COMPUTER HARDWARE TECHNOLOGIES

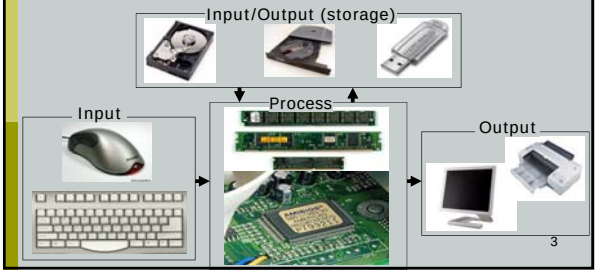
(August 29, 2016)

LEARNING GOALS

- Identify the major components of modern PCs
- Explain the role of the components of a computer system;
  - Explain input devices and how they operate.
  - Describe output devices and how they operate.
  - Describe I/O (secondary storage) devices and how they operate.
  - Explain the role of the CPU and the RAM.
- Describe various types of computers.

The Core Computer Components

- Four subsystems in a computer system:
  1. Input subsystem
  2. Processing subsystem
  3. Output subsystem
  4. I/O (Storage) subsystem



Input subsystem

- Main functions:
  - Allowing the user to enter data
  - Converts data into electronic form
  - Transmitting data to the Processing subsystem
- Includes keyboard, mouse, etc.
- Question: Name five other input devices
  - _____
  - _____
  - _____
  - _____
  - _____

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Input Devices

- Human input devices
  - Allow a person to enter data to the computer
  - User involvement needed
  - Examples: Keyboard, Mouse, Stylus

- Machine-readable input devices
  - Send data directly to computer w/o human involvement
  - No human involvement means no human error
  - Usually faster than human input
  - Examples: Bar codes reader, Optical Characters Recognition (OCR) system, sensors

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Machine-readable Input Devices

- Bar code scanners
  - Uses light to read series of coded stripes
  - Universal Product Code, European Article Number
- Optical Character Recognition (OCR)
  - Includes OCR Software and scanner
  - Translates scanned digital image to character that user can recognize and manipulate
- Magnetic Ink Character Recognition (MICR)
  - Character recognition technology used by banks to allow rapid routing of checks between banks

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Output subsystem

- Main function: Show processing results
- Includes monitor, printer, etc.
- Q: Name two other output devices
  - _____
  - _____

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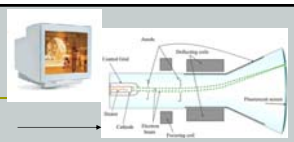
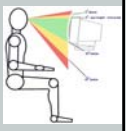
Output Devices



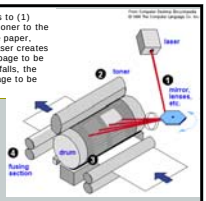
- Monitors' Technology
  - Cathode ray tube (CRT)
  - Liquid crystal displays (LCD) and TFT-LCD
  - Organic Light Emitted Diode (OLED)
    - Better contrast and better viewing angles compared to LCD (1920x1080, 2560x1440)
- Quality of display
  - Resolution; e.g. 640 x 480 pixels
  - Dot pitch in millimeters (e.g. .22, .25, .26)
  - Active-Matrix vs. Passive-Matrix display
  - Viewing angles
- Touch screens:
  - input and output via display device



Video Card	Resolution
Color Graphics Adapter CGA (1981)	640×200
Hercules (1984)	720×348
Extended Graphics Array XGA (1990)	1024×768
Super XGA	1280×1024
Ultra XGA	1600×1200

Printers

The laser printer uses electrostatic charges to (1) create an image on the drum, (2) adhere toner to the image, (3) transfer the toned image to the paper, and (4) fuse the toner to the paper. The laser creates the image by "painting" a negative of the page to be printed on the charged drum. Where light falls, the charge is dissipated, leaving a positive image to be printed.



- Speed and resolution
  - Pages per minute (PPM)
  - Dots per inch (DPI)
    - Number of ink dots to fill a square inch
    - Higher DPI = greater page clarity
- Impact printers
  - Create image by striking paper and ribbon
  - Dot-matrix printers = most common impact printers
- Non-impact printers
  - Create image by spraying or rolling ink on the page

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Non-impact Printers

- Ink-jet technology printers
  - Spray ink on the paper
  - Quiet
  - Color is readily and cheaply available
- Laser printers
  - Laser heats drum which rolls ink (toner) on paper
  - Can be faster than ink-jet
  - More expensive than ink-jet

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I/O or Secondary Storage devices

- Secondary compared to the main primary memory called RAM
- Nonvolatile[1] storage of digital data - Could be Magnetic, Optical,
- Magnetic storage (data stored on magnetically coated surface)
  - Examples: Magnetic tape, Hard disk, floppy disk
  - Sequential access (e.g. tape) or direct access (e.g. HDD)
  - HDDs are electromechanical devices with spinning disks and movable parts
    - Use standards/interfaces like
      - Parallel ATA (PATA) or IDE (Integrated Drive Electronics)
      - Serial ATA (SATA)[2]
      - SCSI (Small Computer System Interface)
    - Disk speed:
      - Transfer rate in MBps (Megabytes per second) or GBps
      - Average Read Time (in milliseconds or ms)
      - Platter rotation speed in RPM (5400/7200/10,000/15,000)

- **State Solid Disks (SSD)**
  - use microchips which retain data in non-volatile memory
  - No moving parts | Have lower access time and latency
  - Can replace your existing HDD if same interface

256GB Crucial m4 2.5-inch SATA 6GB/s

1. Means that the stored data wouldn't disappear (or be deleted) in case of power shortage
2. In SATA and PATA, ATA stands for Advanced Technology Attachment

Optical Secondary Storage

- Optical laser beans used for reading data
- Compact disks (CDs)
  - CD-ROM: Read-Only CD
  - CD-R: Recordable CD (recordings designed to be permanent)
  - CD-RW: Read-Write or Re-recordable CD
- Digital versatile disks (DVDs)
  - DVD-RAM
  - DVD-/+R
  - DVD-/+RW

	Single layer capacity		Dual/Double layer capacity	
Physical size	GB	GB	GB	GB
12 cm, single sided	4.7	4.38	8.5	7.92
12 cm, double sided	9.4	8.75	17.1	15.93
8 cm, single sided	1.4	1.30	2.6	2.42
8 cm, double sided	2.8	2.61	5.2	4.84

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Data Storage units

Name	Storage Amount	Approximate Equivalent
Byte	String of 8 bits	1 character
Kilobyte	1,024 bytes	½ typewritten page
Megabyte	1,048,576 bytes	1 digital picture
Gigabyte	1,073,741,824 bytes	Beethoven's 5th Symphony on CD
Terabyte	1,099,511,627,776 bytes	2,000 CDs
Petabyte	1,125,899,906,842,624 bytes	160,000 DVDs (more than half of all theatrical releases)
Exabyte	1,152,921,504,606,846,976 bytes	½ the amount of information generated worldwide in a year (5 exabytes = all words ever spoken by human beings)
Zettabyte	1,180,591,620,717,411,303,424 bytes	As much data as grains of sand on all the world's beaches
Yottabyte	1,208,925,819,614,629,174,706,176 bytes	As much data as the number of atoms in 2 tablespoons of water

Sources: www.cio.com/archive/011501/tt_numbers.html
www.jamesshuggins.com/h/tek1/how_big.htm
www.magictree.com/dustproof.htm

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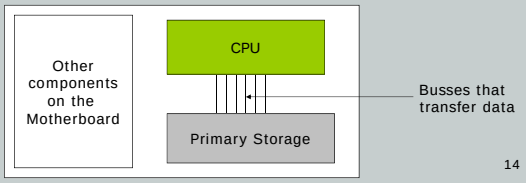
Processing subsystem

- Motherboard: chipset that all components connect to
- Two major components in processing subsys.
  - CPU (Central Processing Unit) or Processor(s)
  - Primary Storage:
    - Random Access Memory (RAM)
    - Read Only Memory (ROM)



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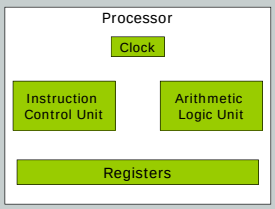
Central Processing Unit



- **Clock:** generate time that synchronize other components
- **ICU:** Fetches instructions from RAM
- **ALU:** Execute instructions (arithmetic & logic operations)
- **Registers:** Store control information, data, intermediate results

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CPU speed

- Speed measured in hertz
  - Hertz = # of instructions executed per second
  - Megahertz = 1 million of instructions per second
  - Gigahertz = 1 billion of instructions per second
- Speed is also measured in FLOPS* ...
  - especially in fields of scientific calculations where long divisions called Floating point divisions are used.

Major Processor manufacturers

Intel
- Celeron
- Pentium 3, Pentium 4, Pentium 4 Xeon, Dual Core
Advanced Micro Devices (AMD)
- K6 series processors (which compete with Intel Pentium 3)
- Athlon series (which compete with Intel Pentium 4)
IBM
- PowerPC 740, 750, 750FX, 750GL, 750GX

*FLoating point Operations Per Second

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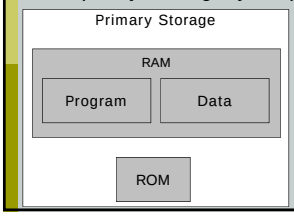
Primary Storage

- Computer's *memory* stored on semiconductor chips
- Two categories:
  - RAM (Random Access Memory) which is volatile
    - Synchronous Dynamic RAM (SDRAM)
    - Double Data Rate SDRAM or DDR SDRAM
  - ROM (Read-Only Memory) which is non-volatile
- Capacity in Megabytes (MB) or Gigabytes (GB)



- **RAM holds running programs and the data they use**
- **ROM contains critical programs such as those that boot the computer**

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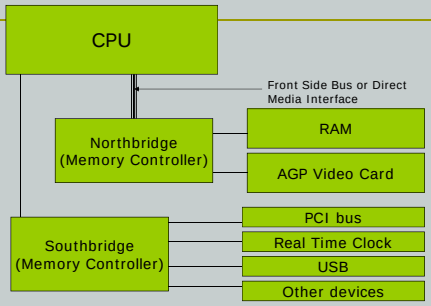
Front Side Bus and Northbridge



- FSB or DMI: bi-directional data bus carrying data b/w CPU and Northbridge
- FSB speed is measured in Hz; e.g. 3 GHz FSB
- DMI speed is measured in transfers/second

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Categories of Computers

- Personal digital assistant (PDA)
- Laptop
- Tablet PC
- Desktop
- Workstation
- Sever (or midrange computer)
- Mainframe computer (e.g. in airline reservation)
- Supercomputer (e.g. in weather forecast, scientific exploration)
- Grid computing ("virtual supercomputers")

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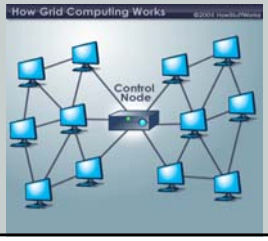
Grid Computing

- Connecting geographically remote computers to create a "virtual supercomputer"
- Takes advantage of fact that most computers use about 25% of their CPU in average.



- Advantages:
  - Cost savings
  - Speed
  - Reliability (because if one fails the system function)

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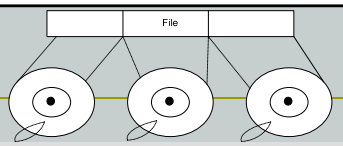
Summary Questions

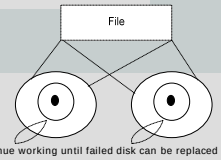
	Notes
1) Name five (3) computer input devices	
2) Name three (3) computer output devices	
3) What computer devices can be used for both input and output? What is the difference b/w impact printers and ink-jet printers?	
4) What is the difference between: (a) a Kilobyte and a Gigabyte? (b) a Megabyte and a Gigabyte?	
5) Name the two main types of monitors used in today's computer systems.	
6) (a) Name main components of the Processing subsystem. (b) What is the function of the ALU?	
7) Explain the difference between RAM and ROM.	
8) Describe the various types of computers.	
9) Distinguish between primary and secondary storage	

RAID



RAID 0

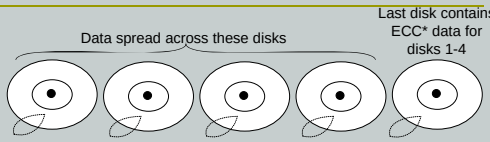
- Strips data across multiple disk
- No redundancy
- Advantage: Fast data access through multiple reads
- Disadvantage: Loosing one disk results in loosing data on all disks



RAID 1

- Doesn't strip data across many disk
- Mirrors data between two disks
- Data kept synchronized between two disks
- Advantage: Fault-tolerance, i.e. If one disk fails, the other continue working until failed disk can be replaced
- Disadvantage: Only half of available storage space is used.

RAID



RAID 3

- Spreads data across multiple disks and uses ECC bits for recovery purpose in case of problem
- ECC bits determined based on data stored on data disks
- If one data disk fails, disk controller automatically regenerates missing data

* Error Checking and Correcting

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Dell XPS 700 Desktop computer

Intel D955XBKLKR motherboard
Pentium® Dual Core E6320 (3.00GHz, 800 MHz FSB)
Windows® Vista Home Premium with re-installation CD
2GB Dual Channel Ddr2 at 667MHz (2 DIMMs)
250GB Serial ATA 3Gb/s Hard Drive (7200RPM and 10 ms ART)
3.5 in Floppy Drive
17 inch UltraSharp LCD Active Matrix screen, 1280x1024 Resolution, 0.26 dot pitch.
16x CD-ROM Drive
16x DVD+/-RW Drive
nVidia GeForce 7900 GS Video card
Sound Blaster® X-Fi™ XtremeMusic (D) Sound Card w/Dolby
Dell A525 30 Watt 2.1 Stereo Speakers with Subwoofer
Dell USB Enhanced Multimedia Keyboard
Logitec Optical USB Mouse
56K PCI Telephony Modem
10/100/1000 NIC PCI
Dell Inkjet Printer 924, Up to 17 PPM Black/White, 600 x 600 dpi
1Yr Ltd Warranty, 1Yr At-Home Service

$1,440.00

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PowerEdge SC1420 server computer

Intel D955XBKLKR motherboard
Dual Pentium® Dual Core Extreme QX6700 (3.46GHz, 1066 MHz FSB)
Genuine Windows® Vista Home Premium with re-installation CD
2.0GB Corsair DOMINATOR SDRAM2 800MHz, 4X512MB SDRAM
Two 73 GB 10K RPM SCSI Hard Drives Ultra 320
PERC Ultra 320 2-Channel SCSI RAID Controller Card
3.5 in Floppy Drive
48X IDE Internal CD-RW/DVD ROM Drive
nVidia GeForce 7900 GS Video card
Sound Blaster® X-Fi™ XtremeMusic (D) Sound Card w/Dolby
Dell A525 30 Watt 2.1 Stereo Speakers with Subwoofer
Dell USB Enhanced Multimedia Keyboard
Logitec Optical USB Mouse
10/100/1000 NIC PCI
Dell Inkjet Printer 924, Up to 17 PPM Black/White, 600 x 600 dpi
1Yr Ltd Warranty, 1Yr At-Home Service

$2,140.00

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