



# Computer Fundamentals

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Lecture 11



# Outline

## ➤ Types of storage devices



# Storage Devices

- Store data when computer is off
- Two processes
  - ❑ Writing data
  - ❑ Reading data
- Storage media
  - ❑ The material for storing data
  - ❑ Storage devices manage media
    - Magnetic devices use a magnet
    - Optical devices use lasers
    - Solid-state devices have physical switches



# Magnetic Storage Devices

- Most common form of storage
  - ❑ Hard drives, floppy drives, tape
- All magnetic drives work the same



Floppy Disk

Hard Disk

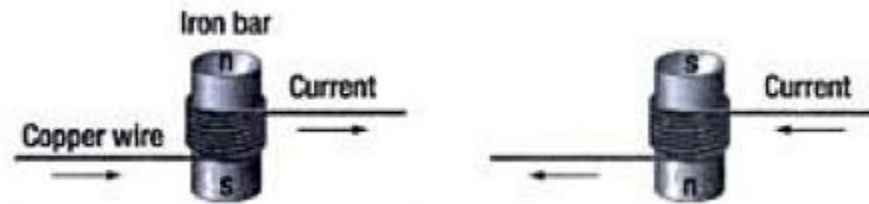
Tape



# Magnetic Storage Devices (cont.)

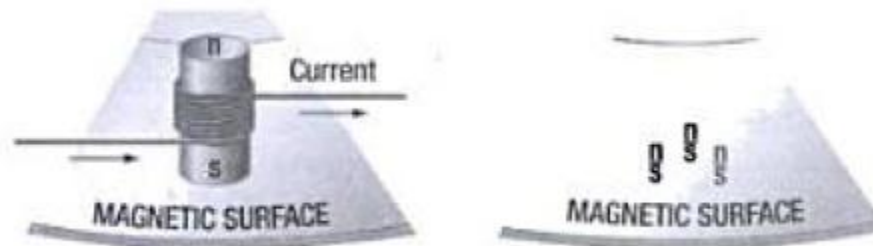
## ➤ Making a magnet

- ❑ Polarity (N/S) determined by current direction



## ➤ Electromagnetic induction

- ❑ Placing electromagnet against magnetic surface induces magnetic field





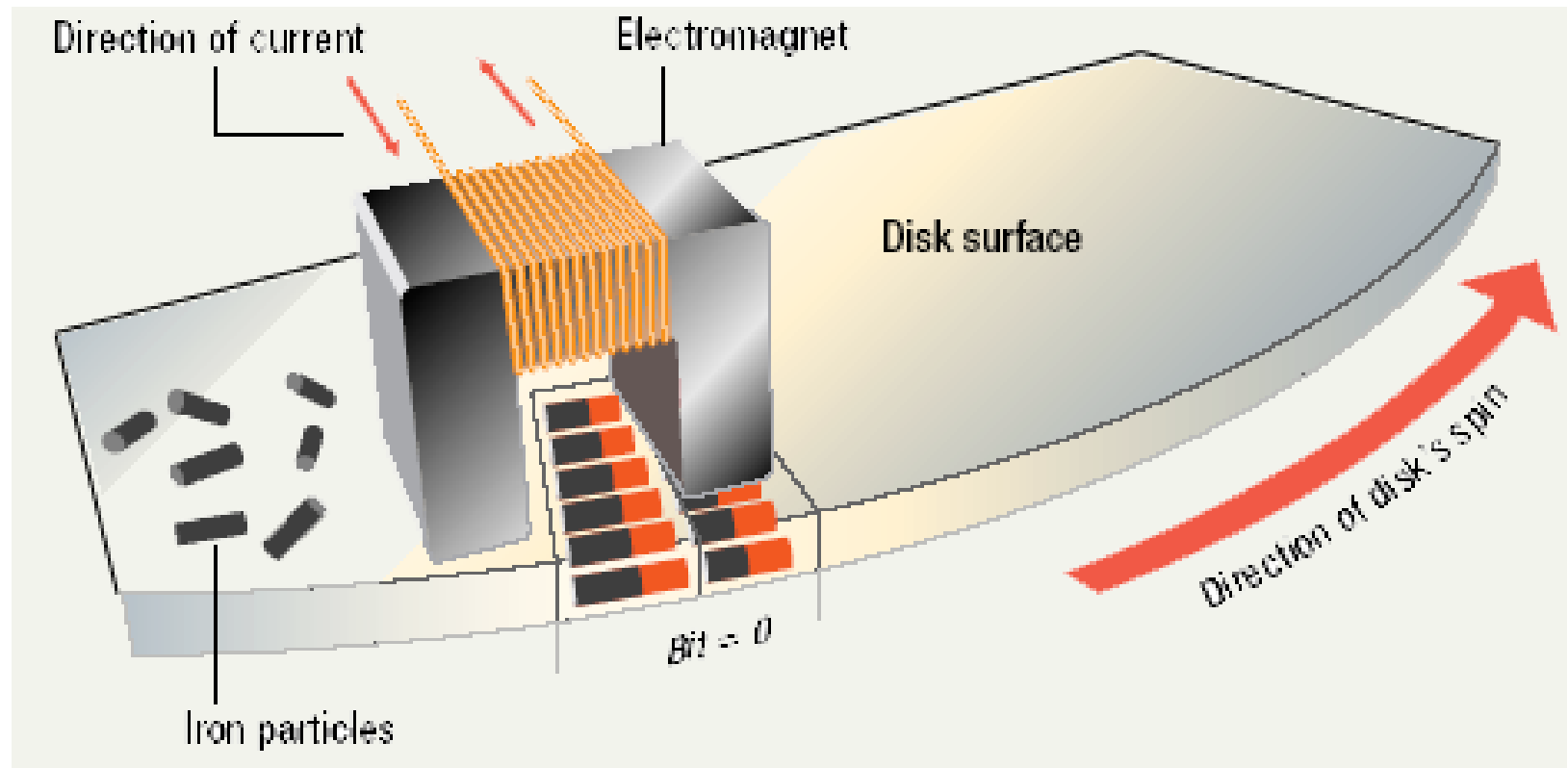
# Magnetic Storage Devices (cont.)

- Data storage and retrieval
  - ❑ Media is covered with iron oxide
  - ❑ Read/write head is a magnet
  - ❑ Magnet writes charges on the media
    - Positive charge is a 1 (if N is used)
    - Negative charge is a 0 (if S is used)
  - ❑ Magnet reads charges
  - ❑ Drive converts charges into binary
  - ❑ Better than transistor for 0 and 1 as continuous power not required



# Magnetic Storage Devices (cont.)

## ➤ Data retrieval

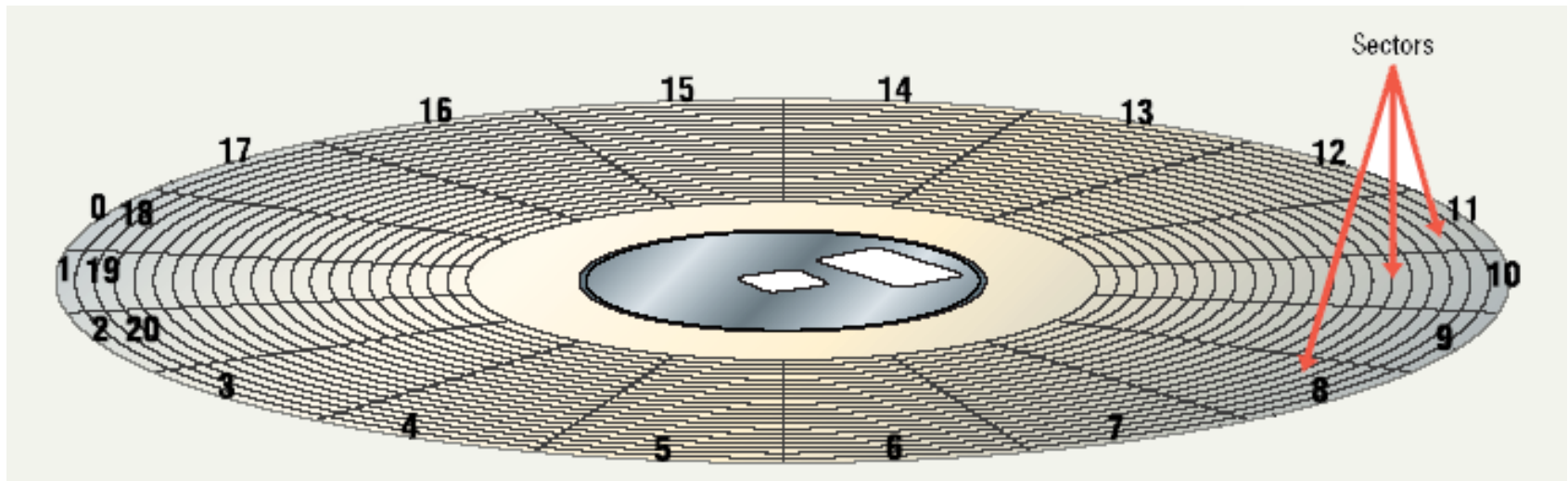




# Magnetic Storage Devices (cont.)

## ➤ Data organization

- ❑ Disks must be formatted before use
  - Mapping disk before use
- ❑ Format draws tracks on the disk
  - Concentric rings
- ❑ Tracks are divided into sectors
  - Amount of data a drive can read
  - Assume 80 tracks on each side, 18 sectors, totals 2880 sectors







# Magnetic Storage Devices (cont.)

- Finding data on disk
  - ❑ Each track and sector is labeled (logical formatting)
  - ❑ File system
    - Logical method for storing data on disk surface
    - Listing of where files are stored
  - ❑ File system examples
    - File Allocation Table (FAT)
    - FAT32
    - NTFS
  - ❑ Data is organized in clusters
    - A group of sectors, storage units
    - Size of data the OS can handle as a single unit



# Magnetic Storage Devices (cont.)

## ➤ After FAT format, disk contains four areas

### ❑ Boot sector

- Program that run on computer startup (booting)
- Control of computer handed over to boot sector after POST

### ❑ FAT area

- Records status of each sector
- Keep track of allocation status of clusters
- Possible FAT entries for clusters: allocated, unallocated, end of file, bad sector

### ❑ Root folder

- Folder required for organizing files on disk
- Records location of each file and directory
- Root folder is master folder
- All other folders are subfolders in root folder

### ❑ Data area

- Kept free for data storage



# Magnetic Storage Devices (cont.)

## ➤ Diskettes

- ❑ Also known as floppy disks
- ❑ Read with a disk drive
- ❑ Recording media of *Mylar*
  - A strong polyester film
- ❑ Spin at 300 RPM
- ❑ Takes .2 second to find data with head
- ❑ 3 ½ floppy disk holds 1.44 MB



## ➤ Hard disks

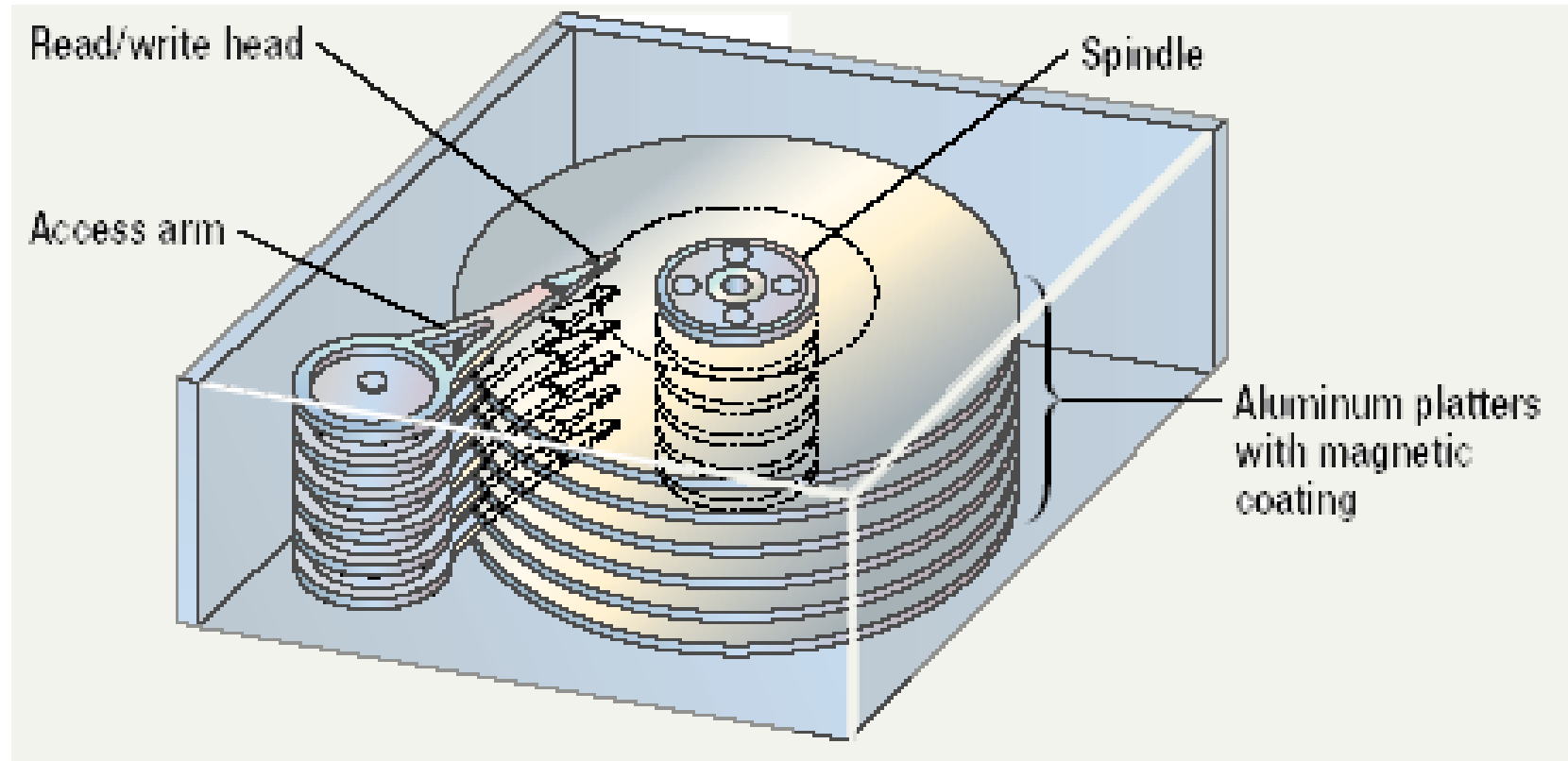
- ❑ Primary storage device in a computer
- ❑ 2 or more aluminium platters
- ❑ Each platter has 2 sides
- ❑ Spin between 5,400 to 15,000 RPM
- ❑ Data found in 9.5 ms or less
- ❑ Drive capacity up to 16 TB

Source: <https://www.amazon.com/Double-Density-MF2-DD-Diskettes-Formatted/dp/B006NNGZ9S>



# Magnetic Storage Devices (cont.)

## ➤ Hard disk illustrated





# Magnetic Storage Devices (cont.)

- Removable high capacity disks (external hard disks)
  - ❑ Speed of hard disk
  - ❑ Portability of floppy disk
  - ❑ Several variants have emerged
  - ❑ High capacity floppy disk
    - Stores up to 750 MB of data
  - ❑ Hot swappable hard disks
    - Provide up to 8 TB of data space
    - Connect via USB



# Magnetic Storage Devices (cont.)

## ➤ Tape drives

- ❑ Best used for
  - Infrequently accessed data
  - Back-up solutions
- ❑ Slow sequential access
- ❑ Capacity exceeds 200 GB

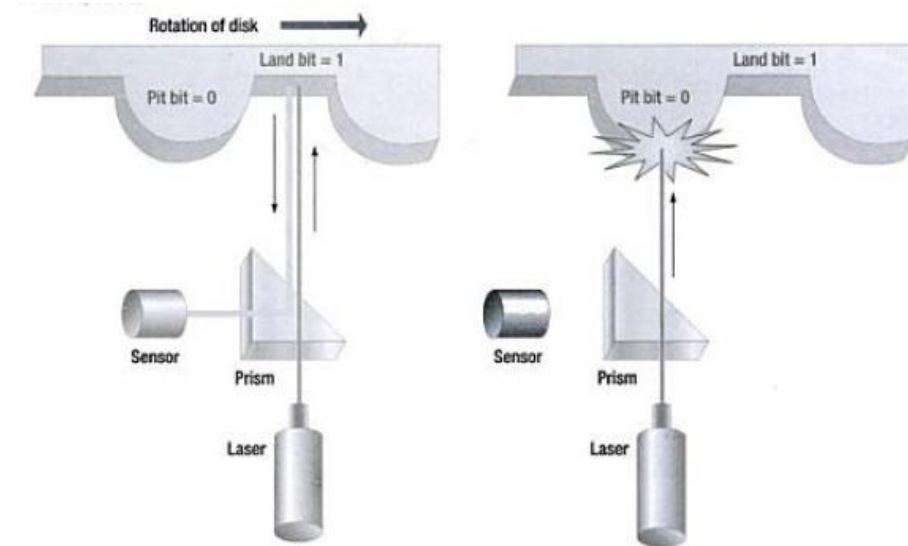




# Optical Storage Devices

## ➤ CD-ROM

- ❑ Most software ships on a CD
- ❑ Read using a laser
  - Lands, binary 1, reflect data
  - Pits, binary 0, scatter data
- ❑ Spiral sectors (all of same width)
- ❑ Written from the inside out
- ❑ CD speed is based on the original
  - Original CD read 150 Kbps
  - A 10 X will read 1,500 Kbps
- ❑ Standard CD holds 650 MB



## ➤ DVD-ROM

- ❑ Digital Video Disk
- ❑ Use both sides of the disk
- ❑ Capacities can reach 18 GB
- ❑ DVD players can read CDs



# Optical Storage Devices (cont.)

- CD Recordable (CD-R)
  - ☐ Create a data or audio CD
  - ☐ Data cannot be changed
  - ☐ Can continue adding until full
- CD ReWritable (CD-RW)
  - ☐ Create a reusable CD
  - ☐ Cannot be read in all CD players
  - ☐ Can reuse about 100 times
- Photo CD
  - ☐ Developed by Kodak
  - ☐ Provides for photo storage
  - ☐ Photos added to CD until full
  - ☐ Original pictures cannot be changed





# Optical Storage Devices (cont.)

- DVD Recordable
  - ☐ Add files until full
  - ☐ Several different formats exist
  - ☐ None are standardized
  - ☐ Allows home users to create DVDs
  - ☐ Cannot be read in all players
- DVD-RAM
  - ☐ Allow reusing of DVD media
  - ☐ Erasing possible
  - ☐ Not standardized
    - Cannot be read in all players



# Solid State Devices

- Data is stored physically
  - ❑ Using physical switches
- No magnets or laser
- Very fast



# Solid State Devices (cont.)

- Flash memory
  - ☐ Found in cameras and USB drives
  - ☐ Combination of RAM and ROM
  - ☐ Long term updateable storage
- Smart cards
  - ☐ Credit cards with a chip
  - ☐ Chip stores data
  - ☐ Eventually may be used for cash
  - ☐ Hotels use for electronic keys
- Solid-state disks (SSD)
  - ☐ Large amount of SDRAM
    - Not a disk actually, is volatile
  - ☐ For large organizations, for network storage or joint projects
    - Availability of quickly changing data for large number of users at once
  - ☐ Extremely fast
  - ☐ Volatile storage
    - Require battery backups
  - ☐ Most have hard disks copying data for backup
  - ☐ Modern SSD are non-volatile