Wednesday, January 4, 2017

Lecture 1

CPUs

- exists almost everywhere (computers, cellphones, dishwasher.. etc)
- **Engineered:** one layer built above a previous layer
- **Programmers** have the capability to **control machines**, **create drivers**, and **communicate with peripherals**

COURSE OUTLINE

Part 1

- circuits
- building circuits
- internal CPU construction (classical, pipeline, multi core)

Part 2

- assembler programming
- low-level peripheral interfacing

Part 3

- System hardware support (circuits that support the OS)

Note: Read “The Soul of A New Machine” for bonus points on the final

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What is this course about?

BINARY!

- A **chip** receives an input, each bit is connected to input wires, and output wires come out the other end
- High or low (1 or 0) volt signals go to into the chip
- As programmer, you manipulate the voltage signals using the chip such that it generates a different output

- Input is an **instruction,** 01 is “add”, 001 is the number 1, 110 is the number 6. So 01001110 will be an instruction to add 6 and 1 to produce 7, generating an output of 0000111

Gates

Located within the chip, determines flow of electricity of output wire

AND: Takes 2 inputs, produces 1 output

OR: Takes 2 inputs, produces 1 output

NOT: Takes 1 input, produces 1 output

Note: Every program in the world, despite the size and complexity, are composed of these gates

Different analogies for flow of electricity: **Water Flow Analogy**, **Balls in a Pipe Analogy**

The System Board

Power Supply: Converts the AC/DC from the home into the steady current needed in the PC.

CPU (Central Processing Unit) (the brain): Math, Logic, Data movement, loops

ROM (Read Only Memory): Used to store built-in instructions (like CMOS), additional instructions for the CPU

Battery: Used to help keep the CMOS parameters(including time)

RAM (Random Access Memory): Volatile main memory bank, large and slow

Cache: A very fast type of memory(pipeline) directly connected to RAM

Bus: A common road for data that interconnects all devices on the motherboard

CLK: Clock: Beats the processing cycle(2 of them)

Slot: Connects to devices external to the motherboard through cards

- There are **4** different busses: Data bus, Internal bus, Local bus, Expansion bus
- All operations (adding integers, subtracting.. etc) happens **within the RAM**

- To print, replace the bytes with wires that connect to devices (printer, computer screen.. etc)
- For the printf function, replace the desired value in an address with a wire to the console, then the value will travel through that wire and ultimately be printed onto the console
- ISA slot contains data in binary, port contains images that convert binary to the desired output
- The Assembly Language: Assembly Text File -> The Assembler Program -> Machine Code
- The chip only understands the binary codes
- There is only 1 assembler (for all languages), it all results in binary code