VISUAL SUMMARY

Secondary Storage

STORAGE

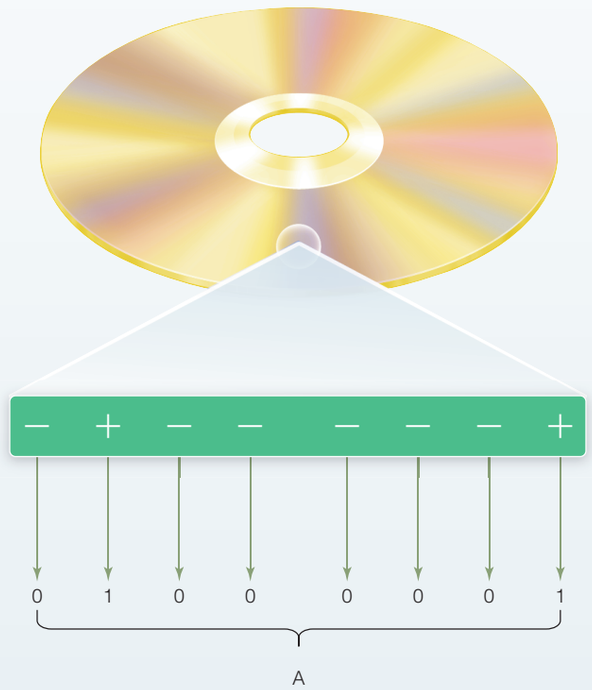
RAM is **primary storage**. Most RAM is volatile, meaning that it loses its contents whenever power is disrupted. **Secondary storage** provides nonvolatile storage. Secondary storage retains data and information after the computer system is turned off.

Writing is the process of saving information to **secondary storage devices**. Reading is the process of accessing information from secondary storage devices.

Important characteristics of secondary storage include

- **Media**—actual physical material that retains data and programs.
- **Capacity**—how much a particular storage medium can hold.
- **Storage devices**—hardware that reads and writes to storage media.
- **Access speed**—time required to retrieve data from a secondary storage device.

HARD DISKS



Hard disks use rigid metallic **platters** that provide a large amount of capacity. They store data and programs by altering the electromagnetic charges on the platter's surface. Files are organized according to

- **Tracks**—concentric rings without visible grooves.
- **Sectors**—wedge-shaped sections.
- **Cylinders**—run through each track of a stack of platters.

Density refers to how tightly electromagnetic charges can be packed next to one another on the disk.

A **head crash** occurs when the hard disk makes contact with the drive's read/write heads.

Two types of hard disks are internal and external hard disks.

Internal Hard Disk

Internal hard disks are located within the system unit. Used to store programs and data files.

To be a competent end user, you need to be aware of the different types of secondary storage. You need to know their capabilities, limitations, and uses. There are four widely used storage media: hard disk, optical disc, solid-state, and cloud storage.

HARD DISKS

External Hard Drives

Unlike internal hard disks, **external hard drives** are removable. External drives use the same basic technology as internal disks.

Performance Enhancements

Three ways to improve hard-disk performance are disk caching, RAID, and file compression and decompression.

- **Disk caching**—provides a temporary high-speed holding area between a secondary storage device and the CPU; improves performance by anticipating data needs and reducing time to access data from secondary storage.
- **RAID (redundant array of inexpensive disks)**—several inexpensive hard-disk drives are connected together; improves performance by providing expanded storage, fast access, and high reliability.
- **File compression and decompression**—files compressed before storing and then decompressed before being used again; improves performance through efficient storage.

OPTICAL DISCS

Optical discs use laser technology. 1s and 0s are represented by **pits** and **lands. Optical disc drives** project light and measure the reflected light.

Compact Disc

Compact discs (CDs) have typical capacity of 700 MB on one side. Three types are **CD-ROM (compact disc–read-only memory)**, **CD-R (CD-recordable;** CD-R drives are also known as CD burners), and **CD-RW (compact disc rewritable, erasable optical discs).**

Digital Versatile Disc

DVDs (digital versatile discs, digital video discs) have far greater capacity than CDs with a typical capacity of 4.7 GB on one side. Three types are **DVD-ROM (digital versatile disc–read-only memory; DVD players** are drives), write once **(DVD+R, DVD-R),** and rewritable **(DVD+RW, DVD-RW, DVD-RAM).**

Blu-ray Disc

Hi-def (high-definition) Blu-ray discs are the next standard optical disc. **Blu-ray discs (BDs)** have a capacity of 50 GB on one side. Same size as other optical media, but much greater capacity and requires special drives. Three basic types: read only, write once, and rewritable.

SOLID-STATE STORAGE

Solid-state storage devices have no moving parts and are more reliable and require less power than hard disks.

Solid-State Drives

Solid-state drives are similar to internal hard-disk drives except they use solid-state memory; are faster, more durable, and more expensive; and generally provide less capacity.

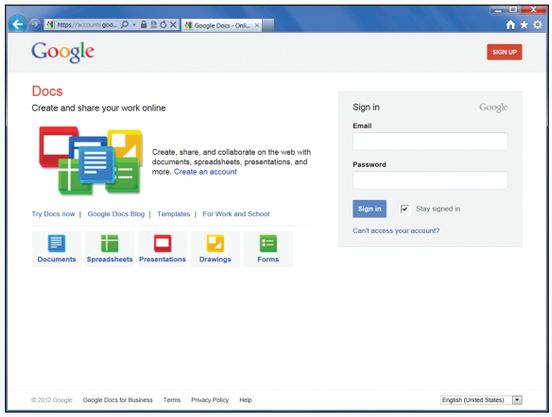
Flash Memory Cards

Flash memory cards are small solid-state storage devices that are widely used with notebook computers. They are used with a variety of specialized input devices including digital cameras to store and transfer images and digital media players like the iPod to store and transfer music and video files.

USB Drives

USB drives (flash drives) are so small that they fit onto a key ring. These drives connect to a computer's USB port and are widely used to transfer data and information between computers, specialty devices, and the Internet.

CLOUD STORAGE



With **cloud computing,** the Internet acts as a "cloud" of servers that supply applications to clients as a service rather than a product. **Cloud storage (online storage)** is supplied by servers.

- Examples include Google Docs for word processing and spreadsheets, Mint.com for financial management, and Amazon S3 for storing data.
- Cloud servers provide storage, processing, and memory.
- With cloud computing software, installation and upgrade are avoided.

MASS STORAGE DEVICES

Mass storage refers to the tremendous amount of secondary storage required by large organizations. **Mass storage devices** are specialized high-capacity secondary storage devices.

Most large organizations have established a strategy called an **enterprise storage system** to promote efficient and safe use of data across the networks within their organizations.

Mass storage devices that support this strategy are **file servers, network attached storage (NAS), RAID systems, tape libraries,** and **organizational cloud storage.** A **storage area network (SAN)** is a method of using enterprise-level remote storage systems as if they were local to your computer.

CAREERS IN IT

Disaster recovery specialists are responsible for recovering systems and data after a disaster strikes an organization. Bachelor's or advanced specialized associate's degree in information systems or computer science, experience, and additional skills in the areas of networking, security, and database administration are desirable. Salary range is $70,000 to $103,000.

KEY TERMS

access speed (189)
Blu-ray disc (BD) (193)
capacity (189)
CD (compact disc) (192)
CD-R (CD-recordable) (192)
CD-ROM (compact disc–read-only memory) (192)
CD-RW (compact disc rewritable) (193)
cloud computing (195)
cloud storage (196)
cylinder (189)
density (189)
disaster recovery specialist (200)
disk caching (190)
DVD (digital versatile disc or digital video disc) (193)
DVD player (193)
DVD-R (DVD recordable) (193)
DVD+R (DVD recordable) (193)
DVD-RAM (DVD random-access memory) (193)
DVD-ROM (DVD–read-only memory) (193)
DVD-RW (DVD rewritable) (193)
DVD+RW (DVD rewritable) (193)
enterprise storage system (199)
erasable optical disc (192)
external hard drive (190)
file compression (191)
file decompression (191)
file server (199)
flash drive (195)
flash memory card (194)
hard disk (189)
head crash (190)
hi def (high definition) (193)
internal hard disk (190)
land (192)
mass storage (199)
mass storage devices (199)
media (189)
network attached storage (NAS) (199)
online storage (196)
optical disc (192)
optical disc drive (192)
organizational cloud storage (200)
pit (192)
platter (189)
primary storage (188)
RAID system (199)
redundant array of inexpensive disks (RAID) (191)
secondary storage (188)
secondary storage device (188)
sector (189)
solid-state drive (SSD) (194)
solid-state storage (194)
storage area network (SAN) (200)
storage device (189)
tape library (200)
track (189)
USB drive (195)

To test your knowledge of these key terms with animated flash cards, visit our website at www.computing2014.com and enter the keyword terms7. Or use the free *Computing Essentials 2014* app.

MULTIPLE CHOICE

Circle the letter of the correct answer.

1. RAM is sometimes referred to as:
   a. primary storage
   b. ratio active memory
   c. read-only memory
   d. secondary storage

2. The actual physical material that holds the data and programs.
   a. primary storage
   b. media
   c. capacity
   d. access

3. Measures how tightly the magnetic charges can be packed next to one another on the disk.
   a. density
   b. cylinders
   c. tracks
   d. sectors

4. When a read/write head makes contact with the hard disk's surface, it causes a head:
   a. crash
   b. land
   c. pit
   d. scratch

5. This hard-disk performance enhancement anticipates data needs.
   a. disk caching
   b. file compression
   c. file decompression
   d. RAID

6. This type of storage uses pits and lands to represent 1s and 0s.
   a. cloud
   b. hard disk
   c. optical
   d. solid state

7. DVD stands for:
   a. digital versatile disc
   b. digital video data
   c. dynamic versatile disc
   d. dynamic video disc

8. USB drives are also known as:
   a. flash drives
   b. optical drives
   c. ports
   d. universal state bus

9. An organizational strategy to promote efficient and safe use of data across the networks.
   a. cloud dynamic
   b. data mission statement
   c. enterprise storage system
   d. RAID

10. A mass storage device that provides access to data archived on tapes.
    a. file system
    b. NAS
    c. RAID system
    d. tape library

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MATCHING

Match each numbered item with the most closely related lettered item. Write your answers in the spaces provided.

a. CD-R
b. file compression
c. formats
d. network attached storage
e. secondary storage
f. sectors
g. solid-state drives
h. storage area network
i. storage devices
j. tracks

___ **1.** Provides permanent or nonvolatile storage.
___ **2.** Hardware that reads data and programs from storage media.
___ **3.** Rings of concentric circles without visible grooves on a hard-disk platter.
___ **4.** Each track is divided into invisible wedge-shaped sections called _____.
___ **5.** Increases storage capacity by reducing the amount of space required to store data and programs.
___ **6.** Discs that can be written only one time.
___ **7.** DVD+R and DVD-R are two competing write-once _____.
___ **8.** Designed to be connected inside a microcomputer system the same way an internal hard disk would be but contains solid-state memory instead of magnetic disks to store data.
___ **9.** Mass storage device that is similar to a file server and widely used for home and small business storage.
___ **10.** An architecture to link remote computer storage devices, such as enterprise storage systems, to computers such that the devices are as available as locally attached drives.

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OPEN-ENDED

On a separate sheet of paper, respond to each question or statement.

1. Compare primary storage and secondary storage, and discuss the most important characteristics of secondary storage.
2. Discuss hard disks including density, platters, tracks, sectors, cylinders, head crashes, internal, external, and performance enhancements.
3. Discuss optical discs including pits, lands, CDs, DVDs, Blu-ray, and hi def.
4. Discuss solid-state storage including solid-state drives, flash memory, and USB drives.
5. Discuss cloud computing and cloud storage.
6. Describe mass storage devices including enterprise storage systems, file servers, network attached storage, RAID systems, tape libraries, organizational cloud storage, and storage area network systems.