Digital Image Formation

Storage Technology
Name one type of data storage?
Storage Technology
Data Storage Device

is a device for recording (storing) information (data).

**Recording** can be done using virtually any form of energy, from manual muscle power in handwriting, to acoustic vibrations in phonographic recording, to electromagnetic energy modulating **magnetic tapes** and **optical discs**.
Digital Data Storage Device

Punch Card

1928: The IBM Punch Card is the Grandfather of binary data storage
Digital Data Storage Device

Teletype Devices

The electro-mechanical typewriter could be used to communicate typed messages over a variety of communications channels that ranged from a simple electrical connection to the use of radio and microwaves.
Digital Data Storage Device

Punch Tape

The first computers used existing teletype writers as a solution for input and output. **Punch tape** became popular for low cost storage.
Magnetic storage refers to the storage of data on a magnetized medium. The information is accessed using one or more read/write heads. Still today, the primarily storage media device for computers are magnetic hard drives. But solid-state memory is the wave of the future.
Digital Data Storage Device

Magnetic Tape Drives

Very reliable backup data system are being used today. Professional systems cost from $2,000 - $10,000
Digital Data Storage Device

Magnetic Hard Disk Drives

is a storage device which stores digitally encoded data on rapidly rotating platters with magnetic surfaces.
Digital Data Storage Device

Magnetic Hard Disk Drives

• Internal & External Hard Drives
• Portable Hard Drives
  • USB
  • Firewire
• RAID Array Systems
Digital Data Storage Device

Magnetic Hard Disk Drive

Advantages

- Magnetic recording surface on stable material
- 2.5 to 3.5 disk size to store large amounts of data
- Cheap and reliable
- Technology was developed in 1956 by IBM
Digital Data Storage Device

Magnetic Hard Disk Drive

Dis-advantages

- Mechanical, uses electrical motors that can break
- Sensitive to heat, water, electrical spikes in voltage, and dropping/shock
- Sensitive to magnetic radiation
- Requires a built-in power supply to work
Digital Data Storage Device

Magnetic Hard Disk Drives

Factors & Considerations

- **Capacity**, the amount of data that can be stored
- **Access Speed**, the speed in which the drive reads and writes data
- **Data Transfer Rate**, the speed in which data is transferred from the hard drive to the buffer
Digital Data Storage Device

Magnetic Hard Disk Drives

Hard Drive Array

“RAID”: Redundant Array of Independent Disks

Internal or External

Price $300 (two drives) - $30,000 (twenty-four drives)
Digital Data Storage Device

“RAID”: Hard Drive Array

A “RAID” setup can increase hard-drive performance and provide automatic protection against data loss from a single drive failure.

RAID comes in a number of levels and a variety of variations and combinations.
Digital Data Storage Device

“RAID”: Hard Drive Array

RAID 0: Increases hard-drive performance by spreading data over two drives so that it can be read and written more quickly. Unfortunately, such an array provides no data protection.
Digital Data Storage Device

“RAID”: Hard Drive Array

RAID 1: protects data from a drive failure by simultaneously writing data to two hard drives: a master drive and a backup drive. Since the second drive carries an exact copy of the first, it provides no usable storage capacity. RAID 1 offers no gain in drive performance.
Digital Data Storage Device

“RAID”: Hard Drive Array

RAID 5: Faster disk performance and data protection, requires a minimum of three hard drives. RAID 5 spreads redundancy information—called *parity bits*—across all of the array's drives, increasing the proportion of usable disk space. A three-drive RAID 5 setup presents two drives' worth of storage capacity, a four-drive array offers three drives for storage, and so on. If one of the drives fails, the data content of that failed drive can be recalculated from the parity bits on the surviving drives and written to a new, replacement drive.
Digital Data Storage Device

“RAID”: Hard Drive Array

Go to B&H Photo for examples.
Digital Data Storage Device

Optical Disc: Invented in 1958
CD 1983 / DVD “mid 90’s” / Blu-Ray 2006

An optical disc is a flat, circular disc encoded with microscopic pits (or bumps) on a special material (often aluminum). The encoding material sits atop a thicker disc base (usually polycarbonate) which makes up the bulk of the disc.
Digital Data Storage Device

Optical Disc

A. A polycarbonate disc layer has the data encoded by using bumps.

B. A reflective layer reflects the laser back.

C. A lacquer layer is used to prevent oxidation.

D. Artwork is screen printed on the top of the disc.

E. A laser beam reads the polycarbonate disc, is reflected back, and read by the player.
The encoding pattern follows a continuous spiral path covering the entire disc surface. The data is written to the disc with a laser, and can be read when the data path is illuminated with a laser diode in an optical disk drive which spins the disc at speeds between 200 - 4000 RPM or more depending on the drive type.
Digital Data Storage Device

Optical Disc: cd
Maximum Storage Size = 700MB

- CD-ROM = read-only memory (is a pre-pressed disc that contains data)
- CD-R = write once read many
- CD-RW = rewritable
- 5.1 Music Disc = contains music in surround sound format
- Photo CD = a system designed by Kodak for storing photos
- Video CD (VCD = standard digital format for storing video)
Digital Data Storage Device

Optical Disc: dvd

Maximum Storage Size = 4.7GB (Single Layered)
Maximum Storage Size = 8.54GB (Double Layered)

- DVD = read-only memory (is a pre-pressed disc that contains data)
- DVD-R = write once read many (Pioneer)
- DVD+R = write once read many (Sony)
- DVD+-RW = rewritable
- DVD-D = designed to be used for a maximum 48 hours after the containing package is opened
Digital Data Storage Device

Flash Memory

- USB Flash Drive (Universal Serial Bus-interface socket that allows plug and play)
- XD-Picture Card
- Compact Flash I and II Cards
- Smart Media
- Secure Digital
- Sony Memory Stick
- MultiMediaCard
Digital Data Storage Device

Flash Memory

- solid state storage
- computer memory that can be electrically erased and reprogrammed
- no power is needed to maintain the information stored on the chip
- for general storage and transfer of data between computers and other digital products
Digital Data Storage Device

Flash Memory

Advantages

• durable, being able to withstand intense pressure, extremes of temperature, and even immersion in water

• cheaper than film and processing

• large storage allow a photographer to shoot many more photographs without stopping to reload the camera.
Digital Data Storage Device

Flash Memory

Limitations

• has a finite number of erase-write cycles (around 100,000 write-erase-cycles)

• sensitive to static electricity

• sensitive to voltage spikes
Digital Data Storage Device

Solid State Hard Drive

SDRAM: synchronous dynamic random access memory

A solid state drive is a storage device that uses solid state memory to store data.
Digital Data Storage Device

Solid State Hard Drive

Advantages

• Higher reliability - no moving parts, there is less that can go wrong mechanically

• Faster data access - information on solid state drives can be accessed immediately (technically at the speed of light)

• Less power usage - less heat, “green”
Digital Data Storage Device

Solid State Hard Drive

Dis-advantages

- **COST** - adding a 512GB SSD drive to a apple lap top adds $900 to the price of the computer.

- Less storage space than conventional magnetic hard drives

- Sensitive to static electricity and voltage spikes
Storage Technology
Digital Data Storage Device
Summary on Reliability

#1: Solid State Drives / Flash Memory
#2: Magnetic Tape Drives
#2: RAID advance levels of level 5 +
#4: Internal & External Hard Drives
#5: CD or DVD

WARNING: None of the above storage solutions are completely permanent. Technology can leave storage devices in the past. Neglect and damage can destroy any of the above.
Storage Technology
Digital Data Storage Device
New Trends

On-line backup systems: “THE CLOUD”

On-line companies such as Carbonite offer a low-cost solution to backing up your digital files.

www.carbonite.com

OR

Companies such as Dropbox offers a free service.

www.dropbox.com
Storage Technology

Digital Data Storage Device

Nothing Is Permanent!

Backup…Backup…Backup…Backup…Backup…Backup…Backup