INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

CSN-101 (Introduction to Computer Science and Engineering)

Lecture 5: Computer Hardware Components and Their Working

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Piazza Class Room: https://piazza.com/iitr.ac.in/fall2019/csn101

[Access Code: csn101@2019]

Moodle Submission Site: https://moodle.iitr.ac.in/course/view.php?id=45

[Enrollment Key: csn101@2019]

Plan for Lecture Classes in CSN-101 (Autumn, 2019-2020)

Week	Lecture 1 (Monday 4-5 PM)	Lecture 2 (Friday 5-6 PM)
1	Evolution of Computer Hardware and Moore's Law, Software and Hardware in a Computer	Computer Structure and Components, Operating Systems
2	Computer Hardware: Block Diagrams, List of Components	Computer Hardware: List of Components, Working Principles in Brief, Organization of a Computer System
3	Linux OS	Linux OS
4	Writing Pseudo-codes for Algorithms to Solve Computational Problems	Writing Pseudo-codes for Algorithms to Solve Computational Problems
5	Sorting Algorithms – Bubble sort, selection sort, and Search Algorithms	Sorting Algorithms – Bubble sort, selection sort, and Search Algorithms
6	C Programming	C Programming
7	Number Systems: Binary, Octal, Hexadecimal, Conversions among them	Number Systems: Binary, Octal, Hexadecimal, Conversions among them
8	Number Systems: Negative number representation, Fractional (Real) number representation	Boolean Logic: Boolean Logic Basics, De Morgan's Theorem, Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR, Truth-tables
9	Computer Networking and Web Technologies: Basic concepts of networking, bandwidth, throughput	Computer Networking and Web Technologies: Basic concepts of networking, bandwidth, throughput
10	Different layers of networking, Network components, Type of networks	Network topologies, MAC, IP Addresses, DNS, URL
11	Different fields of CSE: Computer Architecture and Chip Design	Different fields of CSE: Data Structures, Algorithms and Programming Languages
12	Different fields of CSE: Database management	Different fields of CSE: Operating systems and System softwares
13	Different fields of CSE: Computer Networking, HPCs, Web technologies	Different Applications of CSE: Image Processing, CV, ML, DL
14	Different Applications of CSE: Data mining, Computaional Geometry, Cryptography, Information Security	Different Applications of CSE: Cyber-physical systems and IoTs

Hard Disk:

- Low-level format: organizes both sides of each platter into tracks and sectors to define where items will be stored on the disk.

- Partitioning: divide hard disk into separate areas called partitions; each partition functions as if it were a separate hard disk drive.

- High-level format: defines the file allocation table (FAT) for each partition, which is a table of information used to locate files on the disk.

Display:

- CRT (Cathode Ray Tube)
  - Electron Gun & Florescent Screen
  - Single Gun for Monochrome and 3 Guns for Color Screen
- LCD (Liquid Crystal Display)
  - About blocking light when not needed
  - TFT LCD (Thin Film Transistor LCD)
  - 19” in Desktop and 15” in Laptops
- Power Consumption
  - CRT – 110 watt
  - LCD – 30-40 watt
- Color Depth: 65,000 colors, 24 million colors
- Resolution: 1024x768, 1280x1024, 1600x1200

Display:

LCD

LCD required mercury for their production causing harm to environment.

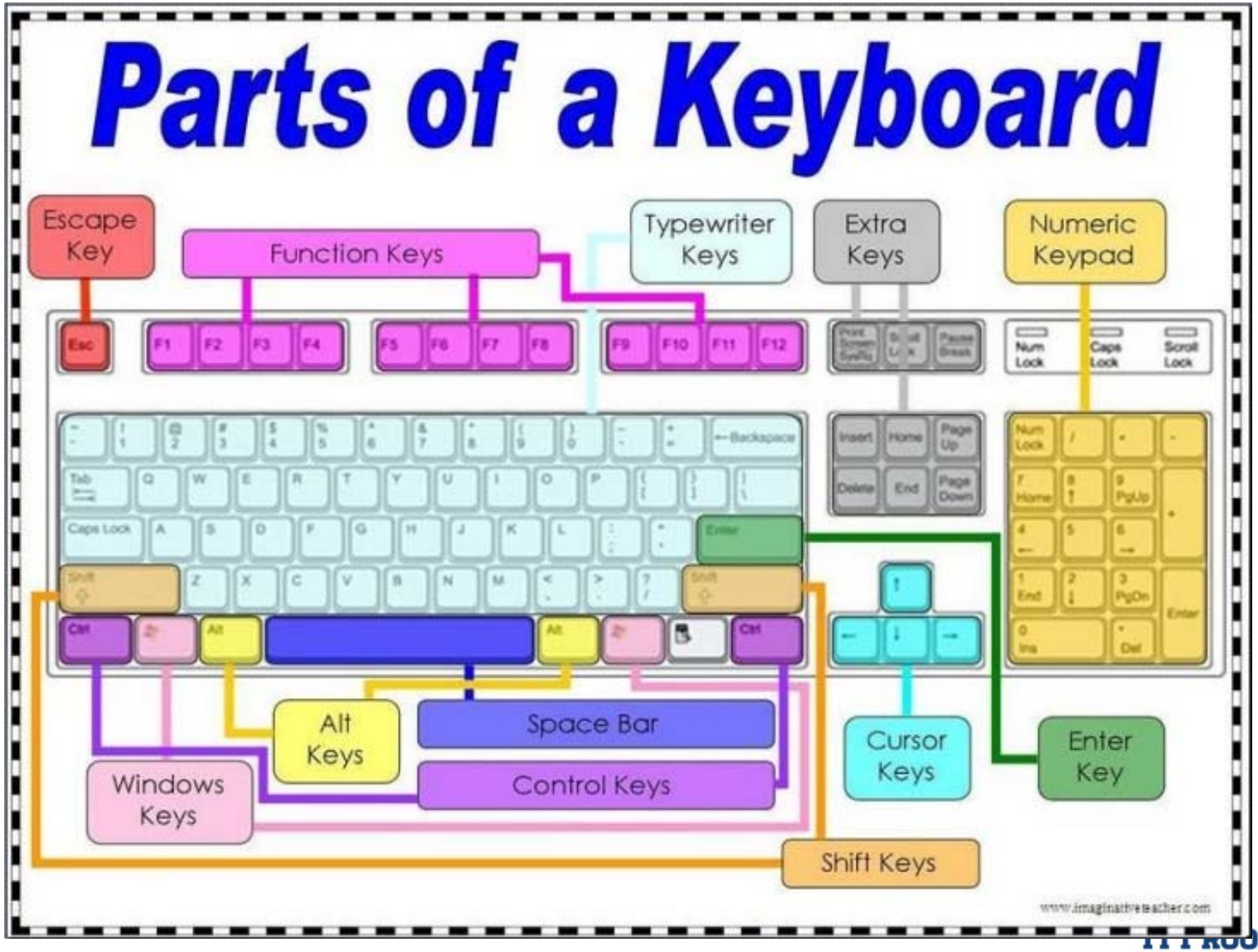
LED

LED use no mercury and is thereby environment friendly.

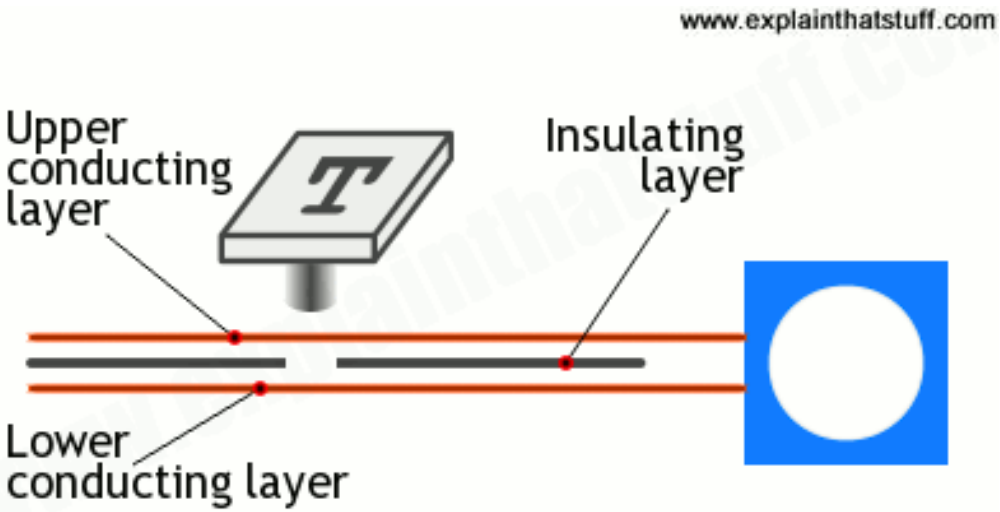
Keyboard:

- 101-key Enhanced keyboard
- 104-key Windows keyboard, 3 more keys
- Press the Key - Detect the position on the key matrix (16 bytes)

Keyboard Layout:



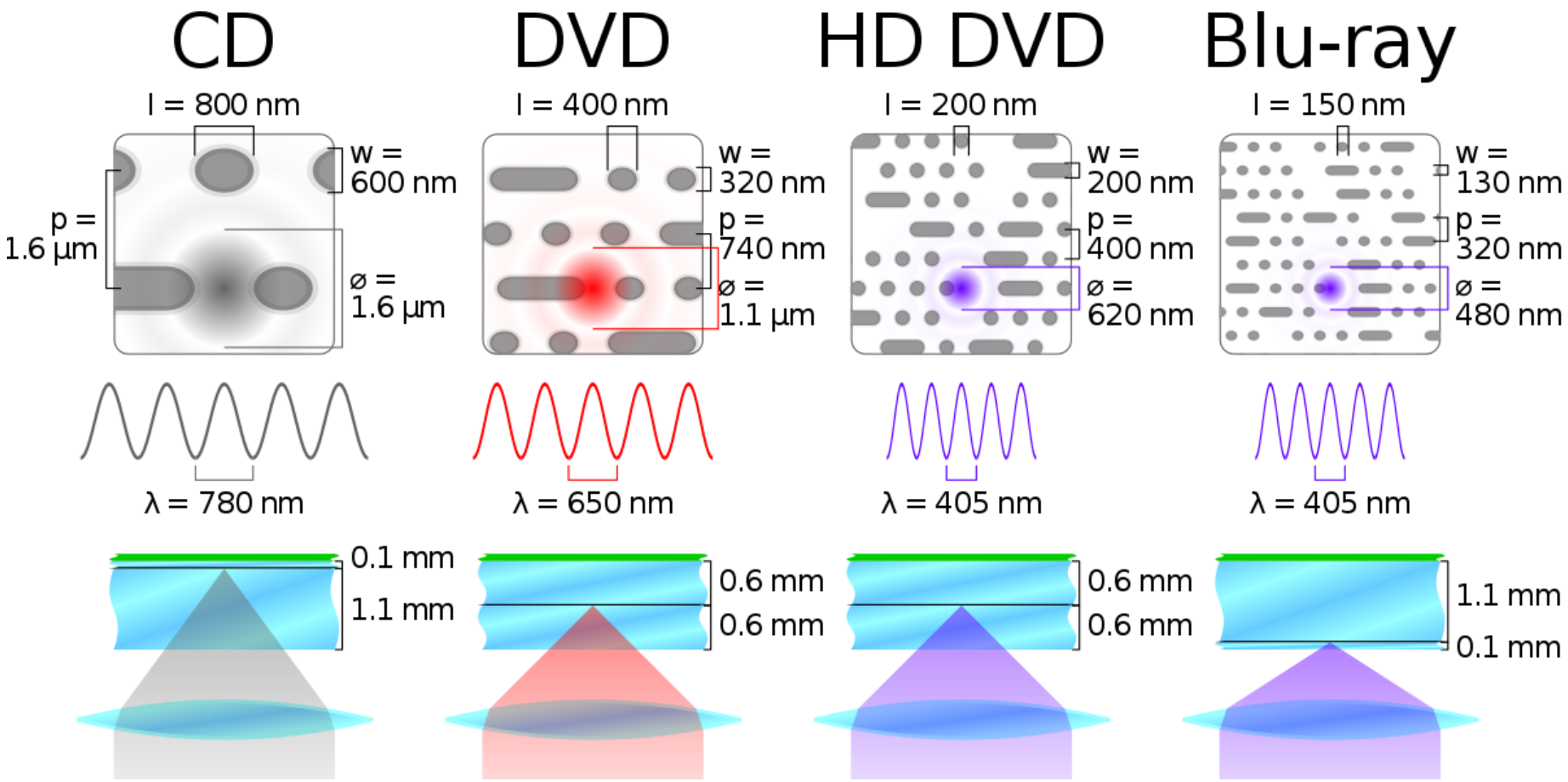
Keyboard: How does it work?



CD/DVD Drive

- CD (Compact Disk)
  - Capacity is 700 to 800 MB
  - Optical storage device. Data is read from CD by a laser.
  - Stores data as light and dark spots on the disk surface.
  - They have an unlimited life-span.
  - RO & RW CDs
  - I/O Rate is Nx where 1x is 150KB/s, Read & Write speeds are not same, up to 52x speeds available
- DVD (Digital Video Disk)
  - 4.7 GB
  - RO & RW DVDs
  - I/O Rate is Nx where 1x is 1.35MB/s, Read & Write speeds are not same, up to 20x speeds available
- Blu Ray
  - Up to 50 GB
  - User Blue Laser

CD/DVD Drive


CD
DVD
HD DVD
Blu-ray
l = 800 nm
l = 400 nm
l = 200 nm
l = 150 nm
w = 600 nm
p = 1.6 µm
ø = 1.6 µm
w = 320 nm
p = 740 nm
ø = 1.1 µm
w = 200 nm
p = 400 nm
ø = 620 nm
w = 130 nm
p = 320 nm
ø = 480 nm
λ = 780 nm
λ = 650 nm
λ = 405 nm
λ = 405 nm
0.1 mm
1.1 mm
0.6 mm
0.6 mm
0.6 mm
0.6 mm
1.1 mm
0.1 mm

Mouse

Scroll Mouse

Cordless Mouse

Optical Mouse

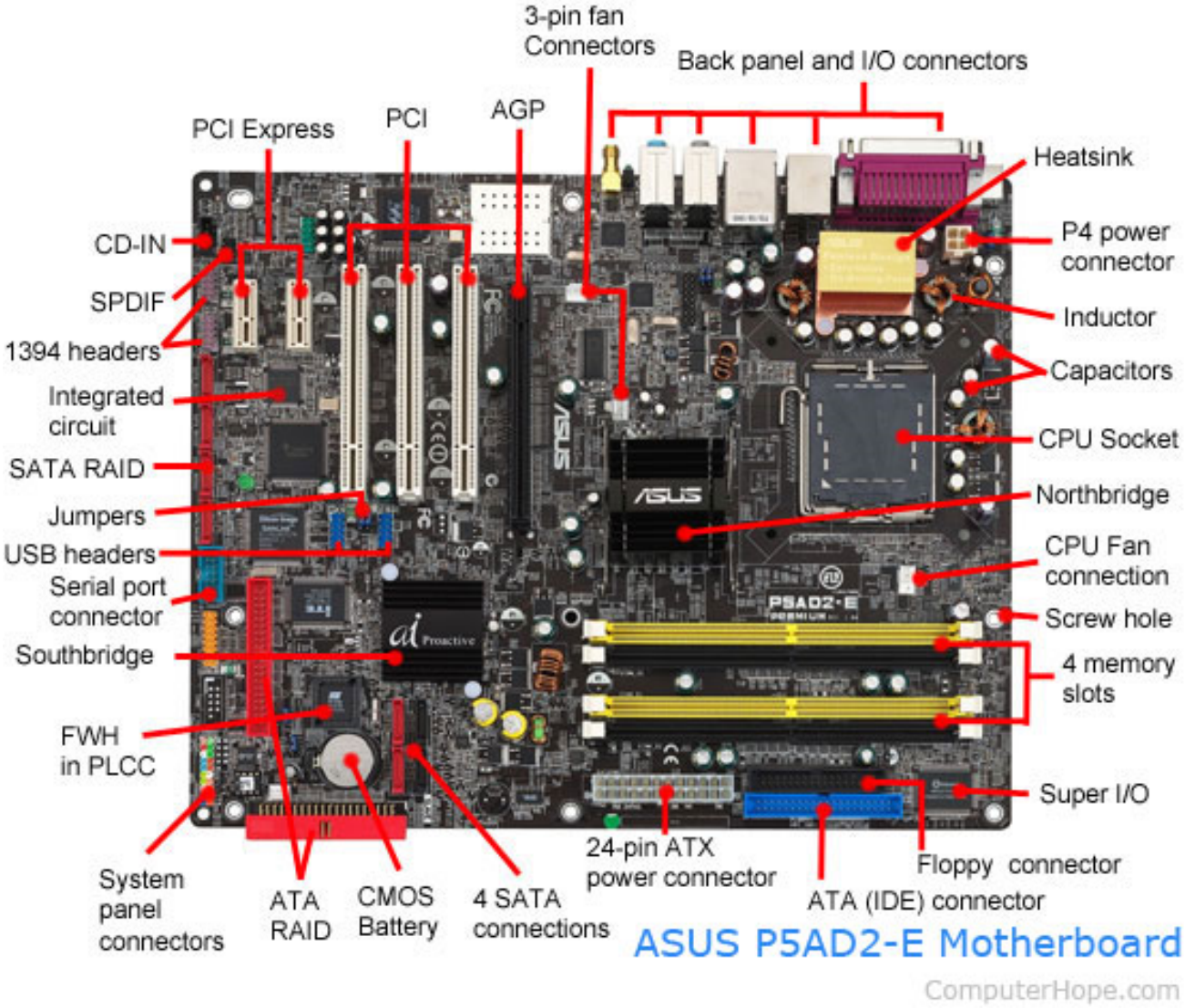
Mouse

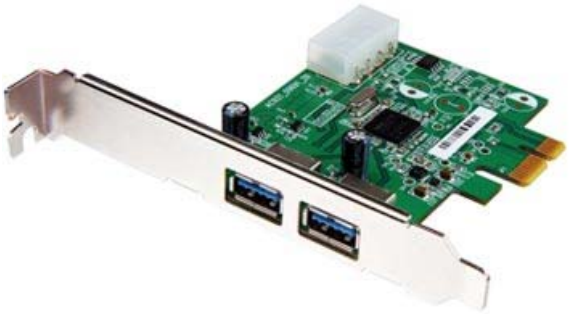
- Mechanical
  - Use two rollers (one vertical and one horizontal) to track motion
  - Rolled by the Track ball
- Optical
  - Use a tiny camera to tracking the motion
  - LED (red light beamer)
- IntelliMouse
  - Extra wheel

Adaptors (Expansion Cards)

- Use PCI Bus: Peripheral Components Interconnect (32 /64bit, Data Transfer Rate: 133 MB/s)
- Mini PCI: used in laptops, 32 Bit, 33 MHz
- PCI Express: Replacing PCI, 32/64 Bit, Data Transfer Rate: 8 GB/s
- Adapters (Often Integrated on Motherboard)
  - Video
  - Sound
  - Network Interface Card (NIC)
  - Modem
  - TV Tuner

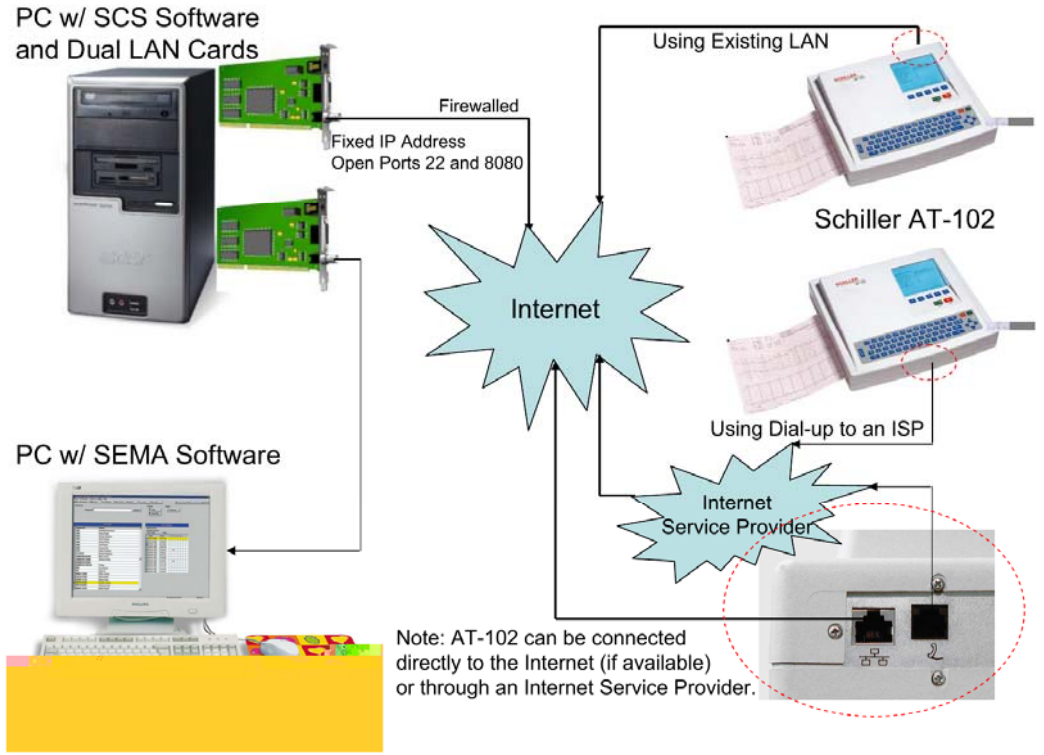
Adaptors (Expansion Cards)





Network Interface

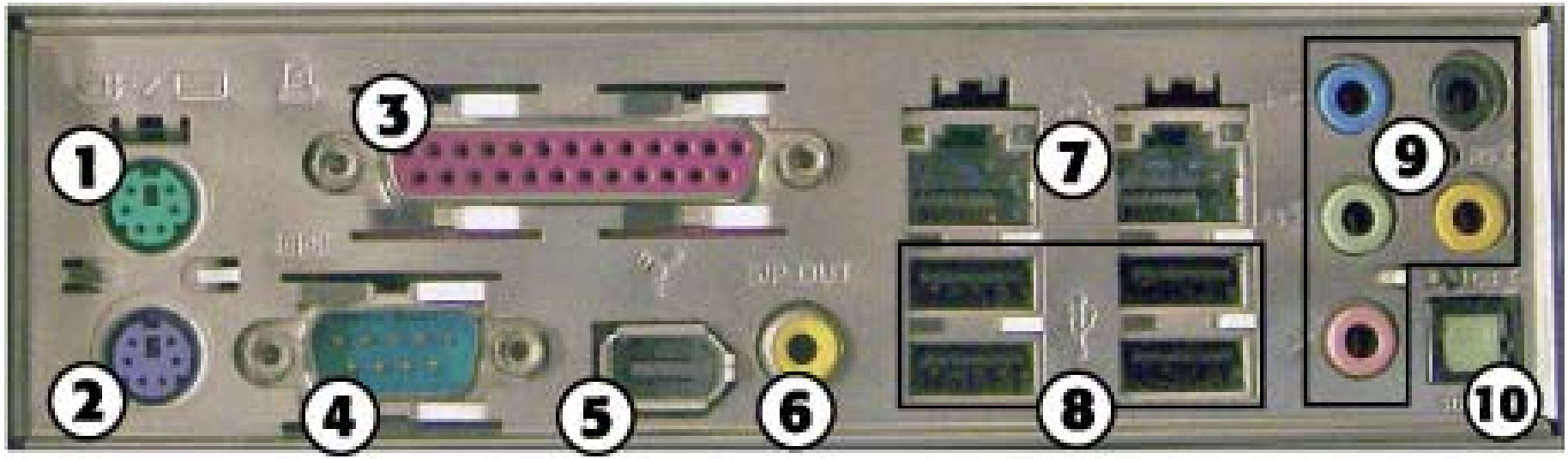
- 10/100/1000 Integrated Network Interface
- 802.11 a/b/g/n Wireless Interface in Laptops



I/O Ports

- Parallel port
  - Parallel because it can move a whole byte at a time
  - Mainly used for connection to a printer
- Serial port (Com port)
  - One bit at a time - Uses thin cable
- Universal serial bus (USB) replaces those
  - 4 wires (2 for power & 2 for communication)
  - Up to 60 MB/s
  - USB Pen Drives, Printers, External Disks, Drives, etc.

I/O Ports



1. PS/2 mouse port
2. PS/2 keyboard port
3. Parallel port
4. Serial port
5. IEEE 1394a port
6. SPDIF coaxial digital audio port
7. Ethernet ports
8. USB ports
9. 1/8-inch mini-jack audio ports
10. SPDIF optical digital audio port

[IBM Personal System/2]

Printers:

- LaserJet (Mono & Color)
- Inkjet
- Dot Matrix
- Line

Daisy Wheel Printer

Other Storage Devices:

- Flash memory cards
  - Flash memory (i.e. chip based)
  - Used in notebooks, cameras, PDAs
  - Need a special drive/slot in device

- USB Flash drives (aka Thumb drives)
  - Comprised of both media and device
  - Don't need special drive/slot, just need a USB port

Solid State Drive (SSD):

- Commercially available for only a few years
- Big use in laptops
- Released the first 512GB last month

- Pros:
  - Lighter
  - Faster (56%)
  - More reliable
  - Uses less power
  - Longer life span
- Cons:
  - Expensive

Solid State Drive (SSD):

- Solid state hard drive (SSD)
  - Uses non-volatile memory chips
  - No moving parts
  - Much faster than magnetic disk (up to 100X)
  - More expensive (up to 20X)
  - Limited number of writes (1-5 mill)

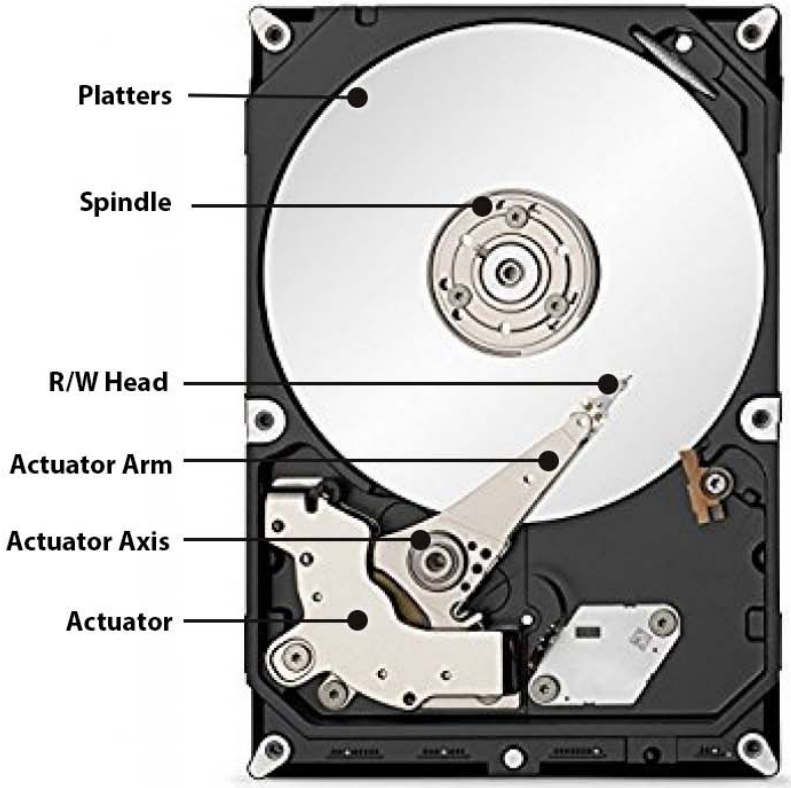
- Often used in combination with magnetic disk
  - SSD acts as cache for frequently used files

Solid State Drive (SSD):

- Compared to a HDD, which has a moving disk
- No moving parts
- Uses flash memory
- Controller- manages the data from and to the computer of the flash memory
- Uses RAM cache base

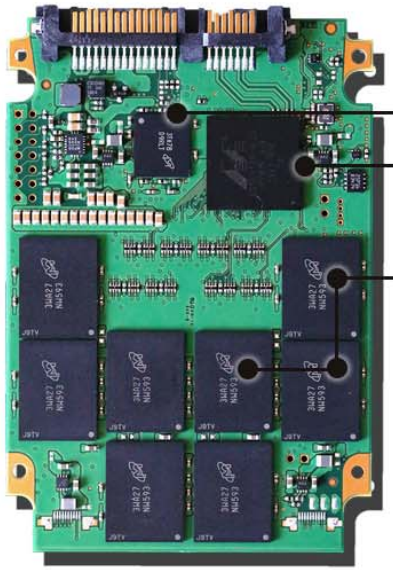
HDD vs. SSD:

HDD
3.5″



Shock resistant up to 55g (operating)
Shock resistant up to 350g (non-operating)

SSD
2.5″



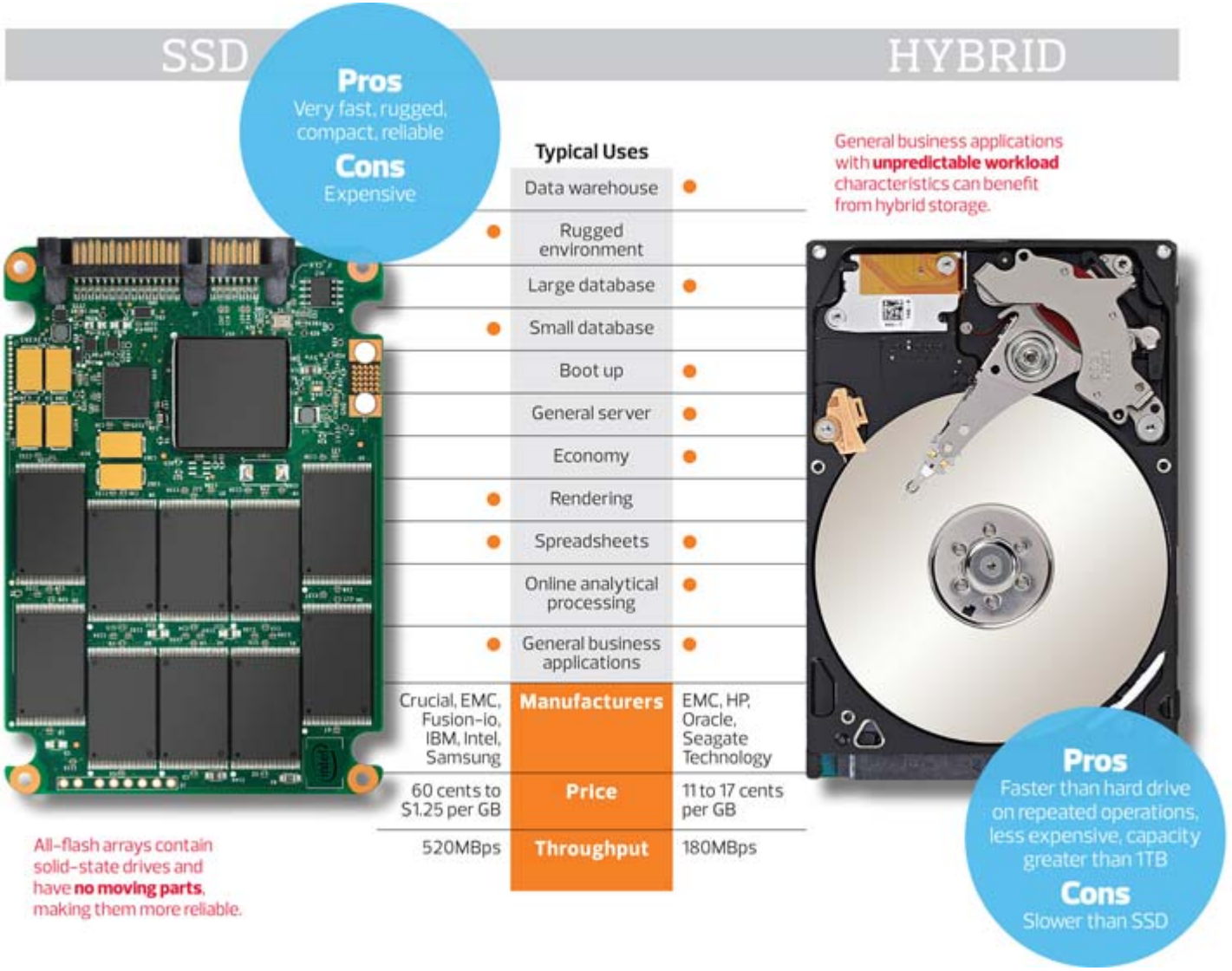
Shock resistant up to 1500g
(operating and non-operating)

HDD vs. SSD:

SSD vs HDD

2.5" SATA 3.0Gbps SSD		2.5" SATA 3.0Gbps HDD
Solid NAND flash based	Mechanism type	Magnetic rotating platters
64GB	Density	80GB
73g	Weight	365g
Read: 100MB/s, Write :80MB/s	Performance	Read: 59MB/s, Write: 60MB/s
1W	Active Power consumption	3.86W
20G (10~2000Hz)	Operating Vibration	0.5G (22~350Hz)
1,500G for 0.5ms	Shock resistance	170G for 0.5ms
0°C to 70°C	Operating temperature	5°C to 55°C
None	Acoustic Noise	0.3 dB
MTBF >2M hours	Endurance	MTBF < 0.7M hours

HDD vs. SSD:


SSD
HYBRID
Pros
Very fast, rugged, compact, reliable
Cons
Expensive
Typical Uses
Data warehouse
Rugged environment
Large database
Small database
Boot up
General server
Economy
Rendering
Spreadsheets
Online analytical processing
General business applications
Crucial, EMC, Fusion-io, IBM, Intel, Samsung
Manufacturers
EMC, HP, Oracle, Seagate Technology
60 cents to $1.25 per GB
Price
11 to 17 cents per GB
520MBps
Throughput
180MBps
All-flash arrays contain solid-state drives and have no moving parts, making them more reliable.
General business applications with unpredictable workload characteristics can benefit from hybrid storage.
Pros
Faster than hard drive on repeated operations, less expensive, capacity greater than 1TB
Cons
Slower than SSD

Points to Remember

- Secondary storage: non-volatile storage managed by a dedicated storage device
- Secondary storage serves as a source of input and target for output
- Wide variety of media measured by
  - Speed
  - Capacity
  - Durability
  - Read/write capability

Continued to Next Class…