Components of Computers

1-22-2003

Opening Discussion

- Do you have any questions about the syllabus or the course that came to you over the weekend?
- If you look at the syllabus, you see that you should have read part of chapter 1. What did you get from that?
- Have you seen anything in the news related to this class?

Physical Decomposition

- Physically we see a computer as a box that connects to a monitor, a keyboard, a mouse, and possibly other devices like printers or networks.
- Opening the box we see distinct entities for drives, power supply, motherboard, various cards, RAM, and a processor.
- This decomposition doesn't help us that much with understanding.

Functional Decomposition

- A more usable way of breaking things up is to break them up by what they do.
  - Input: anything that the computer can get information from.
  - Output: anything that the computer can send data out to.
  - Memory: storage for data that can be readily processed.
  - Processor: datapath processes data and control tells it what to do.

Significant Pieces

- For today I want mostly look at the physical decomposition. We will focus on the functional one most of the semester.
- We also want to think a bit about the levels of abstraction though and how we use them to build flexible machines of such great complexity. What are the interfaces between components? What does that mean in hardware vs. software?

Displays

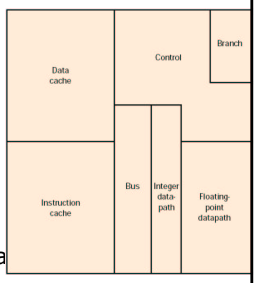
- There are two main types in use today. Displays are made with grids of pixels for making images.
  - Cathode Ray Tubes (CRTs) - These are your basic computer monitors. A beam of electrons are guided by magnets to a phosphorescent screen where it sweeps out lines.
  - LCDs - Liquid crystal displays are found in flat screens. They use the alignment of molecules when a potential is applied.

Future Displays

- There are a fair number of possible future display technologies that different companies are working on. Each has different strengths and weaknesses.
  - OLEDs - Organic light emitting diode displays use collections of organic molecules to produce light. They could be made flexible and they don't require backlighting.
  - Digital paper by e-Ink and others is high resolution and might be cheap to produce.

Processors

- Often referred to as the "brains" of a computer, the processor is where the computation itself is performed.
- Processors come in many forms, but all can be divided into certain areas.
- Current processors families include: x86, PowerPC, Alpha SPARC, MIPS, Arm, etc.



Instruction Set Architecture

- The basic interface between the software and the hardware is the instruction set architecture. This is basically the specification of the machine language or the binary executable format.
- One of the things they mention is the Mac transition from 680x0 to PowerPC and the consistency of x86. What is happening now to make this more interesting?

Motherboards

- The real key to connecting all the components on a modern computer is the motherboard. This circuit board holds the processor, memory chips, and extra cards. It provides all the connections from any peripherals to the processor and memory as well.
- The main slots found on motherboards are ISA, PCI, and AGP. Also have IDE and power connectors.
- Motherboard are being more and more integrated so fewer slots are needed.

Memory

- Memory comes in many formats. Currently the most popular are DDR DRAM (Double Data Rate DRAM) and RDRAM (Rambus DRAM). These are volatile. Storage space has been growing a long time, but speed had been fixed. Recently their speeds have been ramped up.
- Flash RAM is used in many handheld devices and is mostly non-volatile. Typically slower.
- New technologies are also emerging here. For example, MRAM is non-volatile, faster, and uses less energy than DRAM.

Disk Drives

- Currently the majority of non-volatile memory on computers is on magnetic disks. These disks have spinning platters with heads that read the magnetic signature on the platter. They can also record new signatures.
- Disks are random access, but fairly slow. They spin between 5400 and 15000 RPM and have to wait at least one full spin on a seek operation.

Networking

- Today we view a computer as being much more useful with a network connection. These allow your computer to talk to others. The most common networking for small areas is Ethernet. Current popular bandwidths are 100Mbps and 1Gbps. There are faster networking protocols and hardware, but they typically cost more.
- Wireless is also becoming extremely popular.
- Latency is how long you have to wait to send a packet. Bandwidth is number of bytes per unit time.

Exponential Growth

- Almost every part of computers has been improving exponentially for many years now. Different parts has different doubling times.
  - Processors - 18 months
  - Storage - 12 months
  - Networking - 9 months
- Processors are lagging. This leads to things like grid computing.

Minute Essay

- What part of computers do you find most interesting? Why do you feel that way?
- We will be continuing with chapter 1 on Friday, discussing how chips are made. Please keep up with the reading the book really is quite good.