

Chapter Seven

Storage

Discovering Computers 2011

Living in a Digital World



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

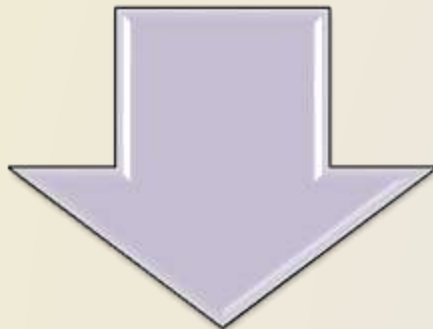
| Storage Terms | | |
|----------------|-----------------------------|---|
| Storage Term | Approximate Number of Bytes | Exact Number of Bytes |
| Kilobyte (KB) | 1 thousand | 2^{10} or 1,024 |
| Megabyte (MB) | 1 million | 2^{20} or 1,048,576 |
| Gigabyte (GB) | 1 billion | 2^{30} or 1,073,741,824 |
| 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



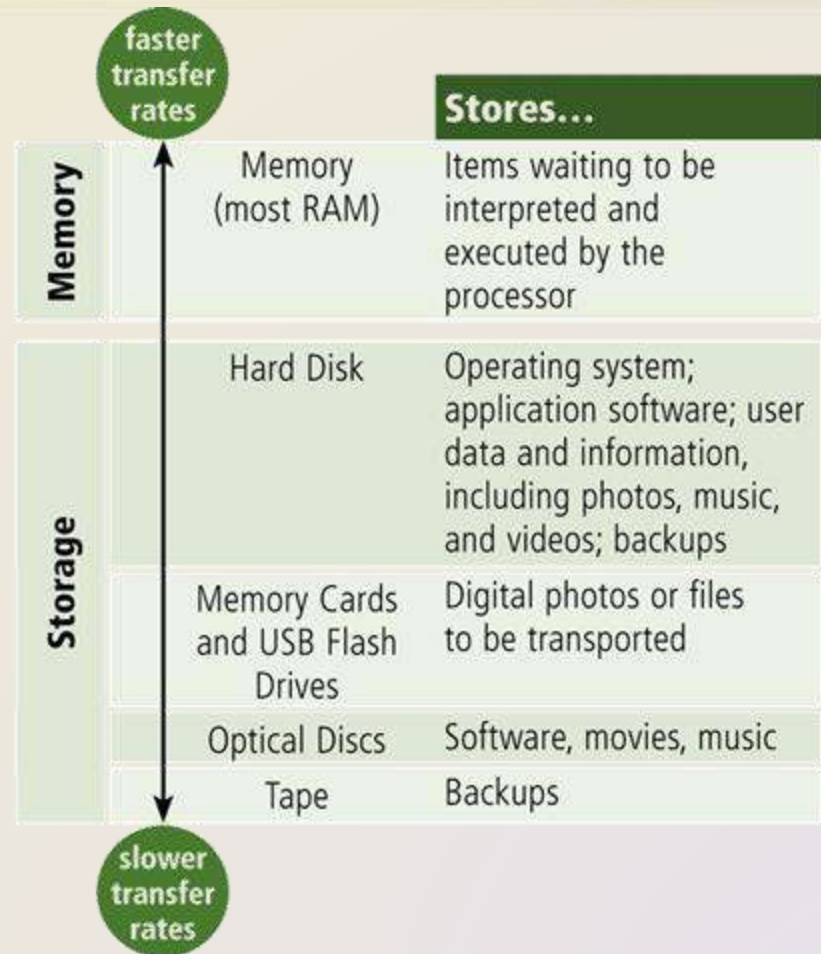
Reading is the process of transferring items from a storage medium into memory



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

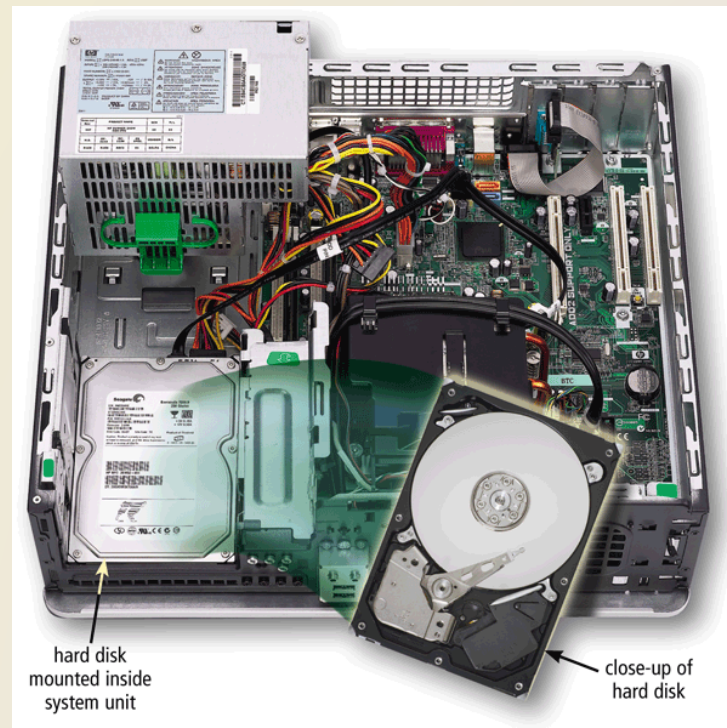
Storage

- **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



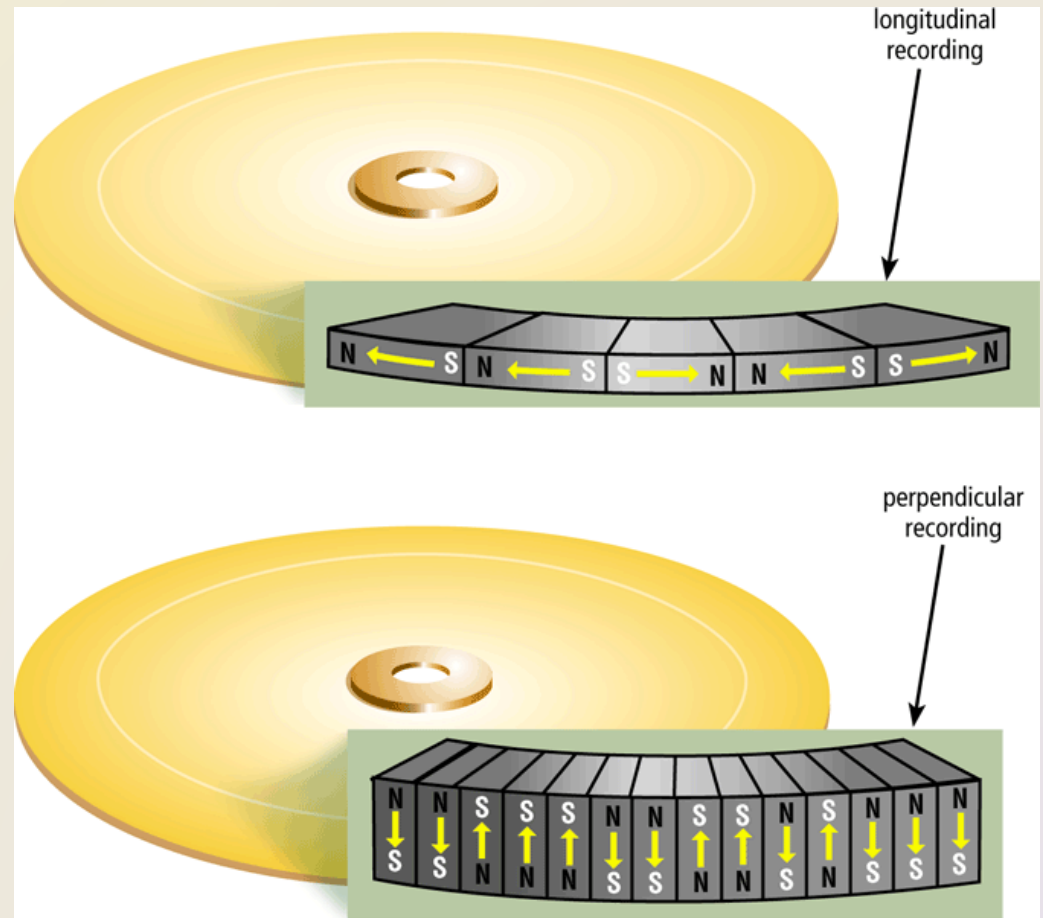
Hard Disks

- 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



Click to view Web Link, click Chapter 7, Click Web Link from left navigation, then click Perpendicular Recording below Chapter 7

Hard Disks

- Characteristics of a hard disk include:

Capacity

Platters

Read/Write Heads

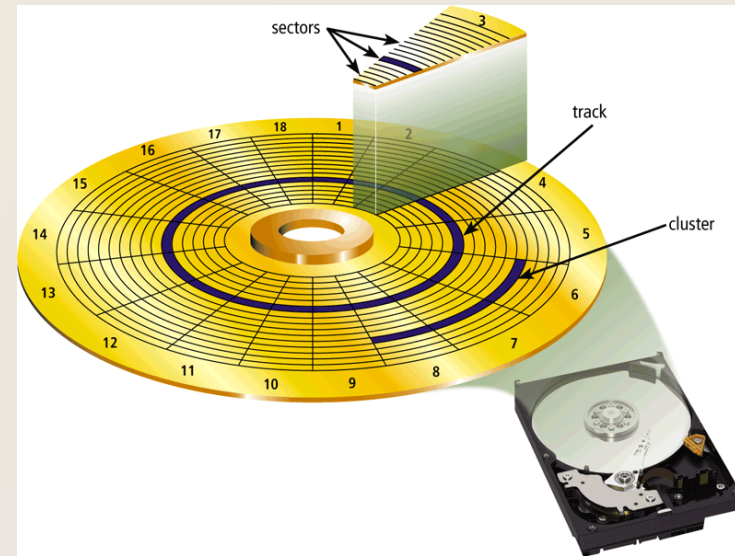
Cylinders

Sectors and Tracks

Revolutions per Minute

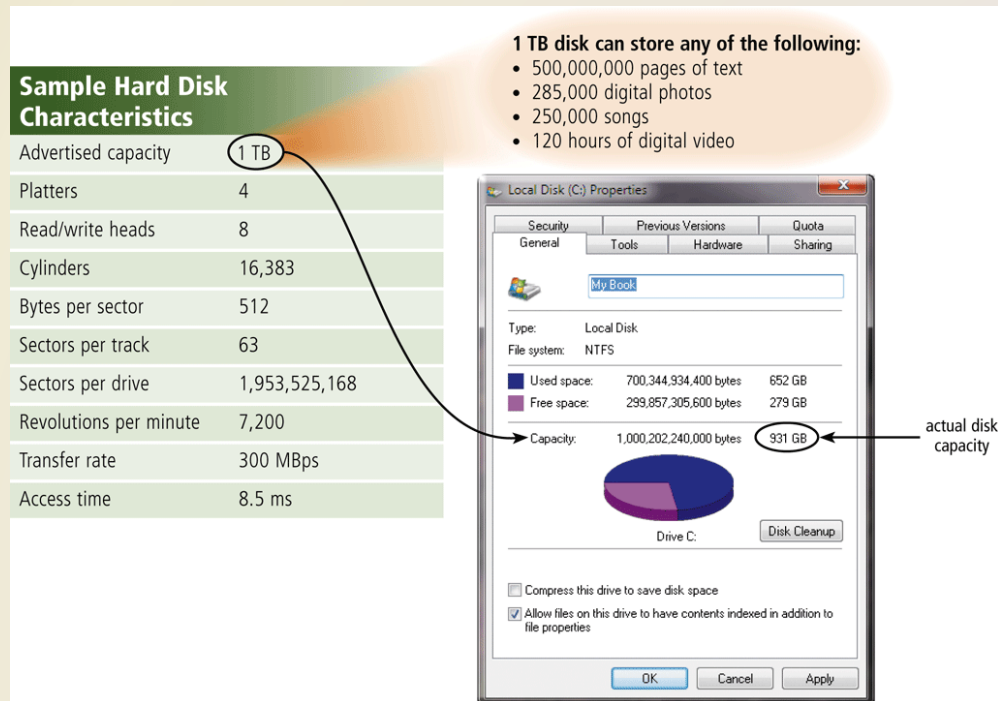
Transfer Rate

Access Time



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.

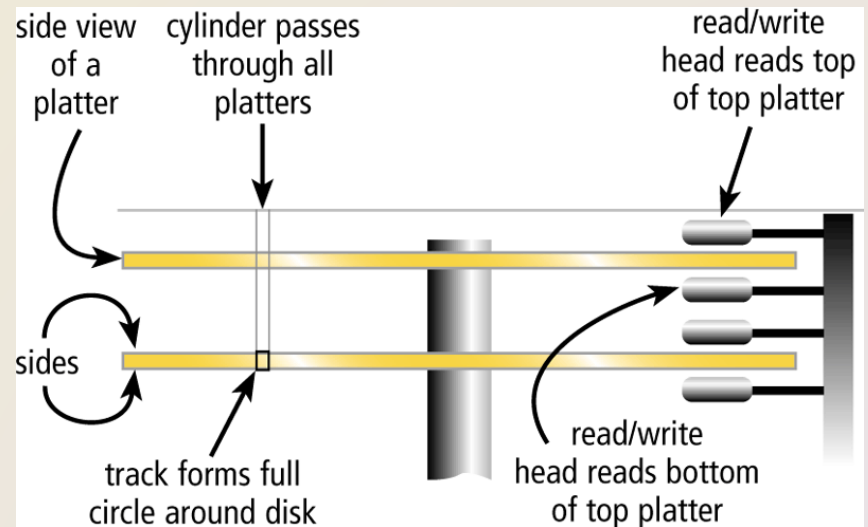
Step 4

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



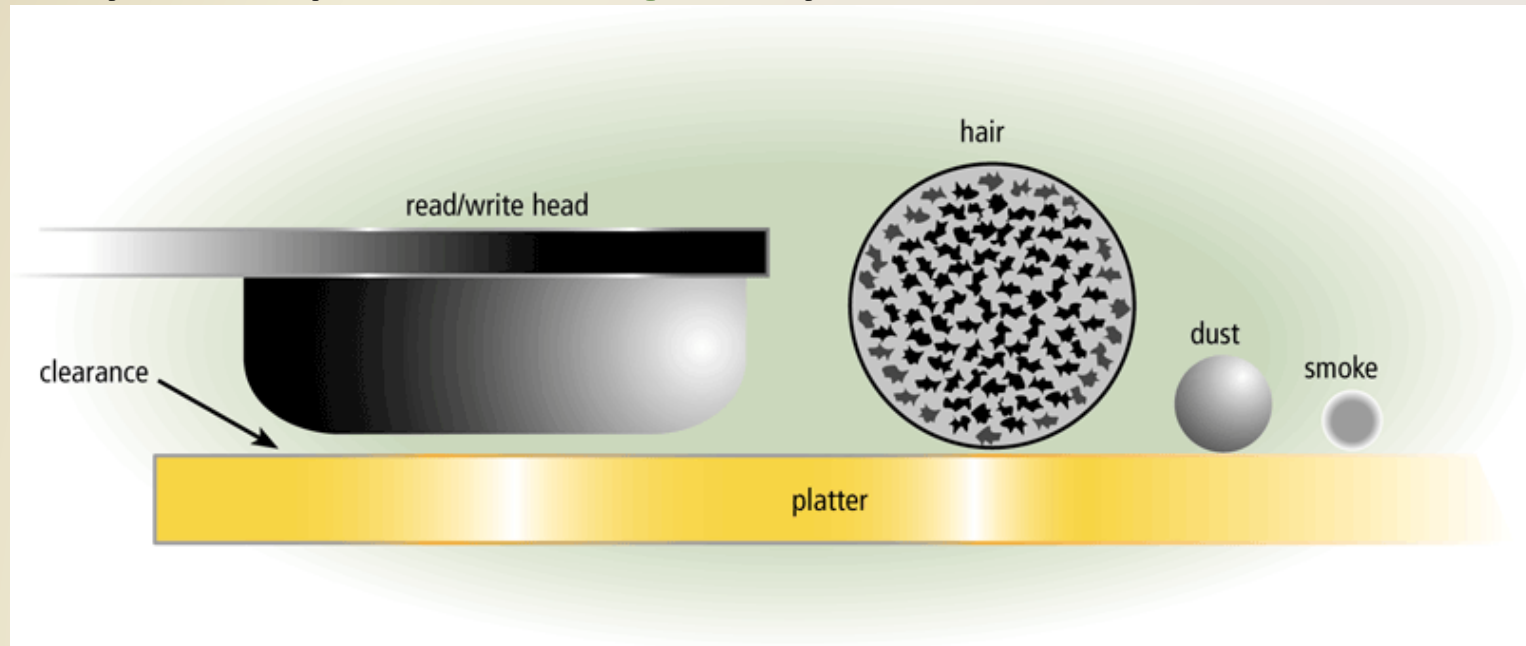
Hard Disks

- 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



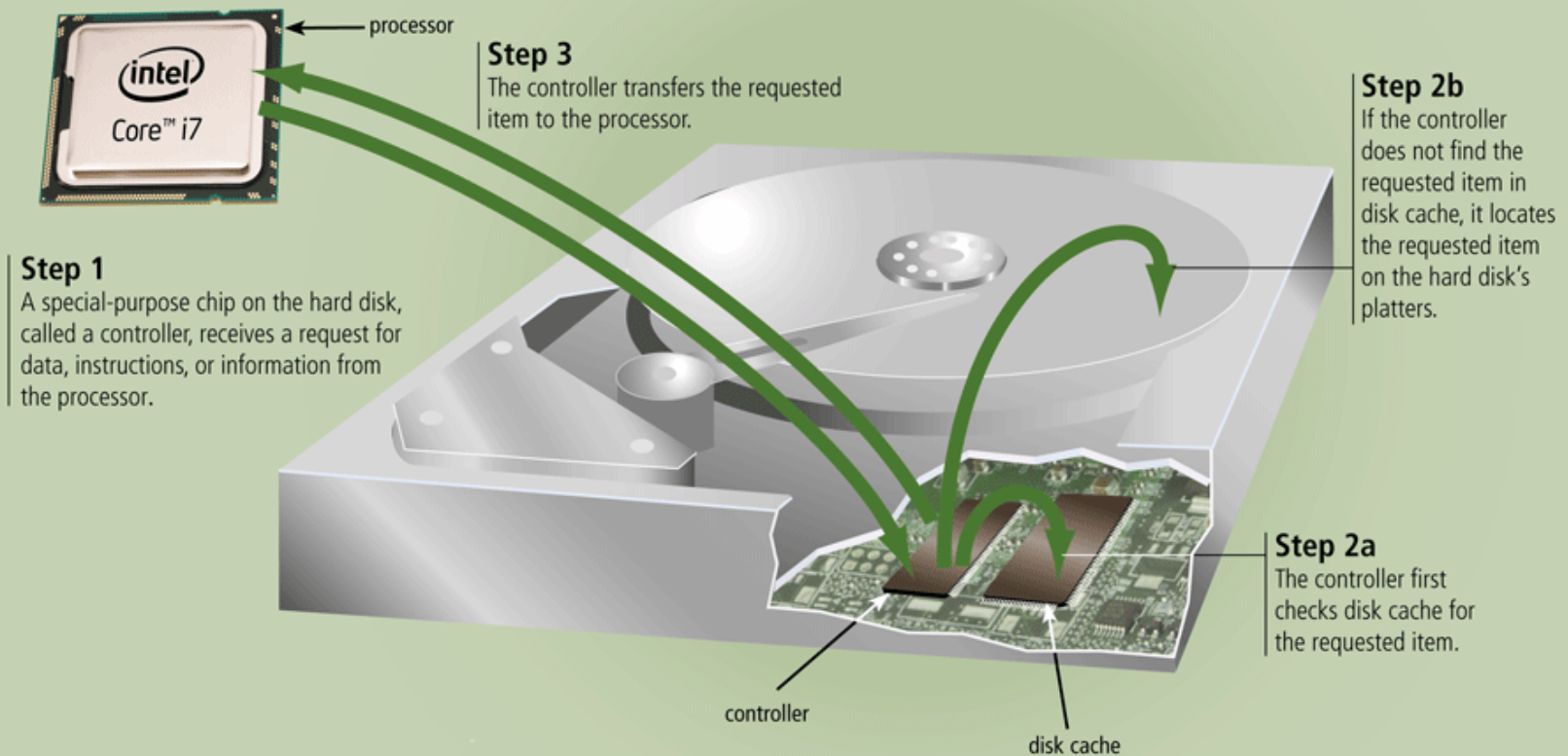
Hard Disks

- 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



Click to view Web Link,
click Chapter 7, Click Web
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then click Network Attached
Storage below Chapter 7

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



Click to view Web Link,
click Chapter 7, Click Web
Link from left navigation,
then click eSATA
below Chapter 7

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



Click to view Web Link,
click Chapter 7, Click Web
Link from left navigation,
then click Solid State Drives
below Chapter 7

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 |



Click to view Web Link, click Chapter 7, Click Web Link from left navigation, then click SDHC Cards below Chapter 7

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.



metallic conductors

card reader/writer

memory card

write-protect switch

notch

Step 4

Some memory cards contain write-protect switches, which prevent users from accidentally erasing photos and other items stored on the flash memory chips.

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.

controller chip

registers

flash memory chips

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

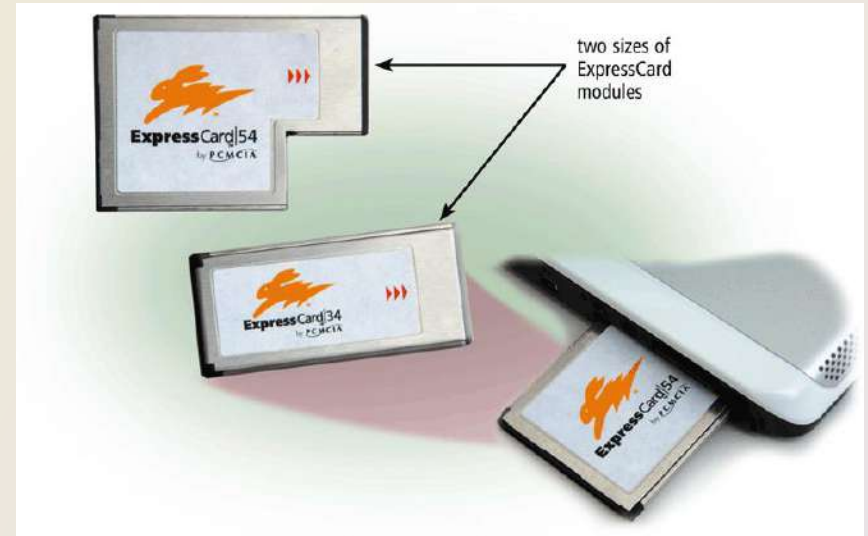


The screenshot shows the CNET Download.com website interface. At the top, there is a search bar and navigation tabs for 'Today on CNET', 'Reviews', 'News', 'Downloads', 'Tips & Tricks', 'CNET TV', 'Compare Prices', and 'Blogs'. Below the navigation, there are links for 'Software', 'Music', and 'PC Games'. The main content area displays a breadcrumb trail: 'CNET.com > Download > Windows > Antivirus, Firewall, & Spyware > Encryption Software'. A sidebar on the left lists categories like 'Antivirus, Firewall, & Spyware', 'Antivirus Software', 'Corporate Security Software', 'Encryption Software', 'Firewall Software', 'Monitoring Software', 'Popup Blocker Software', 'Privacy Software', and 'Spyware Removers'. The main content area features two software listings. The first is 'Advanced Registry Optimizer 5', which is highlighted with a green checkmark and a 'Download Now' button. It has a 5/5 star rating from Tucows Editor Reviews and lists benefits: 'Faster Performance', 'Increased Startup Speed', and 'Cleaner System'. The second listing is 'Remora USB Disk Guard 1.4.0.1', also with a green checkmark and a 'Download Now' button (2.19MB). It is noted as 'Tested spyware free' and has a license of 'Free'. Below the 'Remora' listing, there is a table of details: License: Free; Average User Rating: 4 stars (out of 3 votes); Downloads: 4,450; Requirements: Windows 98/Me/NT/2000/XP/2003 Server; Limitations: No limitations; Date Added: September 21, 2006. A CNET logo is visible in the bottom right corner of the screenshot.

[CLICK TO START](#)

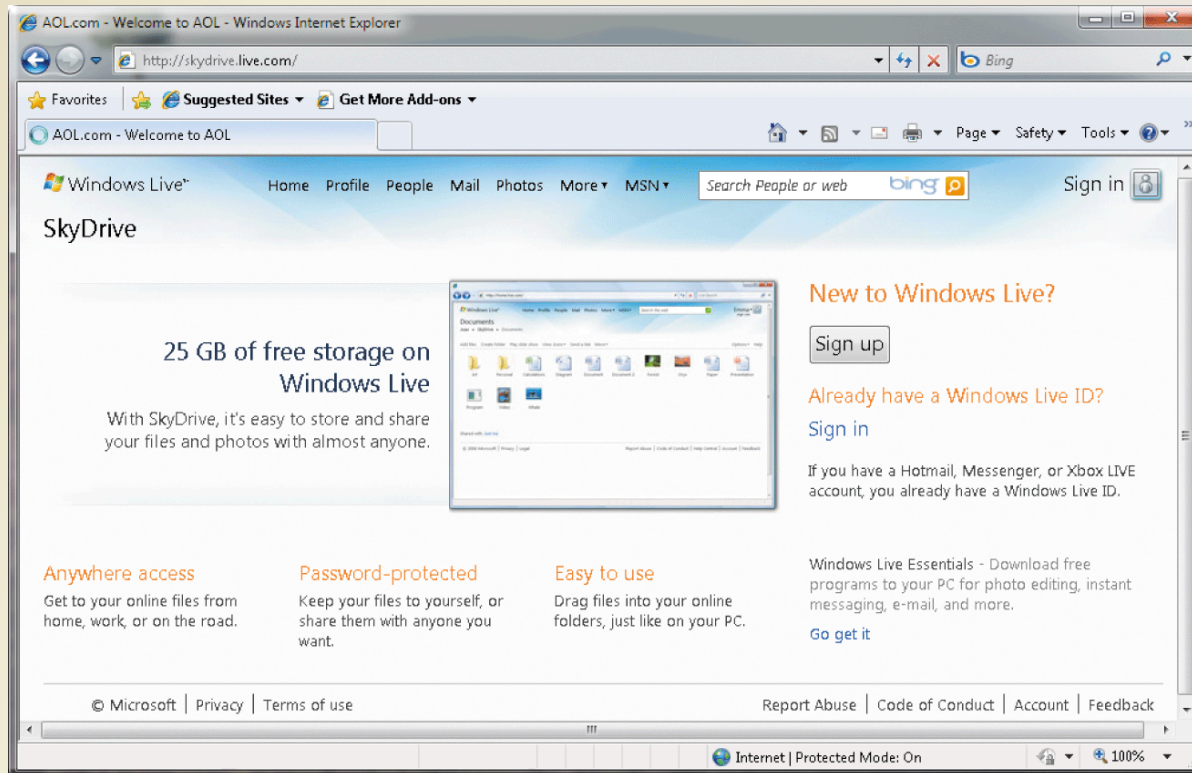
Flash Memory Storage

- 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 | 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

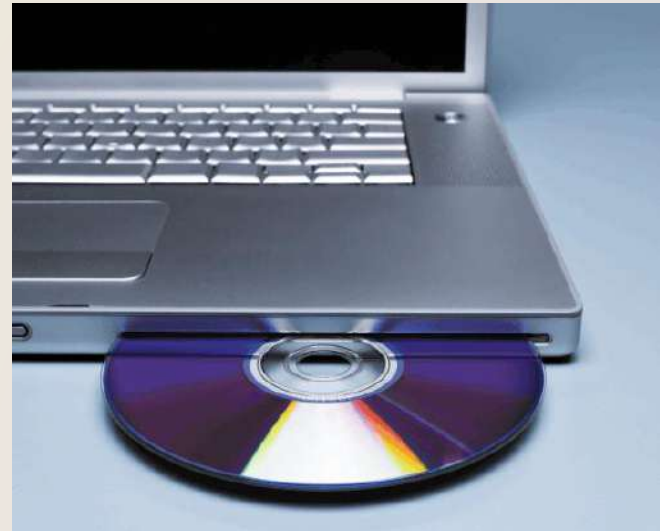
Provide data center functions



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below Chapter 7

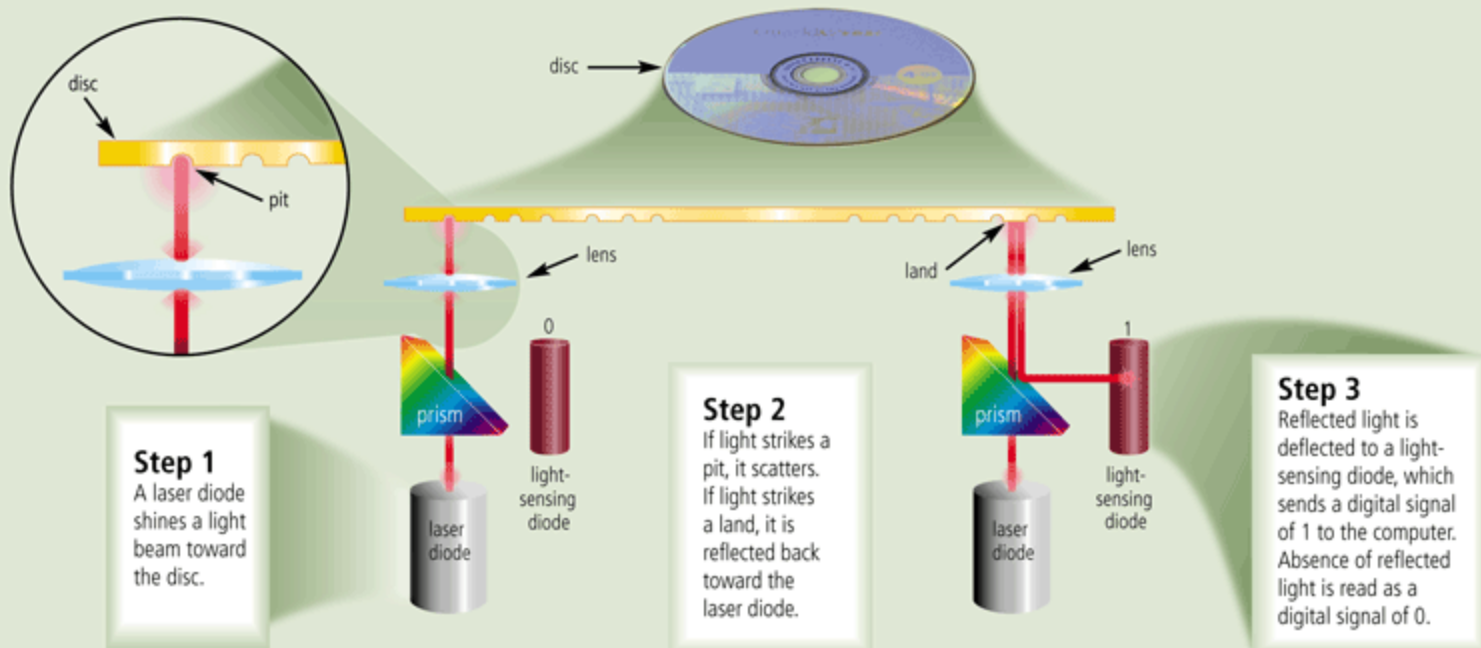
Optical Discs

- 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



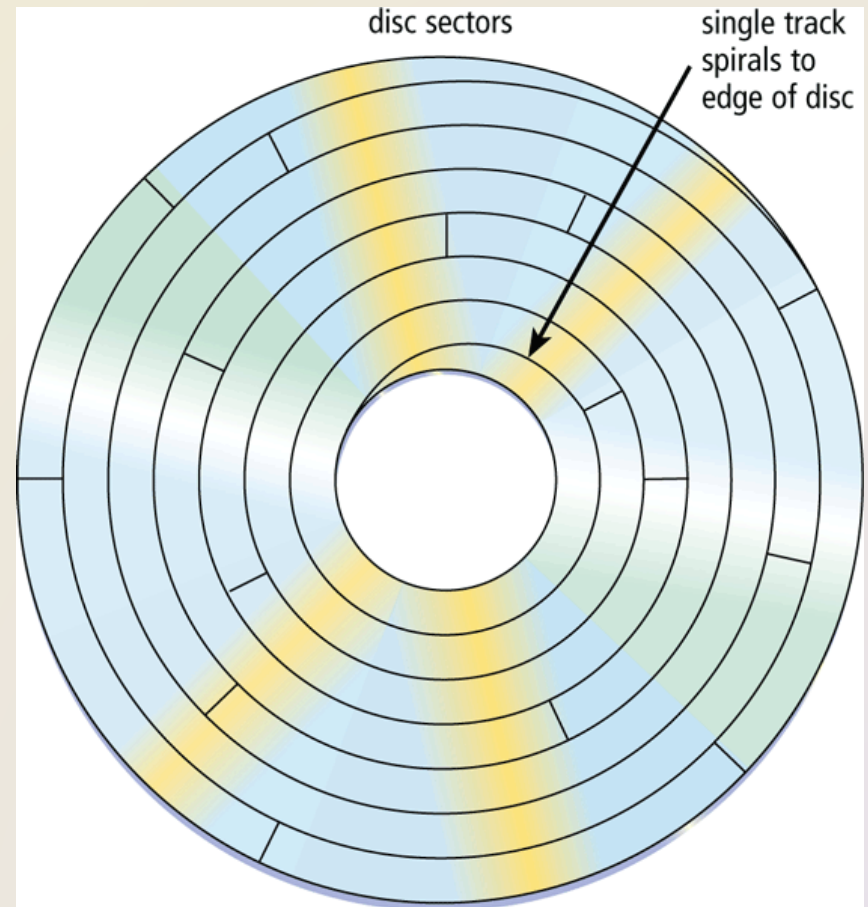
Optical Discs

How a Laser Reads Data on an Optical Disc



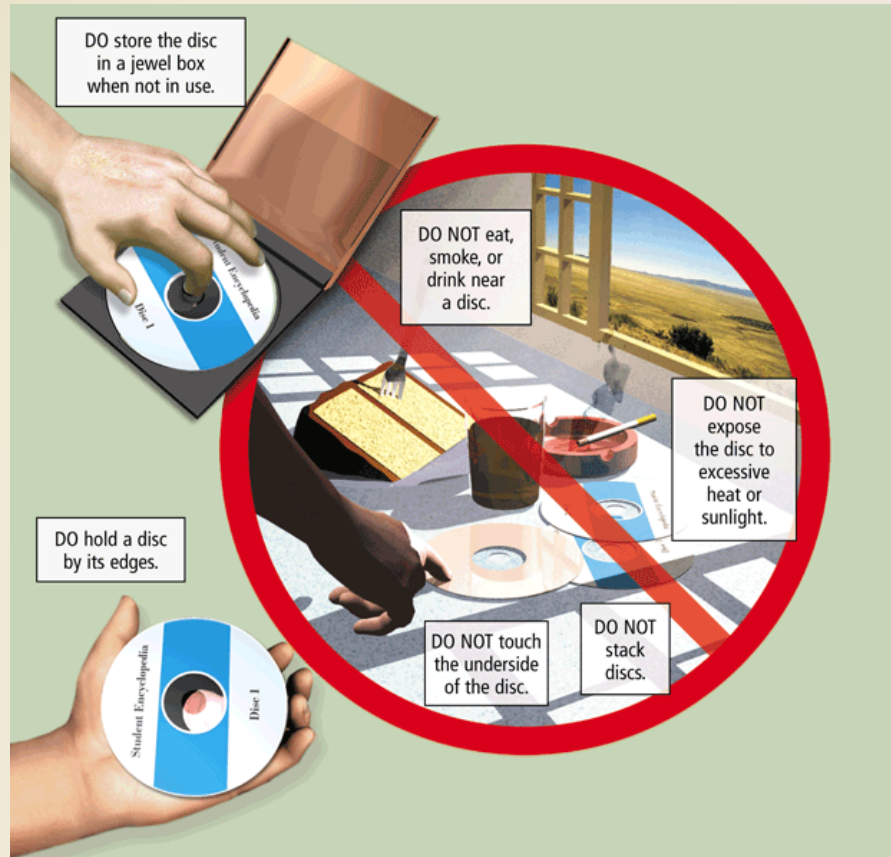
Optical Discs

- 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

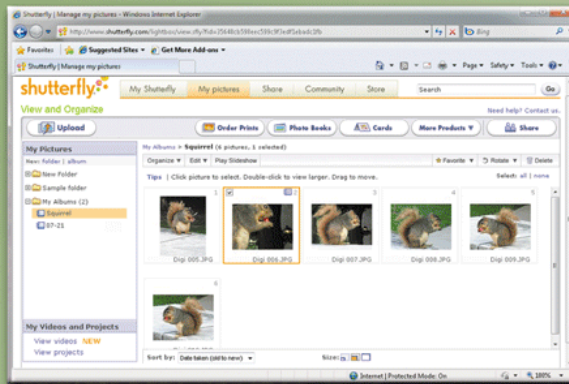
- Single-session CD-ROM that stores digital versions of film
- Typically uses a 1024 x 1536 resolution
- Many photo centers offer Picture CD services

Optical Discs

How an Archive Disc Works

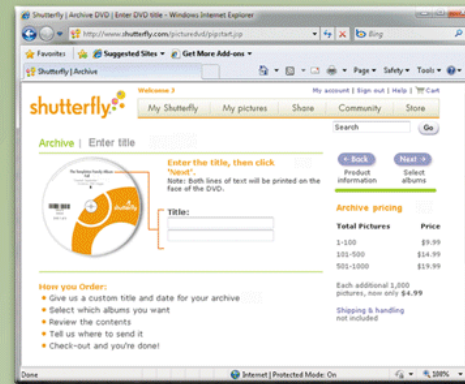
Step 1

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



Click to view Web Link, click Chapter 7, Click Web Link from left navigation, then click Blu-ray below Chapter 7

Other Types of Storage

Tape

Magnetic stripe
cards and smart
cards

Microfilm and
microfiche

Enterprise storage

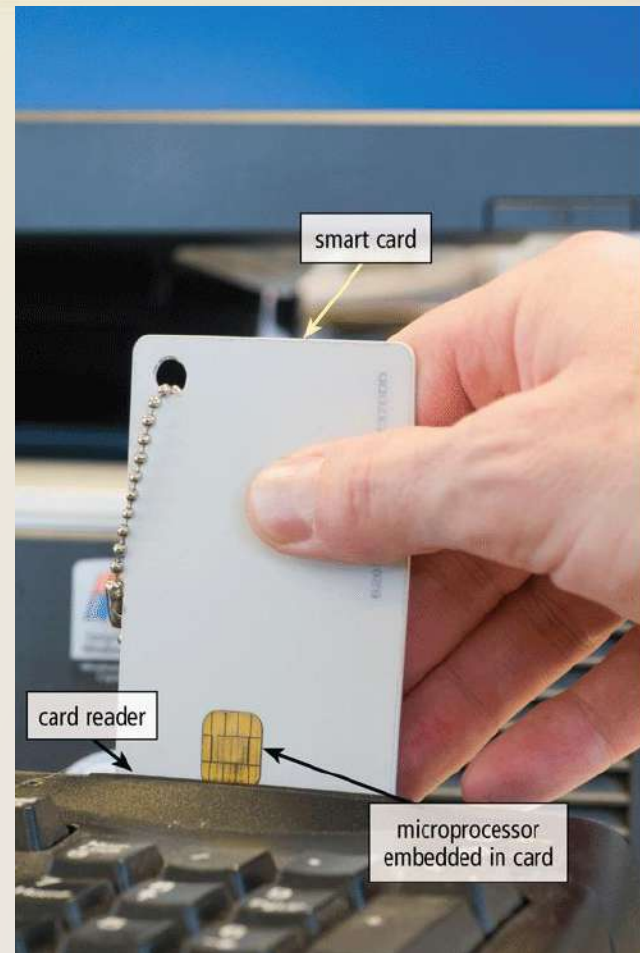
Other Types of Storage

- **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



Click to view Web Link,
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Link from left navigation,
then click Smart Cards
below Chapter 7

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



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