COMP 303
Computer Architecture
Lecture 1

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Introduction

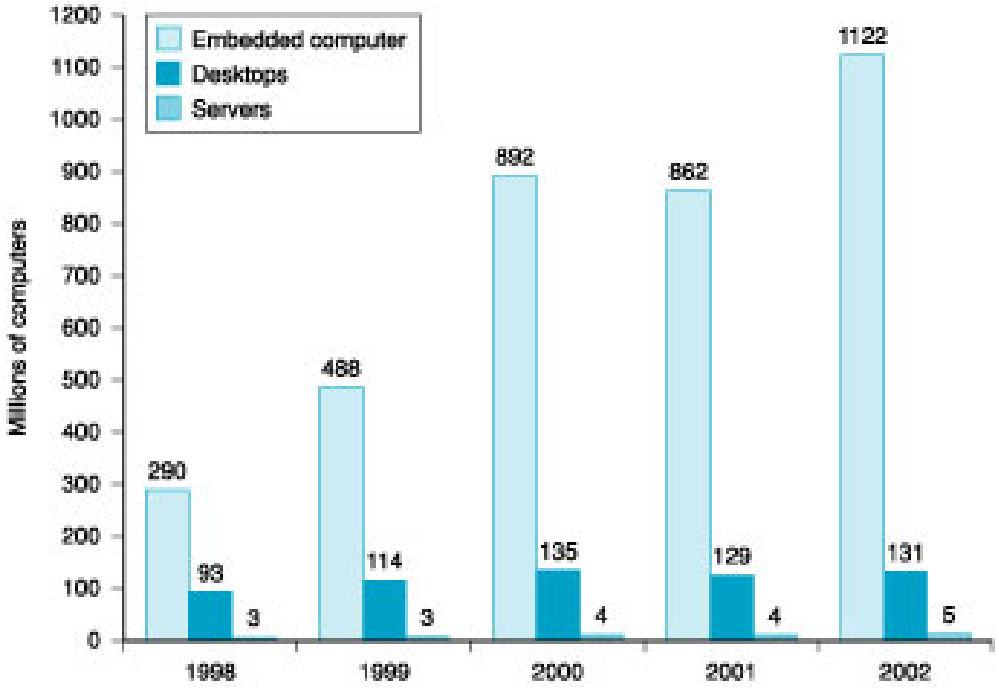
- This course is all about how computers work
- But what do we mean by a computer?
  - Different types: desktop, servers, embedded devices
  - Different uses: automobiles, graphics, finance, genomics…
  - Different manufacturers: Intel, Apple, IBM, Microsoft, Sun…
  - Different underlying technologies and different costs!

Introduction

- Analogy: Consider a course on “automotive vehicles”
  - Many similarities from vehicle to vehicle (e.g., wheels)
  - Huge differences from vehicle to vehicle (e.g., gas vs. electric)
- Best way to learn:
  - Focus on a specific instance and learn how it works
  - While learning general principles and historical perspectives

Classes of Computing Apps.

- Desktop computers
- Servers
- Super computers
- Embedded computers



What to learn

- How are programs written in a high-level language, translated into the language of the hardware
- What is **the interface between the software and the hardware**, and how does software instruct the hardware to perform needed function
- What determines the **performance of a program**
- What techniques can be used by **hardware designers to improve performance**

Performance

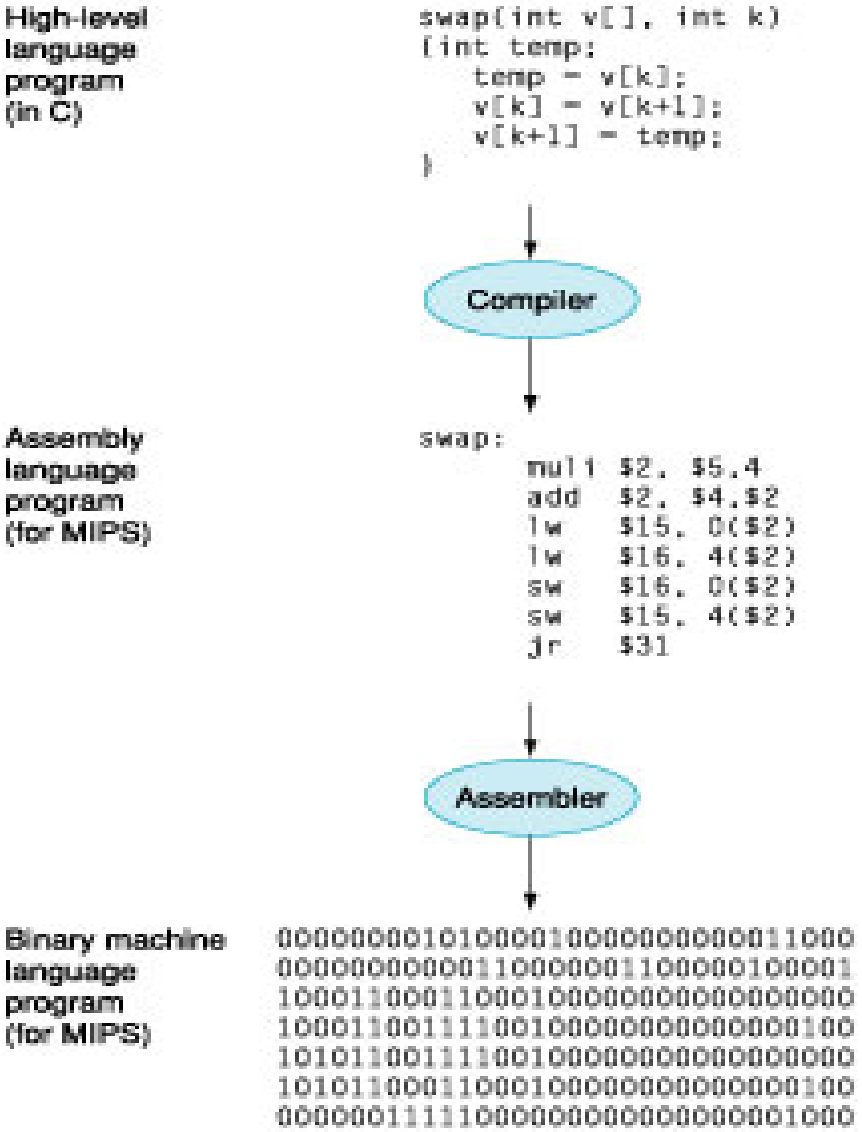
- Both Hardware and Software affect performance:
  - Algorithm determines number of source-level statements
  - Language/Compiler/Architecture determine machine instructions
    (Chapter 2 and 3)
  - Processor/Memory determine how fast instructions are executed
    (Chapter 5, 6, and 7)

Below the application

What is a computer?

- Components:
  - input (mouse, keyboard)
  - output (display, printer)
  - memory (disk drives, DRAM, SRAM, CD)
  - network
- Our primary focus: the processor (datapath and control)
  - implemented using millions of transistors
  - Impossible to understand by looking at each transistor

Abstraction



How do computers work?

- Need to understand abstractions such as:
  - Applications software
  - Systems software
  - Assembly Language
  - Machine Language
  - Architectural Issues: i.e., Caches, Virtual Memory, Pipelining
  - Sequential logic, finite state machines
  - Combinational logic, arithmetic circuits
  - Boolean logic, 1s and 0s
  - Transistors used to build logic gates (CMOS)
  - Semiconductors/Silicon used to build transistors
  - Properties of atoms, electrons, and quantum dynamics

Instruction Set Architecture

- A very important abstraction
  - interface between hardware and low-level software
  - standardizes instructions, machine language bit patterns, etc.
  - advantage: *different implementations of the same architecture*
  - disadvantage: *sometimes prevents using new innovations*

  True or False: Binary compatibility is extraordinarily important?

- Modern instruction set architectures:
  - IA-32, PowerPC, MIPS, SPARC, ARM, and others

Historical Perspective

- ENIAC built in World War II was the first general purpose computer
  - Used for computing artillery firing tables
  - 80 feet long by 8.5 feet high and several feet wide
  - Each of the twenty 10 digit registers was 2 feet long
  - Used 18,000 vacuum tubes
  - Performed 1900 additions per second

Eniac

–Since then:

Moore's Law:

transistor capacity doubles every 18-24 months

Reading Assignment

- Read Ch 1. Especially 1.4 Performance