

The User's Perspective

how do different kinds of users interact with computers?

- personal computer
 - screen interface
 - keyboard
- smartphone
 - similar to pc but features microphone, cameras etc.
- car
 - steering wheel position
 - throttle position
 - display information through gauges/screens

we interact with computers through some I/O channels, whatever they may be for the given application

Hardware: the physical construction of a computer

software: the programs/apps that we run on the computer that define its behavior

The Programmers Perspective

- using a computer to develop software, usually with some high level languages
- working with programs (like compilers) that converts programs into machine code
- usually, programming environments abstract away the fine details of translating your program into a .exe

The Silicon Perspective

- computer hardware consists of transistors implemented on silicon

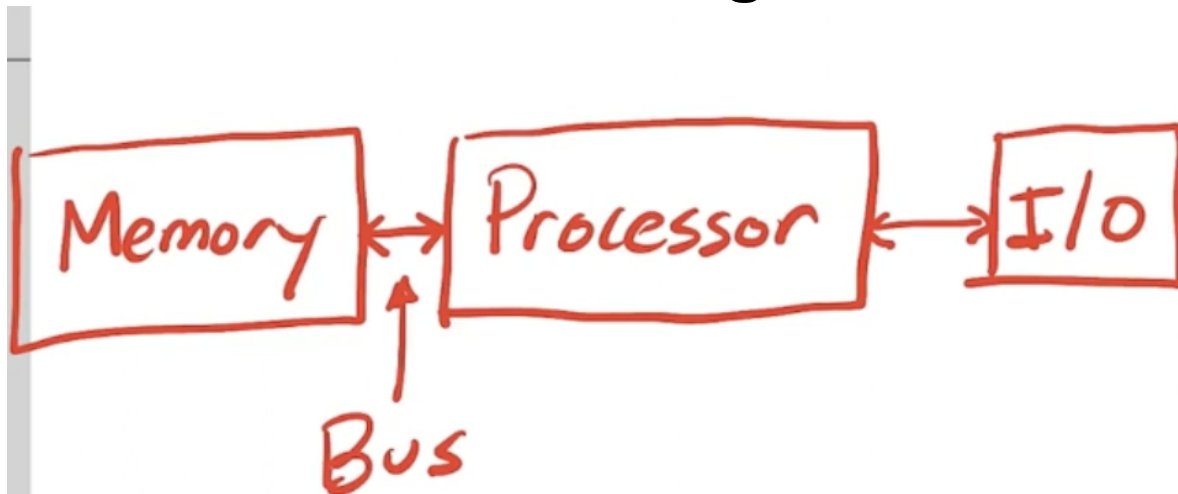
Microarchitecture Perspective

- digital blocks implemented on silicon that make up a computer
- executes a series of *low level instructions*
- the low level instructions come from some program written in a *high level language*
- the instruction set architecture is the set of all commands that will run on some micro-architecture

Some Examples of Microarchitecture

- x86 - supports intel processors
- Advanced RISC Machine (ARM) - most widely used architecture
- AVR (atmega and atmega8) - used by arduino

Microarchitecture Design



- processor: active block of the computer that's responsible for following the instructions making up a program
- Memory: location where programs and data are stored
- I/O: any interface with the computer
- Bus: one or more wires that run in parallel and carry data
- Microprocessors (MPUs): supported by several external chips that implement memory, i/o, etc.
- microcontrollers (MCUs): all functionality contained on a single integrated chip

Buses

digital connections between functional blocks (abstraction)

- **Serial:** one bit is transmitted at a time. Usually consists of one wire for data and few others for clock and control signals
- **Parallel:** several bits are transmitted simultaneously, usually implemented using several parallel wires (simultaneous sending of bits)

8
_____ 8 bit
Parallel Bus

_____ Single Digital
Line

Specialized vs Generalized Computing

- micro architecture is the ultimate in generalized computing
 - actions take by the processor come from instructions stored in memory - a stored program
 - we change what the processor does by changing the instructions, we don't have to modify any hardware
- Some digital circuits are designed to only do one job
 - could be a specific chip (wifi chip)
 - FPGAs
 - ASICs
 - very fast, efficient
 - not versatile
- Specialized hardware
 - digital signal processors (DSPs)
 - GPUs (polygon rendering)

Embedded Design & Firmware

- embedded system is a computer that is embedded in a larger system that does a very specific job
- Examples: ECU for car, home security system controller
- Embedded Systems still use a stored program microarchitecture

Firmware

the software that provides very low level control of the hardware