Hardware - Inside the Box

Question: What is the central brain, inside the box, through which all information goes?

Office Hours

Dr. Urquhart
- Monday 11:10-12
- Tuesday 2-4 pm
- Wednesday 11:10-12

TAs
- Ben Ellis: Monday 6-8
- Andy Speirs: Tuesday 6:45-8:45
- Kash Siddiqui: Wednesday 7-9
- Ben Ellis: Thursday 5:45-7:45

Announcements

READINGS on Website under RESOURCES
- Overview of how Microprocessors are made
- Summary of current INTEL Lineup
- AMD Processors
- BOLD are required

Today’s Information

Microprocessors
Motherboards
Buses, Slots, and Ports
Storage

Metric System

Kilo = 1000
Mega = 1,000,000 = 1 million
Giga = 1,000,000,000 = 1 billion
Tera = 1,000,000,000,000 = 1 trillion
These terms are used frequently to describe storage and speed in computers
**Bits & Bytes**

- 1 Byte = 8 bits = 8 1s or 0s in any combination
  - 10100011
- 1 KB = Kilobyte = 1024 Bytes ($2^{10}$)
- 1 MB = Megabyte = 1024 Kilobytes = $2^{20}$ Bytes
- 1 GB = Gigabyte = 1024 Megabytes = $2^{30}$ Bytes (1,073,741,824 Bytes)

**Millions vs. Binary**

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- 1 GB = Gigabyte = 1024 Megabytes = $2^{30}$ Bytes (1,073,741,824 Bytes)
- Hard drive companies: 1 GB = 10$^9$ Bytes
  - 1,000,000,000
- 1073741824/1000000000 = 1.073
- 7% shortchange on hard drive capacity

**Bytes and MP3s**

- If each song is 3 MB, how many songs can you put on a 120 GB hard drive?
- Use 1,000,000,000 for your GB size
- Use 1,000,000 for your MB size
- *If you have a calculator, try again using 1,000,000,000 for GB and $2^{20}$ for MB

- There are either 1024 MB/GB or 1000 MB/GB
  - 120 GB x 1024 MB per GB = 40,960
  - 120 x 1000/3 = 40,000
- Difference = 960 songs

**Computer Speed**

- Hz = Hertz = Cycles/second = once per second
- MHz = Megahertz = Million cycles/second
- GHz = Gigahertz = Billion cycles/second
- Typical processor today runs at 2 GHz!
- That's 2 Billion times a second it can cycle information!

**Taking a Test**

- Would you rather have a faster brain or one with more stuff stored in it when you take a test?
Two things determine function

- Processor Speed
  - This is the speed at which information is processed

- RAM (Random Access Memory)
  - This is how much information is available for rapid processing

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Evolution of Intel Microprocessors and Pursuit by AMD Processors

**Left off here**

Evolution of the Intel Microprocessor

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AMD – Advanced Micro Devices

- Second largest microprocessor manufacturer
- Always following Intel in development
- For a while leapt ahead of Intel with early Athlon

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Pentium IV and 0.13 η transistors

- Micron is Micrometer, μm, 10⁻⁶ m
- 1/1000th of one millimeter!
- Current Pentium IV transistor is 0.13 microns (eight fit in one micron)
- Next generation 0.09 microns (90 nanometers)—NANOTECHNOLOGY
Size of a Dinner Plate
120 billion transistors!

Important Microprocessor Qualities
- Speed, e.g. 2.5 GHz (Gigahertz)
- Dr. U’s Ranking
  - AMD Athlon XP
  - Pentium IV
  - Celeron
  - Pentium M?
  - Athlon 64?
  - Pentium V?

Athlon vs. Pentium
- AMD released Athlon in August, 1999
- **First time ever** that Intel was not producer of fastest x86 chip
- Athlon XP now 3200+ (~3.2 GHz)***
- Athlon 64 now 3400+
- Intel Pentium IV 3.4 GHz

Athlon XP Processors
- Benchmark Performance
  - Benchmark is a task to test performance
  - Large image processing task or data crunching
- PERFORMANCE RATINGS**
  - XP 3200+ is a 2.2 GHz processor, equivalent to Pentium IV 3.2 GHz in performance

Benchmark Test

**Doubling of Processor Speed**
- Manufacturers always coming out with faster processors
- It takes about **2 years** the fastest processors to double in speed
  - 1996 – 233 MHz
  - 1998 – 450 MHz
  - 2000 – 1.4 GHz (cost $600 in 2000, $100 today)
  - 2002 – 3.06 GHz
  - 2003 – 3.4 GHz
- Take Home Message: Don’t buy the top of the line processor, it will be dated very quickly!
Memory - RAM

- RAM is Random Access Memory
- Short Term, erased frequently
- RAM is memory that is “alive,” constantly changing
- RAM stores program info and data
  - it’s what the processor communicates with to determine how to display the program and file

Types of RAM

- DDR Ram is Double Data Rate, for Athlon and Pentium IV
- SDRAM – Used in a lot of machines, but being phased out
- Adding new RAM is the cheapest and easiest way to make your computer run faster

Adding new RAM

- Must match type to existing memory
- Pull out chip and go to store to match
  - DDR PC2100, DDR PC 2700, PC 133, etc
  - DIMM 184 Pin for desktop
  - SODIMM for laptops
- Can have one 128 MB and one 512 MB (or any other combo) as long as the same type

Choosing a RAM Chip

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<tr>
<th>Form Factor: DIMM</th>
<th>DDR PC2100</th>
<th>DDR PC2700</th>
<th>DDR PC3200</th>
<th>SDRAM PC133</th>
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<td>128 MB, 256 MB, etc.</td>
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RAM Prices

- RAM $100 a Megabyte in 1990 – Typical computer had 1 MB of RAM
- $1 a MB in 1999
- $2 a MB in late 1999?
- $0.60 a MB last year
- $0.15 a MB now (256 MB < $40) – Typical computer has 256 or 512 MB of RAM

Analogy

- If the processor is the brain of the computer, then what is the motherboard?
  - The Spinal Cord
  - Processor and Motherboard make up Central Nervous System
Motherboards
- Circuitry that connects all items to the processor
- Card slots for modems, sound cards, graphics cards
- Socket for processor
- Bus speed determines processors
- Good ones have Intel Chipset

Motherboards and Microprocessors
- Motherboard must have appropriate socket or slot for processor
- Motherboard must support processor’s speed and have the same bus speed
- Motherboards support specific types of RAM also

Upgrading your computer
- Generally must upgrade motherboard, processor and memory at same time
- Not very cost efficient anymore
- Can buy new Dell for under $400
- Build your own costs:
  - $100 new Motherboard
  - $100 new Processor
  - $80 new RAM