CSE 305: Computer Architecture

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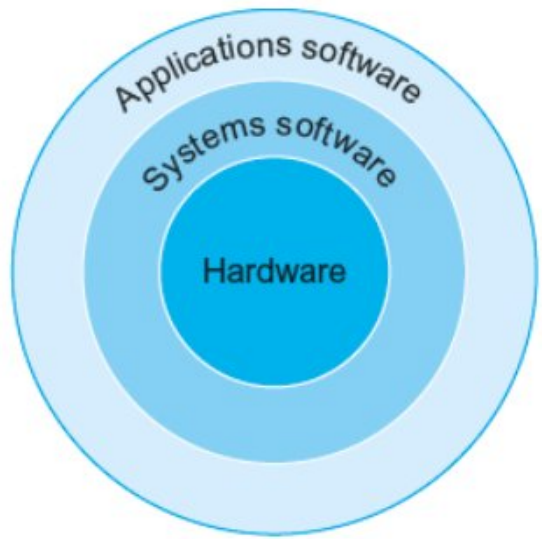
Recap

Below Our Program

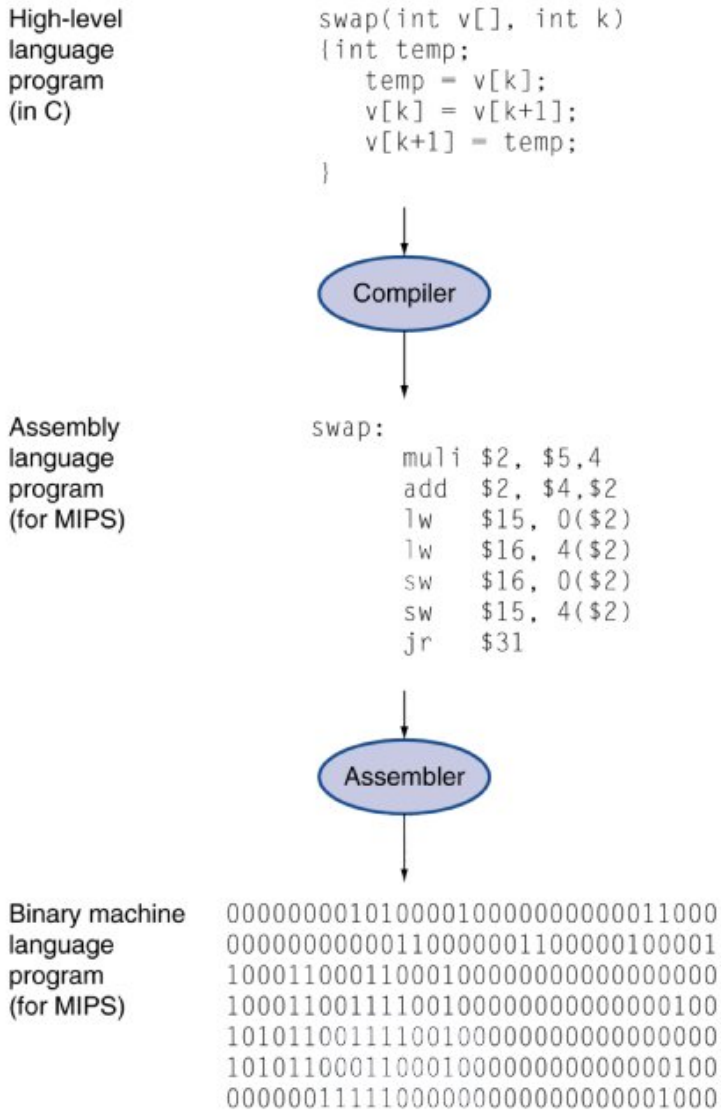
- application software
  - written in high-level language
- system software
  - operating system
    - handles basic I/O
    - allocates storage and memory
    - provides protected sharing of computer amoung multiple applications
  - compiler
    - translates HLL code to machine code
- hardware
  - processor
  - memory
  - I/O



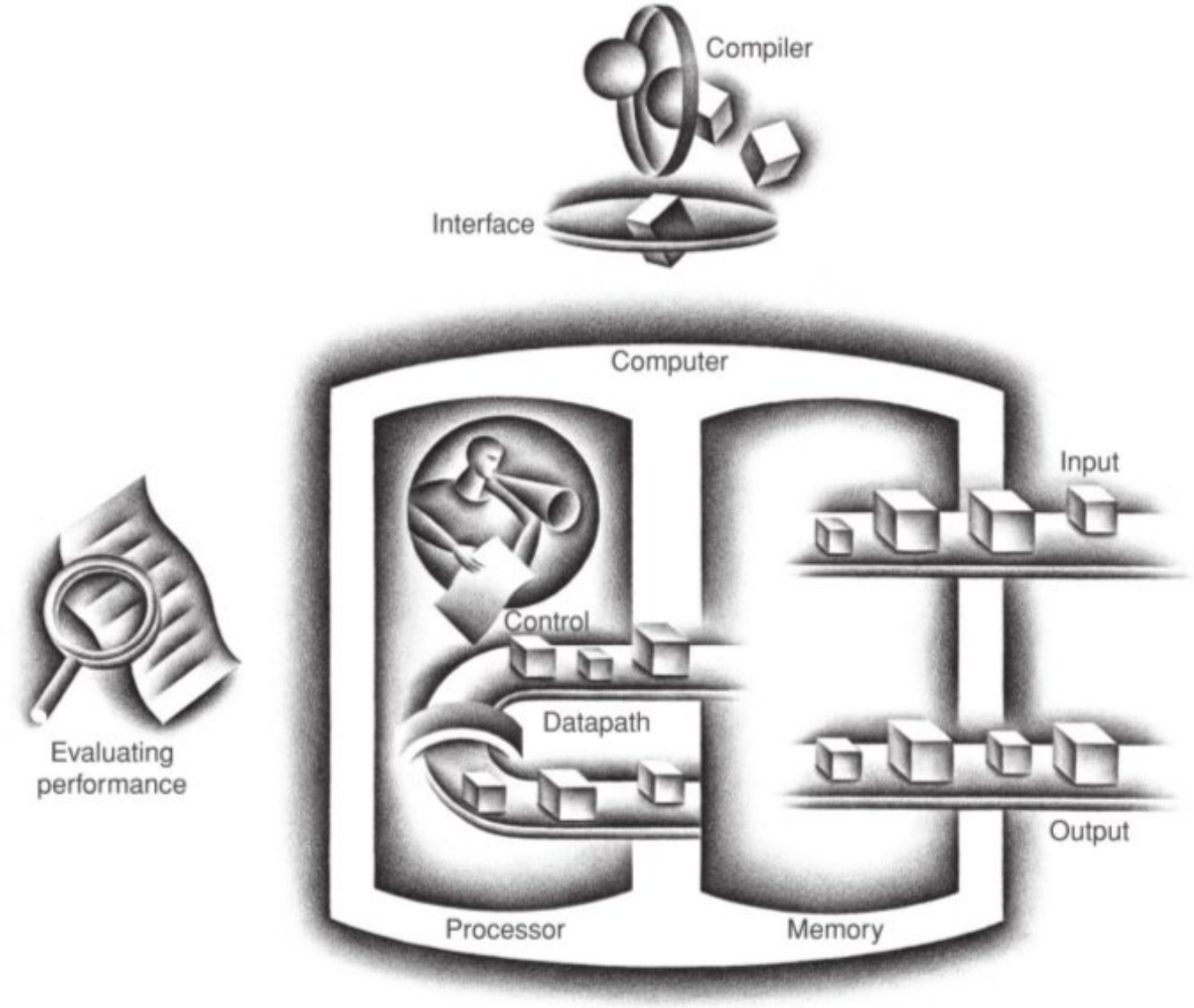
Below Our Program

From a High-Level Language to the Language of Hardware

- Why use high-level programming languages?
  - thinking in a more natural language
  - domain specific languages designed accordingly
  - conciseness
  - portability



Organization of a Computer



Organization of a Computer

Opening the Box

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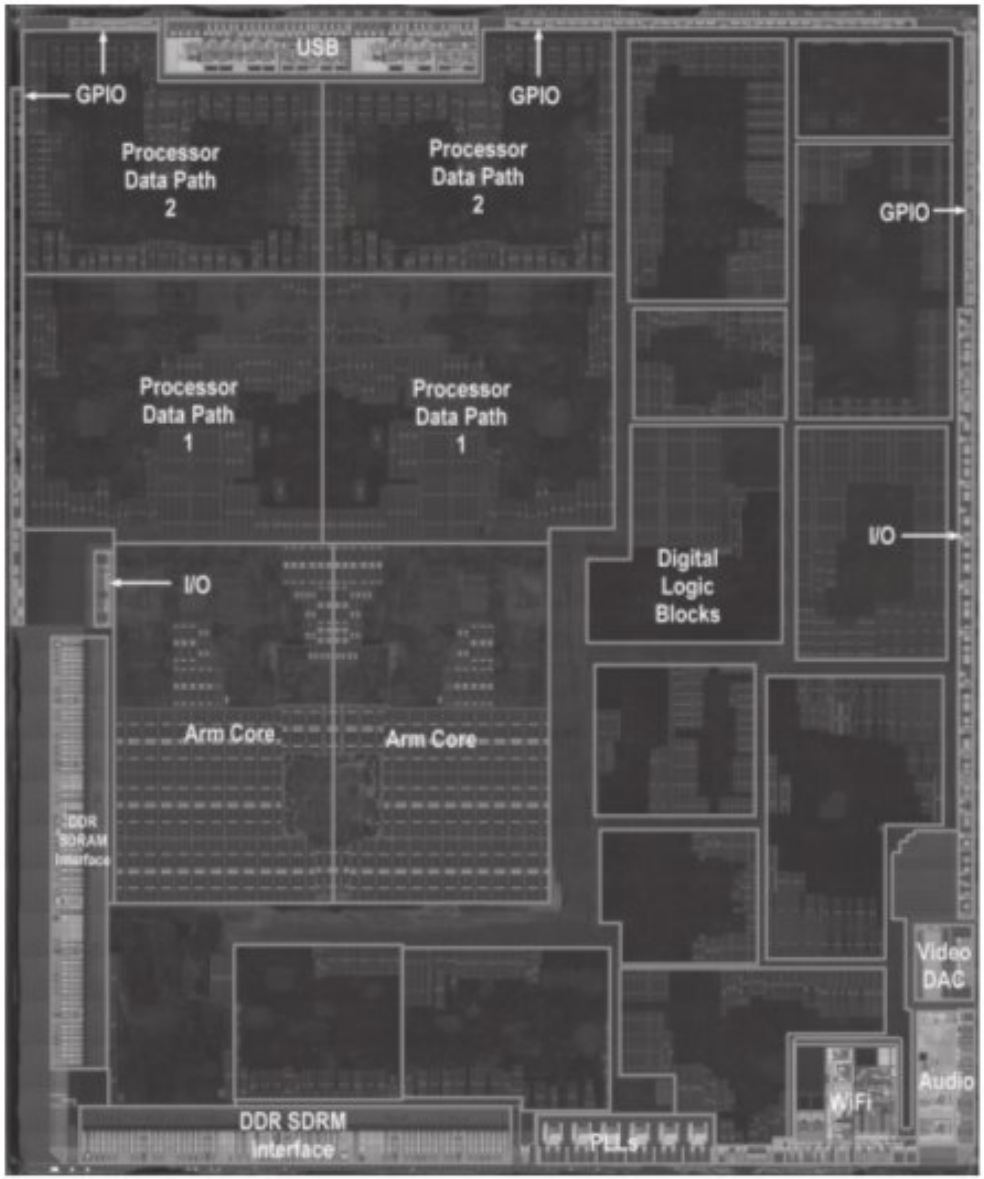
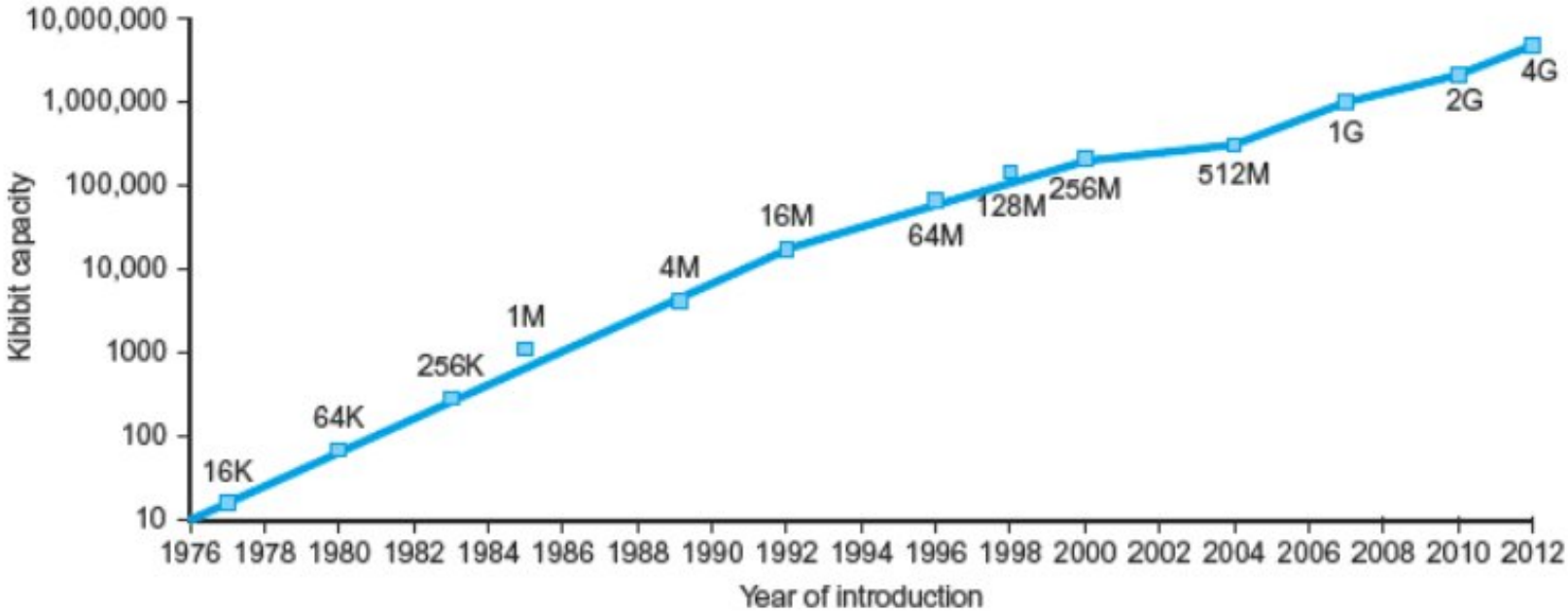


Technologies for Building Processors and Memory

Year	Technology used in computers	Relative performance/unit cost
1951	Vacuum tube	1
1965	Transistor	35
1975	Integrated circuit	900
1995	Very large-scale integrated circuit	2,400,000
2013	Ultra large-scale integrated circuit	250,000,000,000

Technologies for Building Processors and Memory



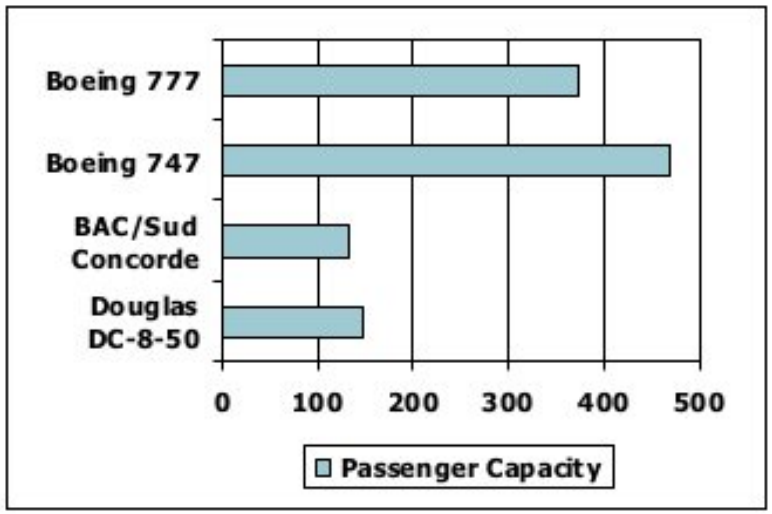
Today's Topic

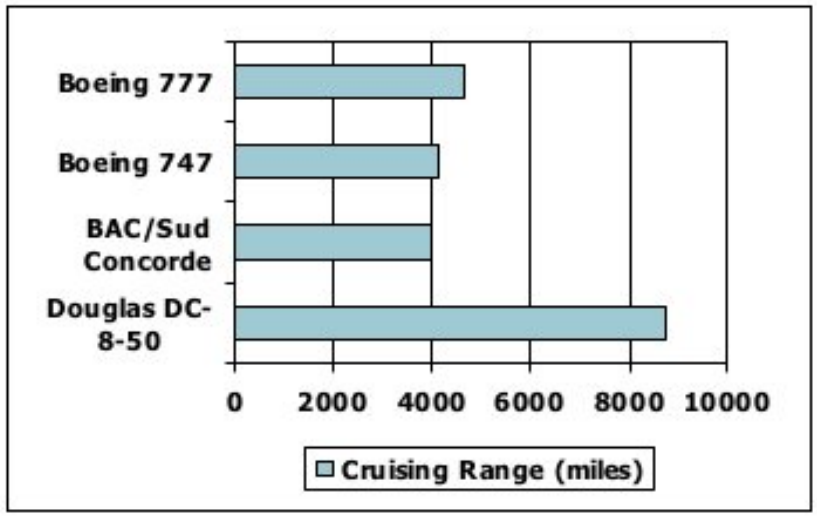
Measuring Computer Performance

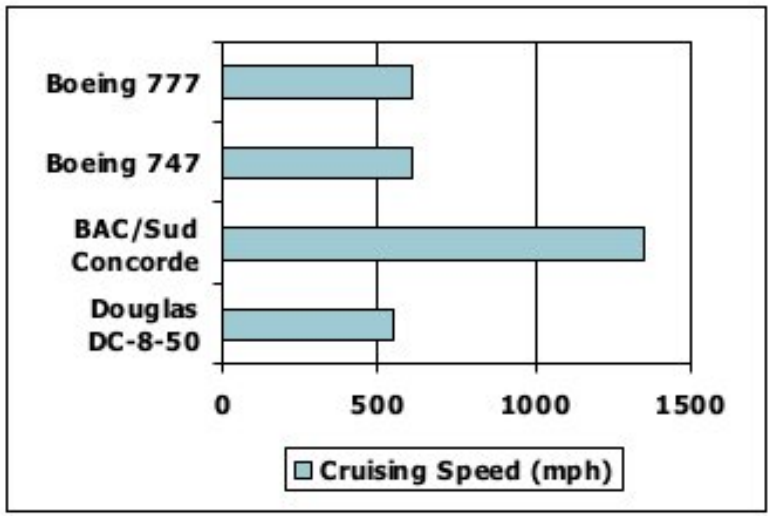
Defining Performance

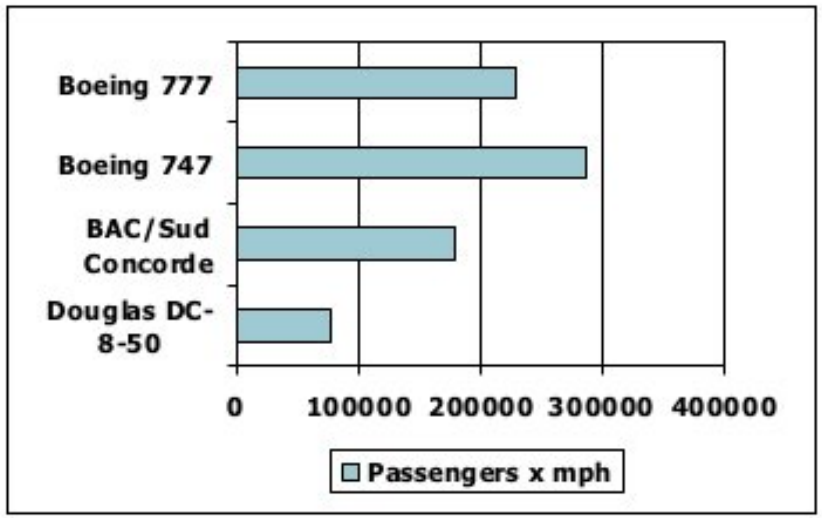
An Analogy with Passenger Airplanes

- Which airplane has the best performance?









Defining Performance

What About Computers?

- desktop
  - gets the job done first
- datacenter server
  - completed the most jobs during a day

Defining Performance

What About Computers?

- desktop
  - gets the job done first
    - Response time
- datacenter server
  - completed the most jobs during a day
    - throughput

Execution Time & Bandwidth

Execution/Response time

- the time between the start & completion of a task

Bandwidth/Throughput

- the total amount of work done in a given time

Execution Time & Bandwidth

Example

Do the following changes to a computer system increase throughput, decrease response time, or both?

1. Replacing the processor in a computer with a faster version
2. Adding additional processors to a system that uses multiple processors for separate tasksfor example, searching the web

Relative Performance

$$\text{Performance}_X = \frac{1}{\text{Execution time}_X}$$

$$\frac{\text{Performance}_X}{\text{Performance}_Y} = \frac{\text{Execution time}_Y}{\text{Execution time}_X} = n$$

Relative Performance

Example

If computer A runs a program in 10 seconds and computer B runs the same program in 15 seconds, how much faster is A than B?

What's Next

Measuring Computer Performance

- CPU clocking and clock rate
- Instruction Count
- Clock cycle per instruction
- The classic CPU performance equation

Reference

- Computer Organization and Design: The Hardware/Software Interface, *Chapter 1, 1.6*
  - David A. Patterson
  - John L. Hennessy