CIS1 Chapter 7

Permanent Storage
Permanent Storage

What is in charge of permanent storage devices?

The operating system software!
Cost vs. Speed

Diagram showing a pyramid with the following levels from top to bottom:
- Memory (RAM): most expensive, fastest
- Solid State
- Hard Disk
- Optical Disk
- Floppy Disk
- Tape
- Mass Storage: least expensive, slowest

The diagram illustrates the relationship between cost per megabyte and access speed for different types of storage devices.
Direct Access Devices vs. Sequential Access

Analogy:
• Record/CD vs. Cassette Tape
Sequential Access Devices

**Sequential Access** - In order to access specific information, the device must sequentially pass through all preceding information

- 9 Track Tape (Reel to Reel)
- Cartridge Tapes
Reel to Reel Tape
(9 Track Tape)
Using a Cartridge Tape Drive
Recording information

• Bits are recorded as positive and negative polarity on magnetic tape ("magnetic media")

Advantages

• inexpensive
• durable
• portable

Disadvantages

• slow access rate

Primary Use

Backing up “on-line” information
Direct Access Devices

Direct Access - The specific information is accessed directly

Examples
- floppy disk drives
- hard disk drives
- cartridge disk drives
- CD ROM drives
Floppy Disk - iron oxide coating on a portable mylar plastic disk

3 1/2 inch diskette
- high density - 1.4 MB capacity

Notch with slide - write protection
- closed - Read/Write
- open - Read Only
Recording information

• Bits are recorded as positive and negative polarity on magnetic tape ("magnetic media")
Magnetic Media is sensitive to:
• temperature
• magnets
• touch, smoke, dirt
• folding, bending, pressure
Hard Disk Drives

**Hard Disk** - Iron oxide coating on one or more rigid aluminum disks called platters
Hard disk drive (with the cover removed)
Common Sizes

Older Disks
• 5 MB, 10 MB, 20 MB, etc.

Typical sizes today
• 1 GB - 40 GB and more!

Advantages of Hard Disk Drives over Floppy Disk Drives
• more capacity
• faster access
How data is stored on disks

Hotel analogy

Who's in charge of how information (data and software) is stored on the disk?

The operating system software
track - a series of concentric rings on the disk

- A track is divided into several sectors

sector - a section of a track which stores a predetermined number of bytes (bits)
Several sectors are combined to create clusters or blocks

cluster (Windows and Macs) or block (UNIX) - The number of sectors which is allocated on the disk each time a file needs space on the disk.

This is the basic unit of storage for the OS.
FAT (File Allocation Table) and Directory - A file, a table, which is found on one of the first sectors of every diskette and hard disk drive (created when the disk is formatted), and contains information regarding every file stored on that disk including the file name, the date and time that file was created or modified, the size of the file, and which sectors are allocated for that file.

Example

Creating a new file and saving an existing file to disk
Fragmentation and Defragmenting
How data is physically stored on the disk

**Read/Write Heads** - Part of disk drive which skims the disk (ten millionths of an inch) in order to retrieve or store information.

**Disk Crash or Head Crash** - When the R/W head touches the disk.
What does formatting a disk do?

1. Erases all of the information on the disk
2. Prepares disk to be used by the operating system software.
   - divides tracks into sectors
   - determines cluster size
   - creates a file allocation table (FAT) or similar table on other operating systems
How Data is Removed from Floppy disks and Hard disks

Who's in charge of deleting files?
The OS!

May not really be deleted
(Recycle Bin on the PC
Trash on the Mac)

Deletion vs. Marked-for-reuse

* Short talk on Data Recovery
Optical Disks
CD ROMs

Recording bits of data

• Data is permanently recorded by a laser beam on a disk

• WORM - Write Once Read Many
Pit - On
No Pit (Land) - Off

1. The bottom surface of an optical disk like a CD-ROM has flat areas, called lands, and microscopic holes, called pits. The pits have been turned into the surface with a high-powered laser.

2. A lower powered laser is used to read the optical disk. The laser beam passes through a prism and a lens that focuses the beam on the disk surface.

3. Lands reflect the laser beam back to the prism, which then directs the light to a photodiode, which is a component that converts light to an electrical signal. Reflected light is read as the binary bit 1.

4. Pits scatter the laser beam and no light is reflected to the photodiode. No reflected light is read as the binary bit 0.
Advantages of CD ROM over magnetic tapes

• capacity and durability

Capacity

• 650 MB (standard)
  700 – 800MB with tricks

_was considered large, but is now insufficient
  – for example software programs may require many disks_
What are CD ROMs good for?
• graphics, videos, games, software, (backups)

Speed of CD ROM Drives
• 4x, 12x, 40x, 50x, etc.
• larger the number, faster the transfer speed from the CD ROM to RAM

What’s next?
• Need more capacity and faster speeds.
Types of CD technology

CD-ROM
reads disks

CD-R
reads disks and can write new information on a CD-R disk once

CD-RW
reads disks and can write or erase CD-RW disks and write CD-R disks once.
DVD Disks: The next generation

DVD - Digital Versatile Disk or Digital Video Disk (companies couldn’t agree)

• The bigger, faster CD ROM (about 14GB double side/layer)

DVD-Video

• for movies and music

DVD-ROM

• for computer data
Upcoming Format Battles

(It’s VHS vs. BETA again!)

for audio (replacing the CD):
DVD-Audio vs.
SuperCD (SCD) vs.
High Definition Compatible Digital (HDCD)
plus other new CD types

for DVD recordable:
DVD-R
DVD-RW
DVD+R
DVD+RW
(none of these are similar to regular DVD – e.g. max 4.7GB)
Disk Cartridges

Disk Cartridges - portable disks.

In size and capacity, they are a compromise between floppy and hard disk drives.

Uses
• same as floppy or tape

Examples:
Iomega Zip Drive - 100 MB or 250 MB
Iomega Jaz Drive - 1 GB or 2 GB
Iomega Jaz Drive