
(CF)

Secure Digital
(SD)

Secure Digital
High Capacity
(SDHC)

microSD

microSDHC

xD Picture
Card

Memory Stick

Memory Stick
Micro (M2)

Flash Memory Storage



Various Memory Cards

Media Type	Storage Capacity	Use
CompactFlash (CF)	512 MB to 100 GB	Digital cameras, smart phones, PDAs, photo printers, portable media players, notebook computers, desktop computers
Secure Digital (SD)	512 MB to 8 GB	Digital cameras, digital video cameras, smart phones, PDAs, photo printers, portable media players
SDHC	4 to 32 GB	Digital cameras
microSD	1 to 2 GB	Smart phones, portable media players, handheld game consoles, handheld navigation devices
microSDHC	4 to 16 GB	Smart phones, portable media players, handheld game consoles, handheld navigation devices
xD Picture Card	256 MB to 2 GB	Digital cameras, photo printers
Memory Stick PRO Duo	1 to 16 GB	Digital cameras, smart phones, handheld game consoles
Memory Stick Micro (M2)	1 to 16 GB	Smart phones

Flash Memory Storage

How One Type of Memory Card Works

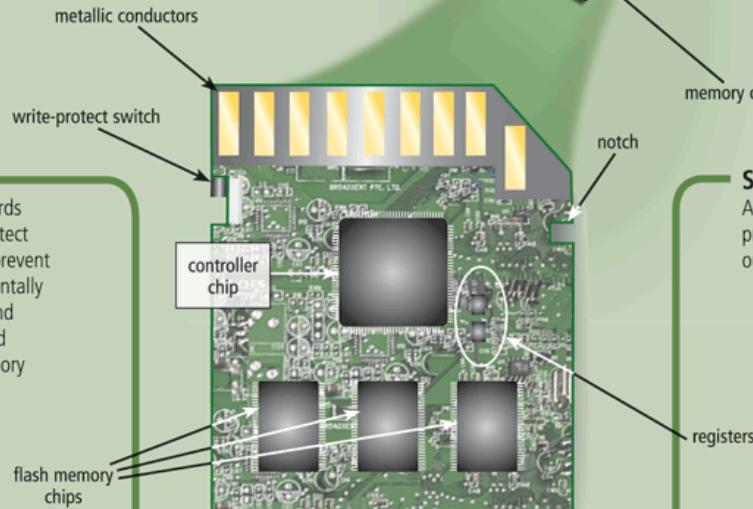
Step 1

When you insert a memory card in a card reader/writer or card slot, the memory card's metallic conductors make contact with connectors in the card reader/writer or card slot, allowing the transfer of photos and other items between the card and the reading/writing device.



Step 2

A notch on the side of the memory card prevents the card from accidentally slipping out of the card reader/writer or card slot.



Step 3

Flash memory chips store photos and other types of data and information. When requested, the controller transfers items stored on the flash memory chips to the metallic conductors, using registers for temporary storage, as needed.

Flash Memory Storage

- **USB flash drives** plug into a USB port on a computer or mobile device



Video: Thumb Drive (USB Flash Drive) Encryption

The screenshot shows a web browser displaying the CNET DOWNLOAD.com website. The main content area features a review for "Advanced Registry Optimizer 5". The review includes a 5-star rating from S/5 Mac OS X User Reviews. To the right, there are three bullet points: "Faster Performance", "Increased Startup Speed", and "Cleaner System". Below this, another software listing for "Remora USB Disk Guard 1.4.0.1" is shown, including a download button and user ratings. A sidebar on the left lists categories like Antivirus Software, Corporate Security Software, and Encryption Software. At the bottom of the sidebar, there's a link to "Advanced Registry Optimizer 5". A large red "c|net" logo is visible in the bottom right corner.

Advanced Registry Optimizer 5

5/5 Mac OS X User Reviews

Faster Performance
Increased Startup Speed
Cleaner System

Remora USB Disk Guard 1.4.0.1

Download Now (2.19MB)

Tested spyware free

License: Free

Average User Rating: ★ ★ ★ ★ (out of 3 votes) Rate it!

Downloads: 4,450

Requirements: Windows: 98/Me/NT/2000/XP/2003 Server

Limitations: No limitations

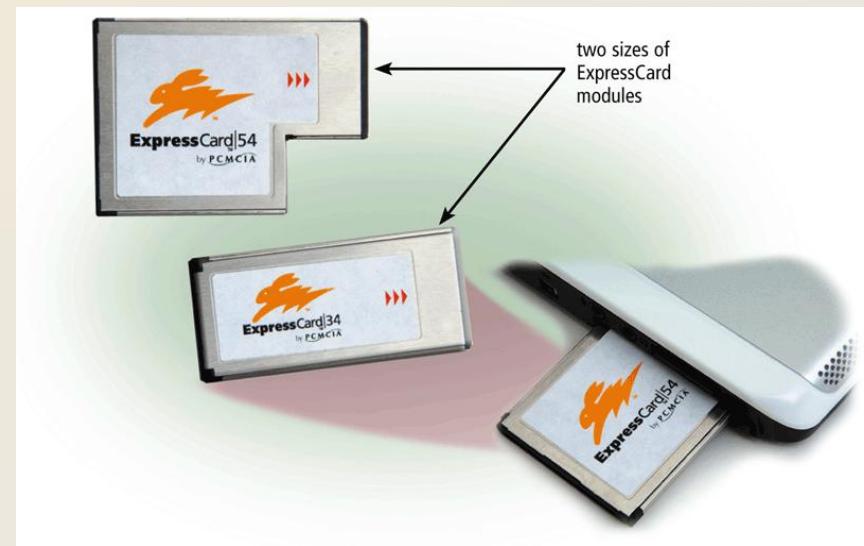
Date Added: September 21, 2006

Advanced Registry Optimizer 5

[CLICK TO START](#)

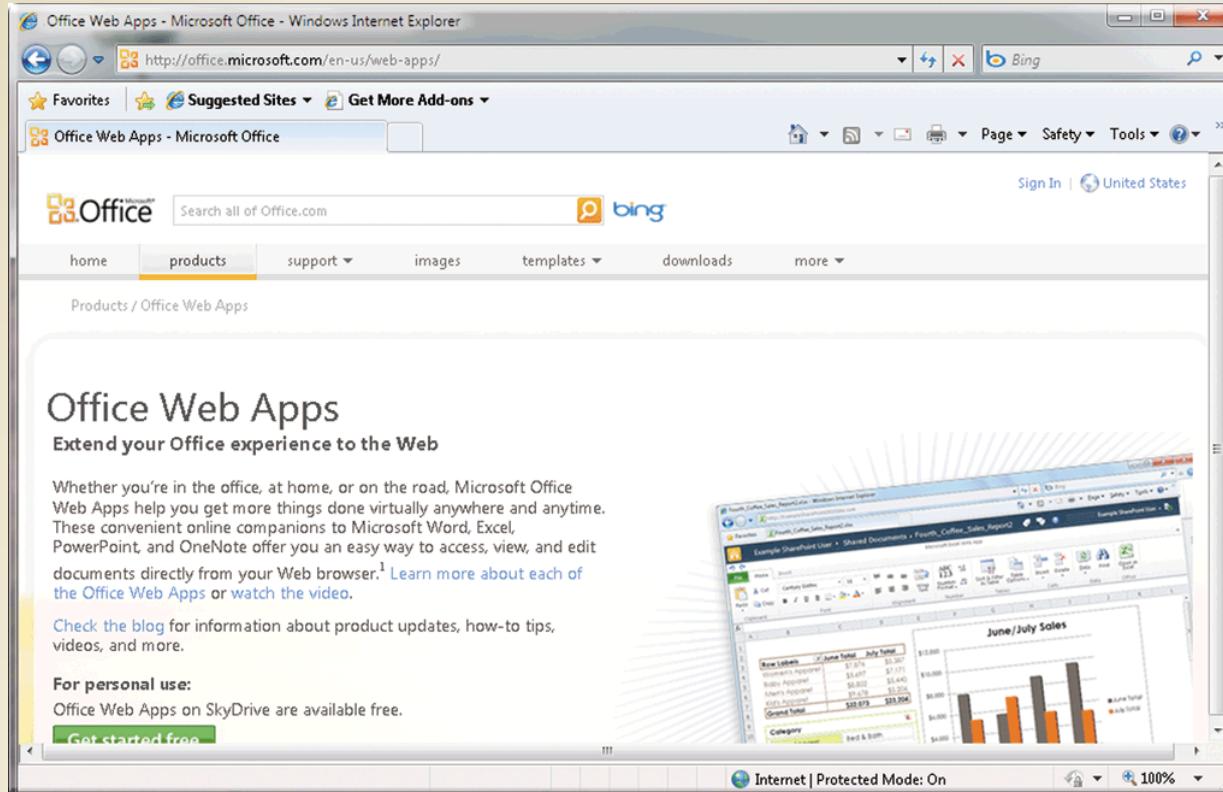
Flash Memory Storage

- An **ExpressCard module** is a removable device that fits in an ExpressCard slot
- Developed by the PCMCIA
- Commonly used in notebook computers



Cloud Storage

- **Cloud storage** is an Internet service that provides storage to computer users



Cloud Storage

Cloud Storage Providers

Web Site Names	Type of Storage Provided	Other Services
Box.net, iDrive, Windows Live SkyDrive	Backup or additional storage for any type of file	
Flickr, Picasa	Digital photos	Photo editing and photo management
YouTube	Digital videos	
Facebook, MySpace	Digital photos, digital videos, messages, and personal information	Social networking
Google Docs, Office Web Apps	Documents, spreadsheets, presentations	Productivity suite
Gmail, Windows Live Hotmail, Yahoo! Mail	E-mail messages	
Amazon EC2, Amazon S3, Nirvanix	Enterprise-level storage	Web services, data center services

Cloud Storage

- Users subscribe to cloud storage for a variety of reasons:

Access files from any computer

Store large files instantaneously

Allow others to access their files

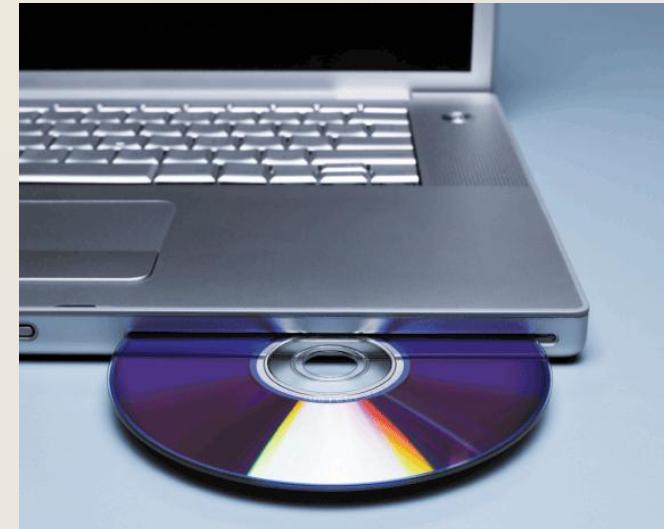
View time-critical data and images immediately

Store offsite backups

Provide data center functions

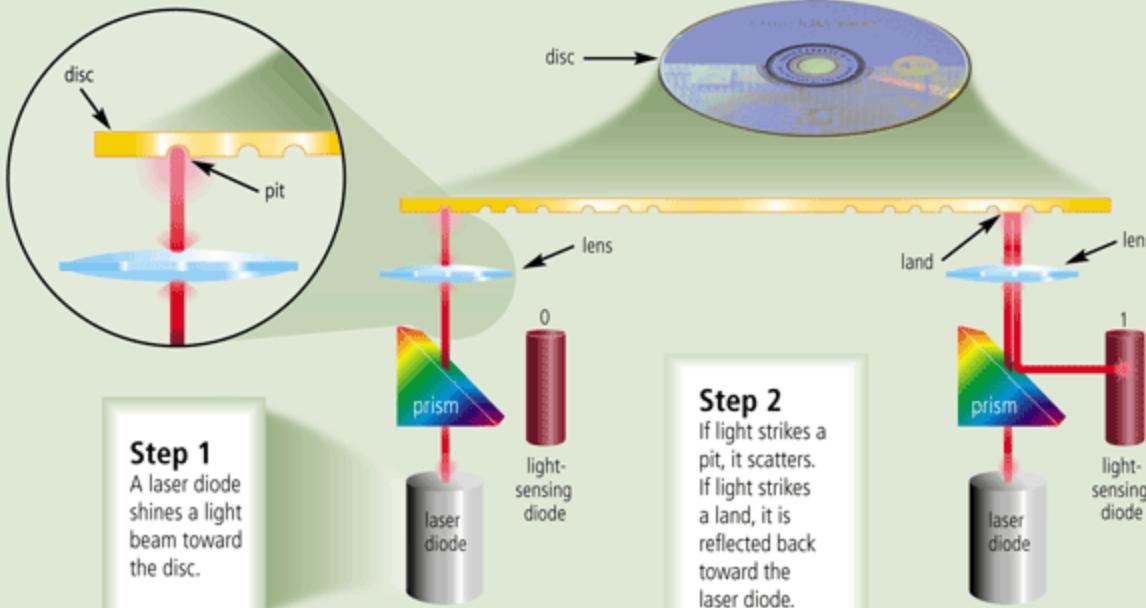
Optical Discs

- An optical disc consists of a flat, round, portable disc made of metal, plastic, and lacquer that is written and read by a laser
- Typically store software, data, digital photos, movies, and music
- Read only vs. rewritable



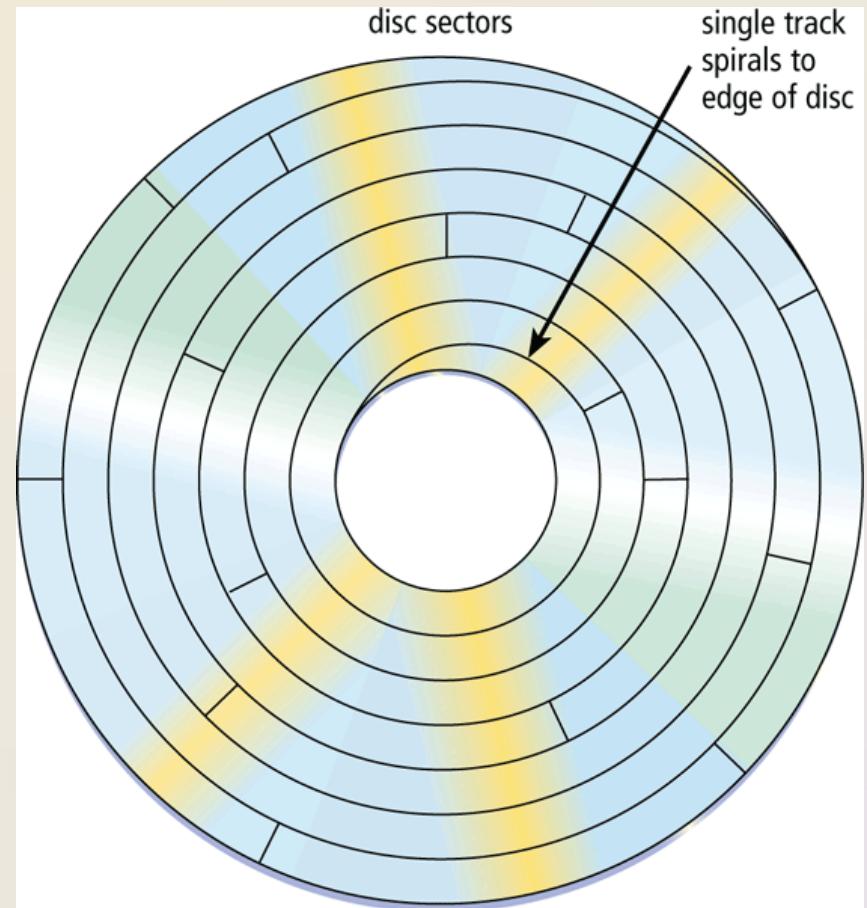
Optical Discs

How a Laser Reads Data on an Optical Disc



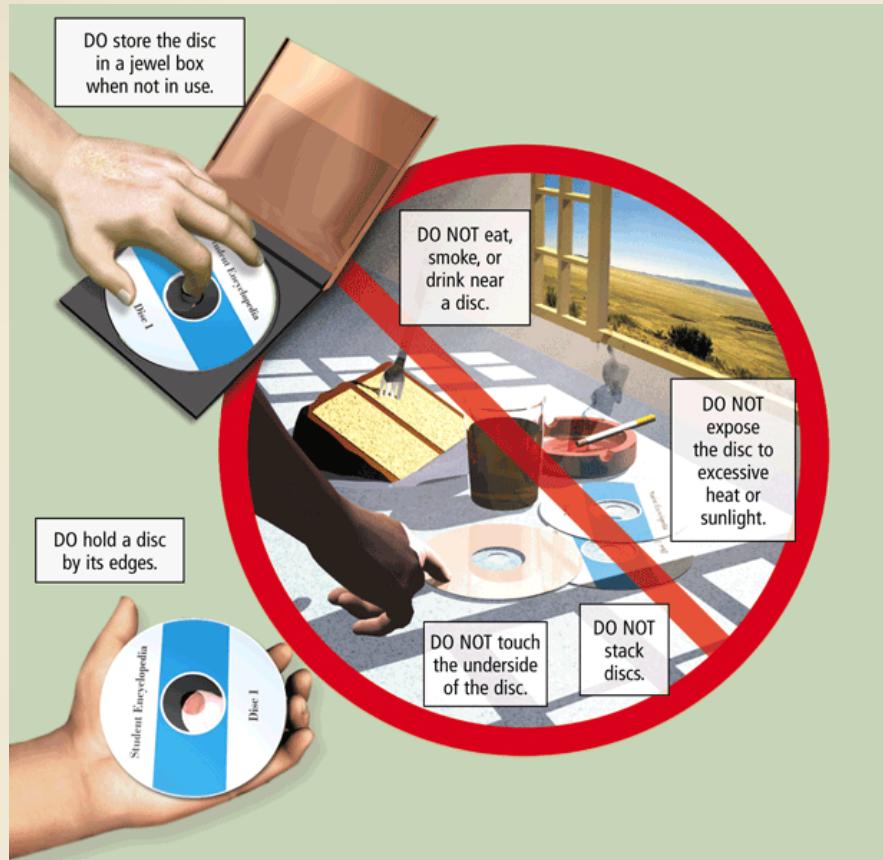
Optical Discs

- Optical discs commonly store items in a single track that spirals from the center of the disc to the edge
- Track is divided into evenly sized sectors

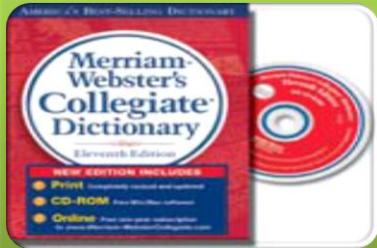


Optical Discs

- Care of optical discs



Optical Discs



A **CD-ROM** can be read from but not written to

- Read from a **CD-ROM drive** or CD-ROM player



A **CD-R** is a multisession optical disc on which users can write, but not erase



A **CD-RW** is an erasable multisession disc

- Must have a **CD-RW drive**

Optical Discs

Archive disc

- Stores photos from an online photo center
- Resolution usually is 7200 pixels per photo
- Cost is determined by the number of photos being stored

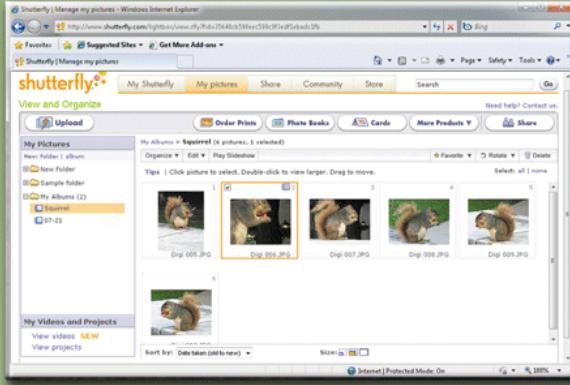
Picture CD

- Single-session CD-ROM that stores digital versions of film
- Typically uses a 1024 x 1536 resolution
- Many photo centers offer Picture CD services

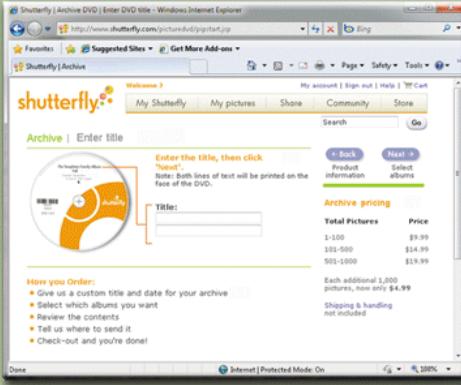
Optical Discs

How an Archive Disc Works

Step 1 →
Upload your digital photos to a photo sharing community for others to view.



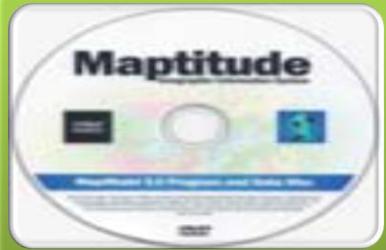
Step 2 →
Select the photos to be stored on the archive disc and then place your order.



Step 3 ←
Pick up your archive disc at a designated store or receive it in the mail. At home, edit and/or print images from the archive disc on your ink-jet or photo printer, or view the images on a monitor or television screen. At a store, edit and/or print images from the archive disc at a kiosk.



Optical Discs



A **DVD-ROM** is a high-capacity optical disc on which users can read but not write or erase

- Requires a **DVD-ROM drive**



A Blu-ray Disc-ROM (BD-ROM) has a storage capacity of 100 GB



DVD-RW, **DVD+RW**, and **DVD+RAM** are high-capacity rewritable DVD formats

Other Types of Storage

Tape

Magnetic stripe
cards and smart
cards

Microfilm and
microfiche

Enterprise storage

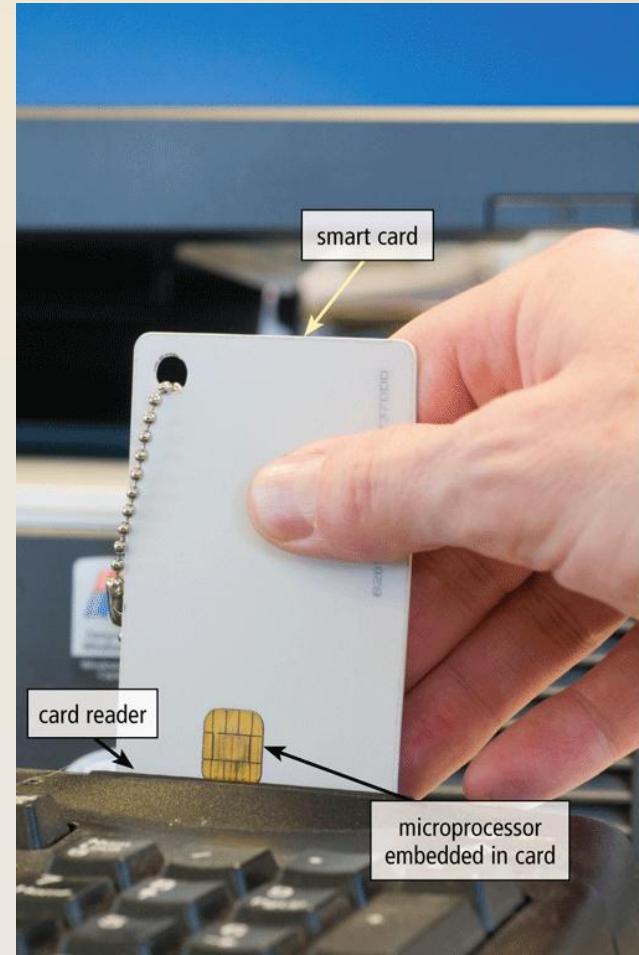
Other Types of Storage

- **Tape** is a magnetically coated ribbon of plastic capable of storing large amounts of data and information
- A **tape drive** reads and writes data and information on a tape



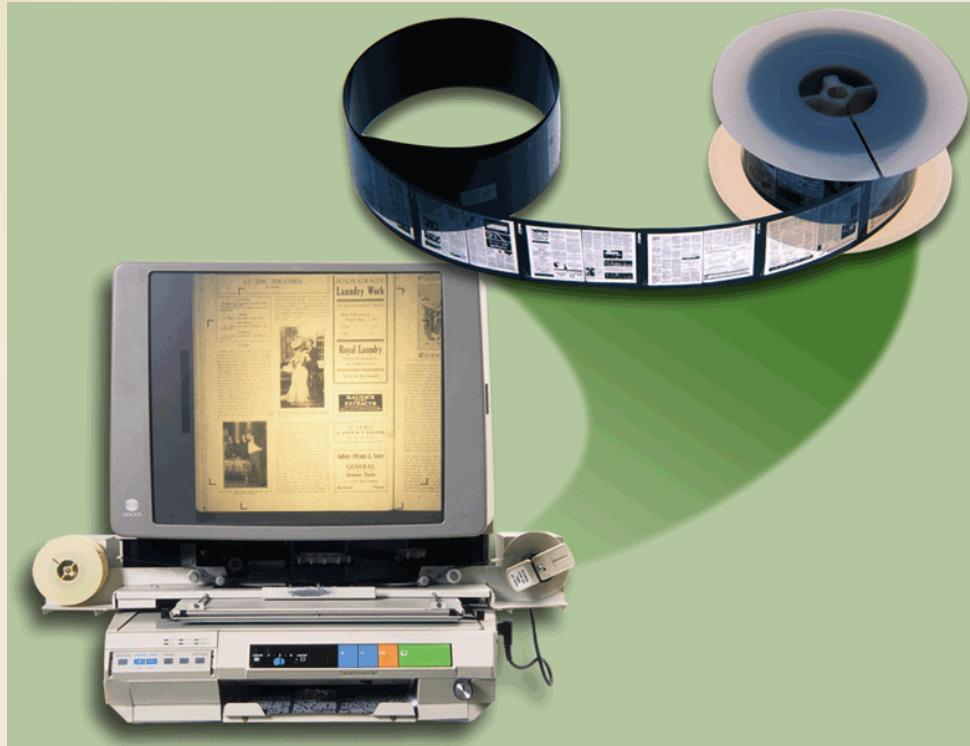
Other Types of Storage

- A **magnetic stripe card** contains a magnetic stripe that stores information
- A **smart card** stores data on a thin microprocessor embedded in the card



Other Types of Storage

- **Microfilm** and **microfiche** store microscopic images of documents on a roll or sheet film



Other Types of Storage

Media Life Expectancies* (when using high-quality media)

Media Type	Guaranteed Life Expectancy	Potential Life Expectancy
Magnetic disks	3 to 5 years	20 to 30 years
Optical discs	5 to 10 years	50 to 100 years
Solid state drives	50 years	140 years
Microfilm	100 years	500 years

* according to manufacturers of the media

Other Types of Storage

- Enterprise storage stores huge volumes of data and information for large businesses
 - Uses special hardware for heavy use, maximum availability, and maximum efficiency



Putting It All Together



Home user

- 500 GB hard disk
- Cloud storage
- Optical disc drive
- Card reader/writer
- USB flash drive

Small Office/Home Office user

- 1 TB hard disk
- Cloud storage
- Optical disc drive
- External hard disk for backup
- USB flash drive

Mobile

- 250 GB hard disk
- Cloud storage
- Optical disc drive
- Card reader/writer
- Portable hard disk for backup
- USB flash drive

Putting It All Together



Power User

- 2.5 TB hard disk
- Cloud storage
- Optical disc drive
- Portable hard disk for backup
- USB flash drive

Enterprise User (desktop computer)

- 1 TB hard disk
- Optical disc drive
- Smart card reader
- Tape drive
- USB flash drive

Enterprise User (server or mainframe)

- Network storage server
- 40 TB hard disk system
- Optical disc server
- Microfilm or microfiche

Summary

Various storage media and storage devices

Internal hard disks, external and removable hard disks, solid state drives, memory cards, USB flash drives, ExpressCard modules, cloud storage, CDs, DVDs, and Blu-ray Discs, tape, smart cards, and microfilm and microfiche

Chapter Seven

Storage

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Chapter 7 Complete

