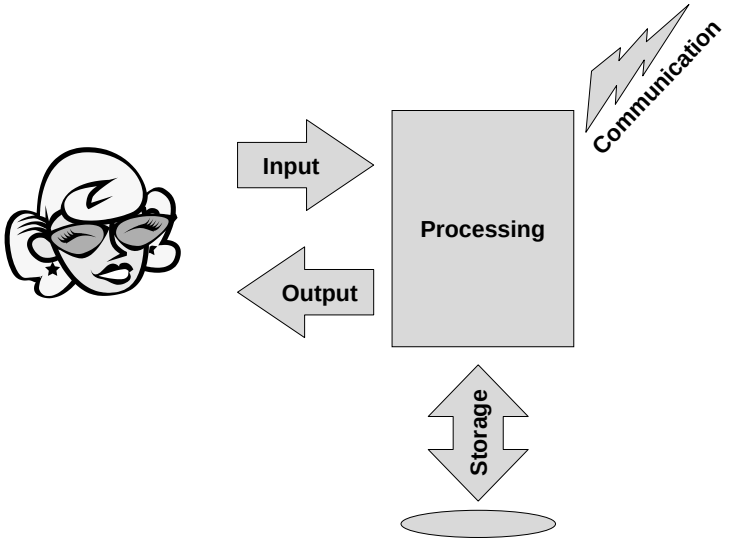
COMPSCI 111 / 111G

Mastering Cyberspace:
An introduction to practical computing

Hardware

IBM's BlueGene/L

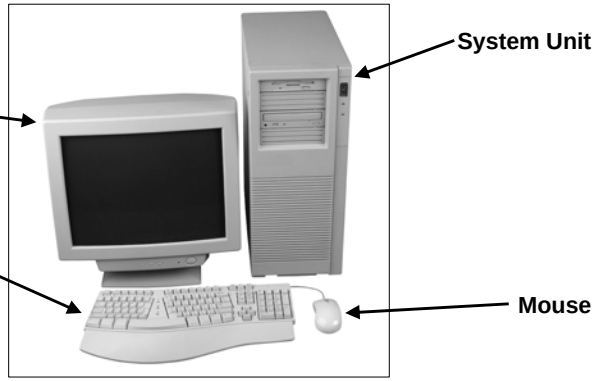
Design of a computer



Introduction to Hardware

Computer Hardware

- "Those parts of the system that you can hit with a hammer (not advised) are called hardware**"**
- Modular

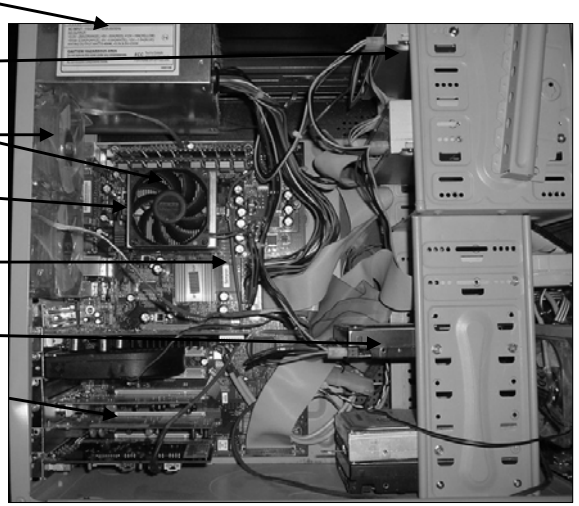


http://en.wikipedia.org/wiki/Computer_hardware

Inside the System Unit

Modular Components

- Power Supply
- CD Drives
- Cooling Fans
- CPU
- Motherboard
- Hard Drives
- Expansion Cards



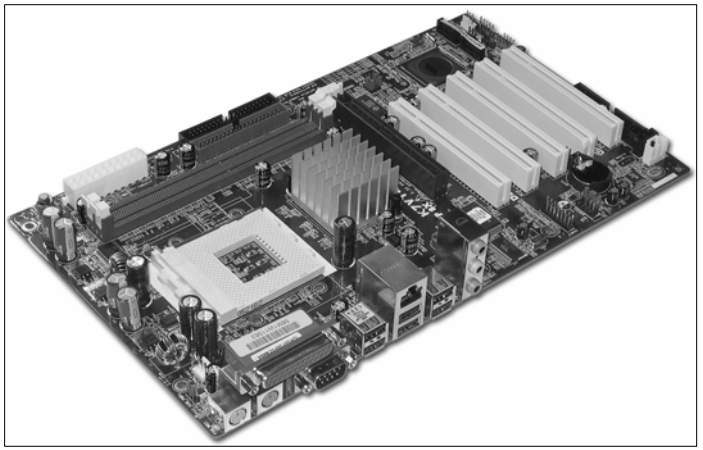
Power Supply

Converts AC to lower DC voltage

Motherboard

Main circuit board for the computer

- Everything else connects to the motherboard



Central Processing Unit

CPU

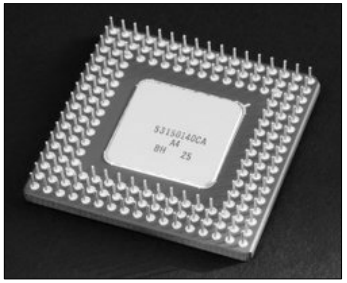
- "Brain"
- Follows instructions

Speed

- Computation speed often measured in operations per second (OPS)
- Clock speed (Hz) is the speed with which electrical signals pass through the CPU
- The faster the better

Cooling

- Heat is one of the major limitations
- CPU must be kept cool
- Cooling fan, Heat sink, Water cooled



Clock Speed of a CPU

Speed	CPU
1 MHz	6052 (Commodore 64)
4 MHz	8088 (IBM XT)
16 MHz	80286 (IBM AT)
24 MHz	80386
66-100 MHz	80486
75 - 166 MHz	Intel Pentium / AMD K5
166 - 233 MHz	Intel Pentium MMX
200 - 450 MHz	Intel Pentium II / AMD K6
400 - 1 GHz	Intel Pentium III / AMD Athlon
1GHz – 3.4 GHz	Intel Pentium 4 / AMD Athlon XP

Moore's Law

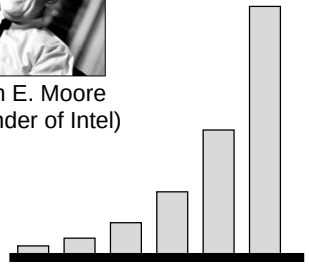
Number of transistors on a single chip doubles every 18 months, while the price remains the same.

In 5 Years
- 10 times as powerful

In 15 years
- 1,000 times as powerful
- 15 mins work in 1 second

In 30 years
- 1,000,000 times as powerful
- 11.5 days work done in 1 second
- 100 years work done in 50 minutes

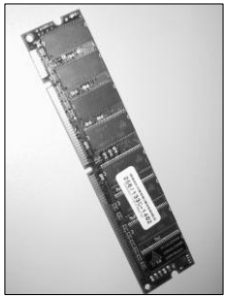
Gordon E. Moore
(co-founder of Intel)



http://en.wikipedia.org/wiki/Moore%27s_law

Memory

Random Access Memory (RAM)
- Primary memory, main memory
- Data is lost when electricity switched off
- Size of the RAM is most important
- Speed also important (dependant on Motherboard)
- One memory access takes a couple of nanoseconds (one billionth sec.)



http://en.wikipedia.org/wiki/Random_access_memory

Memory Capacity

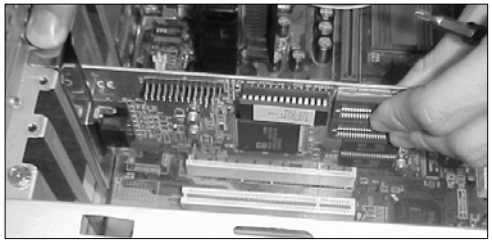
Measured in Bytes

Plain Text (approx.)	
1 byte	1 character
1 KB	200 words / 10 lines
1 MB	300 pages
1 GB	175 phone books
Music (approx.)	
1 GB	2 hours
DVD (approx.)	
1 GB	20 minutes

"640K ought to be enough for anybody."
Bill Gates in 1981

Expansion Cards

Circuit board that provides additional functionality
- Sound Card
- Graphics Card
- Network Card
- Internal Modem
- RAID controller



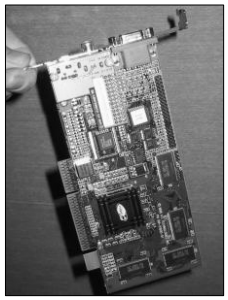
Plugs into the Motherboard using standard slots
- ISA
- PCI
- AGP
- PCI-Express

http://en.wikipedia.org/wiki/Expansion_card

Graphics Card

Converts the internal representation of an image into something that can be displayed using a computer monitor

- 2D Graphics Card
- 3D Graphics Card
  - NVidia - GeForce
  - ATI - Radeon



Secondary Storage

Mass Storage

- Long-term storage
- Persistent
- Much slower to access than RAM
- Much cheaper than RAM

Devices

- Hard Disk (HDD)
- Floppy Disk (FDD)
- Flash Memory
- Magnetic Tape

Optical Devices

- CD
- DVD

http://en.wikipedia.org/wiki/Hard_disk

CD / DVD Media

Different Media

- CD-ROM: read-only, 700 MB, manufactured by a press
- CD-R: recordable once, 700 MB
- CD-RW: rewritable, 700 MB
- DVD-ROM: read only, 4.7 GB, manufactured by a press
- DVD-R: recordable once, 4.7 GB
- DVD+R: recordable once, 4.7 GB
- DVD-RW: rewritable, 4.7 GB
- DVD+RW: rewritable, 4.7 GB
- DVD-RAM: rewritable, 4.7 GB
- DVD-R DL: dual layer record once, 8.5 GB
- DVD+R DL: dual layer record once, 8.5 GB
- DVD-RW DL: dual layer rewritable, 8.5 GB
- DVD+RW DL: dual layer rewritable, 8.5 GB

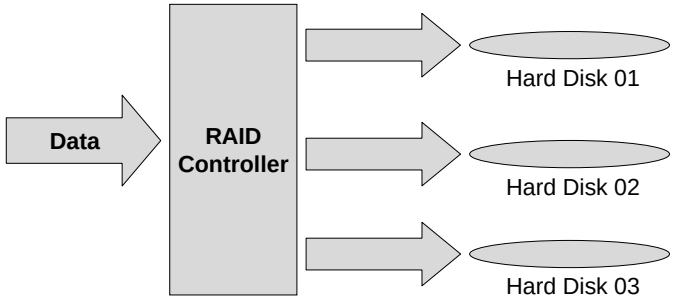
http://en.wikipedia.org/wiki/CD
http://en.wikipedia.org/wiki/DVD

RAID

Bottleneck of performance on many systems is the secondary storage

Redundant Array of Independent Disks

- Read and write in parallel
- Write additional information to prevent lost data
- Fast, cheap and reliable



Input Devices

A machine that feeds data from a user into a computer

Keyboard
- Typewriter (QWERTY / DVORAK)
- Keypad

Pointing Device
- Mouse, Trackball, Touch Screen
- Digitizing Tablet, Digital Pen

Direct Entry
- Scanner
- Webcam, Microphone, Scanner
- Magnetic Stripe Reader

Output Devices

A machine that takes information processed by a computer and presents it in a form that a human can understand

Screen
- Cathode-Ray Tube
- Flat-Panel display (LCD, Plasma)
- Projector
- Head-mounted

Printer
- Inkjet, Laser

Speakers

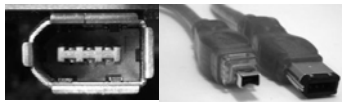
"A printer consists of three main parts:
the case, the jammed paper tray and the blinking red light"

Connectors

Universal Serial Bus (USB)
- Used for almost everything except monitors
- Version 1 is slow (~1.5MB/s)
- Version 2 is fast (~60 MB/s)

PS/2 connector
- Used for mouse & keyboard

Firewire
- Used for video cameras, HDs
- High-speed (~60-100MB/s)



Video Graphics Array (VGA) connector
- Used only for monitors

Digital Visual Interface (DVI)
- Used for LCD monitors or projectors
- Transmits video data digitally (better quality)

Understanding Advertisements

Specifications
- CPU Type
- CPU Clock Speed
- Size of RAM
- Size of HDD
- Size/Type of Monitor
- Other drives (FDD, CD, DVD)

Intel® Pentium® D Processor 930 with Dual Core Processor 3GHz
- Genuine Windows® XP Home Edition
- 512MB DDR2 SDRAM at 533MHz
- 160GB SATA 3.0Gb with NCQ
- 16X Max DVD+/-RW with Dual Layer Write Capabilities
- 19" LCD Flat Panel
- 256MB ATI® Radeon™ X600 HyperMemory™ Graphics
- Integrated 7.1 Audio

Buying a Computer

What do you want it for?

- Games - 3D Graphics Card, CPU, RAM
- Internet - Modem / Network Card
- Home / Office Applications

Desktop or Laptop

- Price
- Portability
- Ease of use

Laptop

- Battery capacity!!! How long can you use it without external power?
- Weight: how much do you want to carry around?
- Screen size: want to watch movies on your laptop?
- Internal speakers: usually very bad, sometimes surprisingly good

Buy cheap

- http://www.pricespy.co.nz

Some Advice

Spend a bit extra on the screen

- Interface between you and the machine

Buy more RAM

- More applications open at once
- Better performance
- 512MB - 2GB

Hard Drive Capacity

- Depends on use
- Digital Photos
- Music Storage

Processor

- Anything will be adequate

More Human Computer Interfaces

Voice recognition

- Automated Telephone Systems
- Voice tags for phone numbers, and other commands

Biometric scanners (fingerprint, retina, face, body)

- US customs
- Some laptops have them
- Biometric data often proposed for new passports

Radio-frequency identification (RFID) tags

- Small chips that respond to a signal, and send back ID data
- Used in university swipe cards
- In the USA:
  - Scheme to voluntarily implant RFID with medical info
  - School uses RFID to track student's attendance
- Soon also in passports, products, grocery shopping bags?
- Problem: we do not want everybody to read our RFID chips
- Suggested solution: RFID chips are shielded or destroyed after use

References

Simple Introduction to Hardware

- http://www.coolnerds.com
- http://www.howstuffworks.com

Images from:

- http://www.regstevens.co.uk
- http://www.dansdata.com
- http://en.wikipedia.org

The internet is an excellent resource for computer hardware

Announcements:

- **See Ann in the OTL today and Friday 2pm – 5pm**
- **Buy coursebook at Student Resource Center in the basement of the science building and bring it to the lab!!!**