CHAPTER 1

Computer Abstraction and Technology

By Pattama Longani
Collage of arts, media and Technology

Components of a Computer

Input

Processor

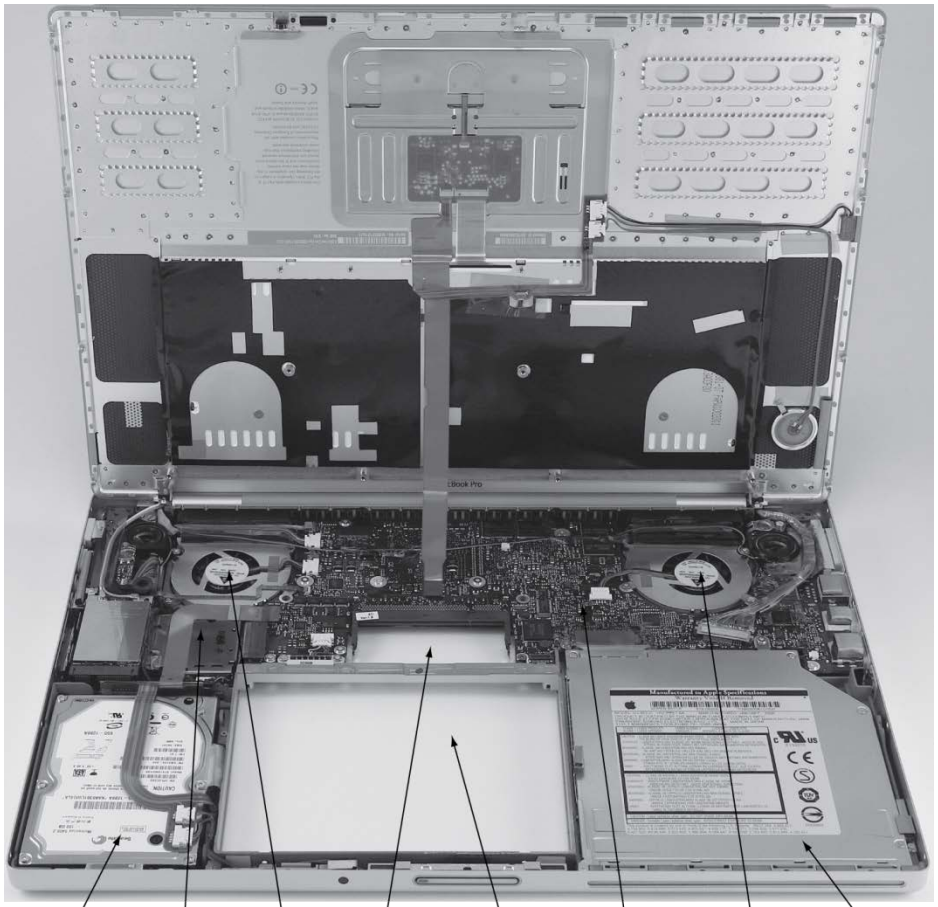
Control

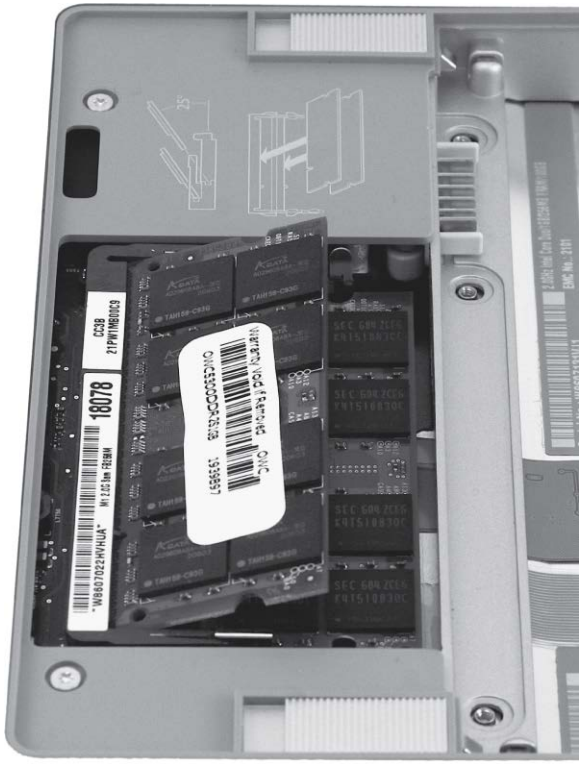
Data Path

Output

Storing Data

Opening the Box





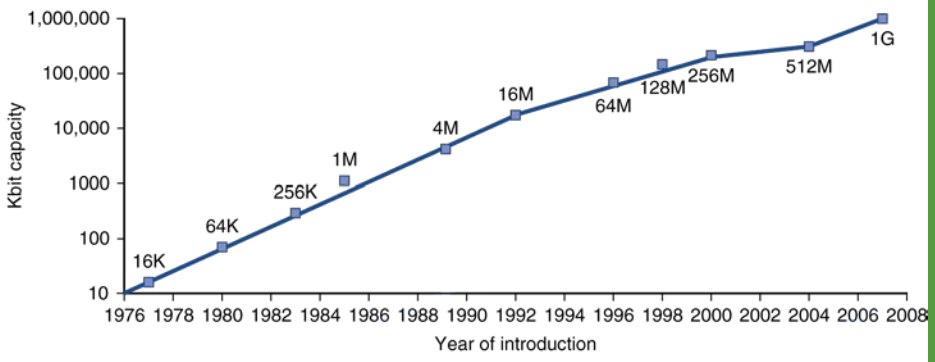
Inside the Processor (CPU)

There are 3 components;

- Datapath: performs operations on data
- Control: commands datapath, memory, and I/O devices.
- Cache memory
  - Small fast SRAM memory for immediate access to data

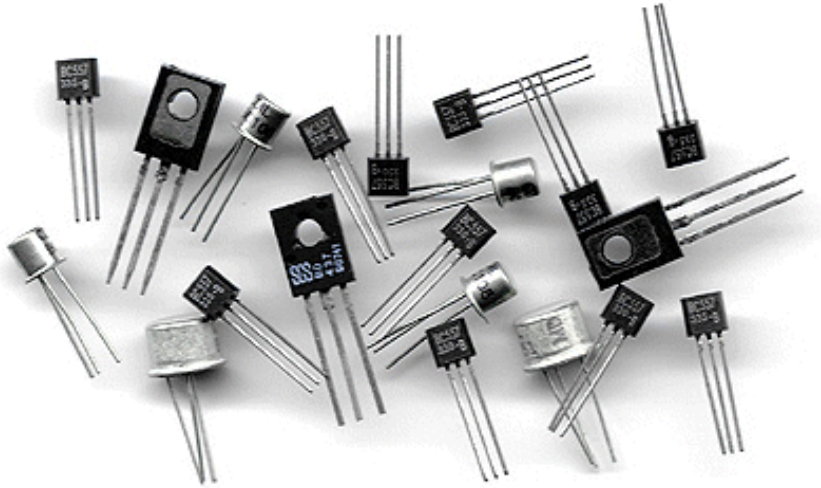
Technology Trends

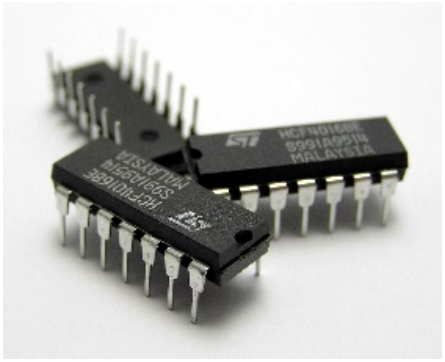
- Electronics technology continues to evolve
  - Increased capacity and performance
  - Reduced cost

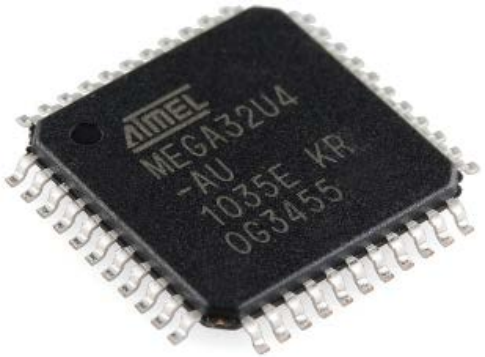


DRAM capacity

Year	Technology	Relative performance/cost
1951	Vacuum tube	1
1965	Transistor	35
1975	Integrated circuit (IC)	900
1995	Very large scale IC (VLSI)	2,400,000
2005	Ultra large scale IC	6,200,000,000



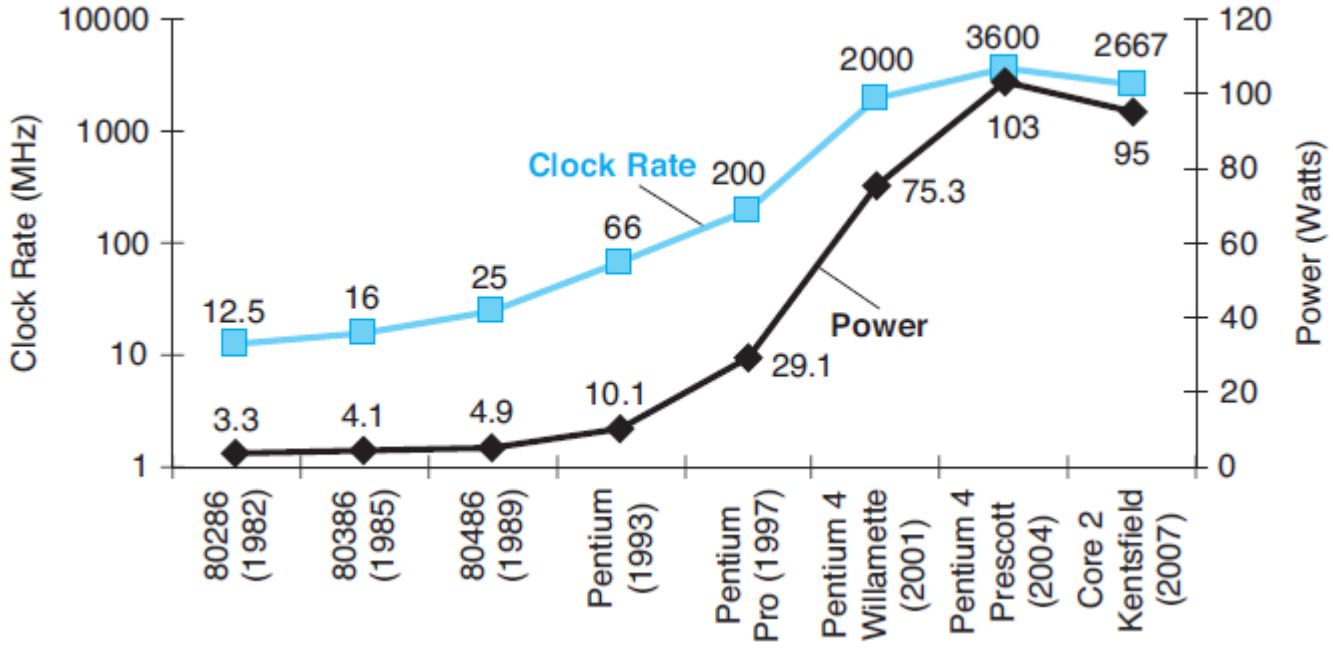



ATMEL
MEGA32U4
-AU
1035E KR
0G3455

The Computer Revolution

- Progress in computer technology
  - Underpinned by Moore's Law
  - **Moore's law** is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.
    - http://en.wikipedia.org/wiki/Moore's_law
  - **Moore's Law Inspires Intel Innovation**



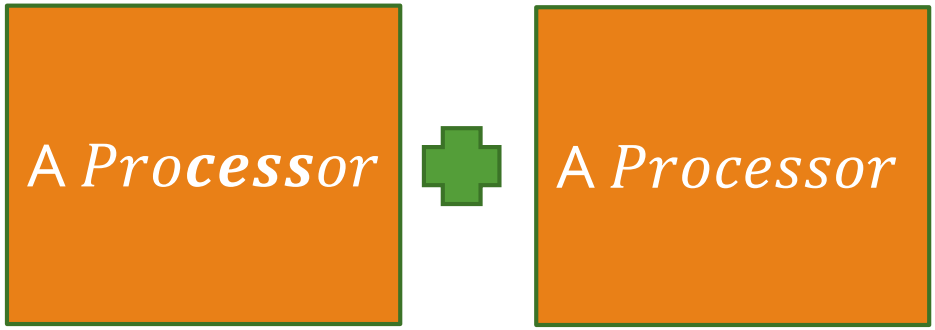


- **CLOCK RATE** and **POWER** are correlated
- They increased rapidly for decades, and then flattened off recently.
- we have run into the practical power limit for cooling commodity microprocessors.

A program
run in a processor

continually Increase response time

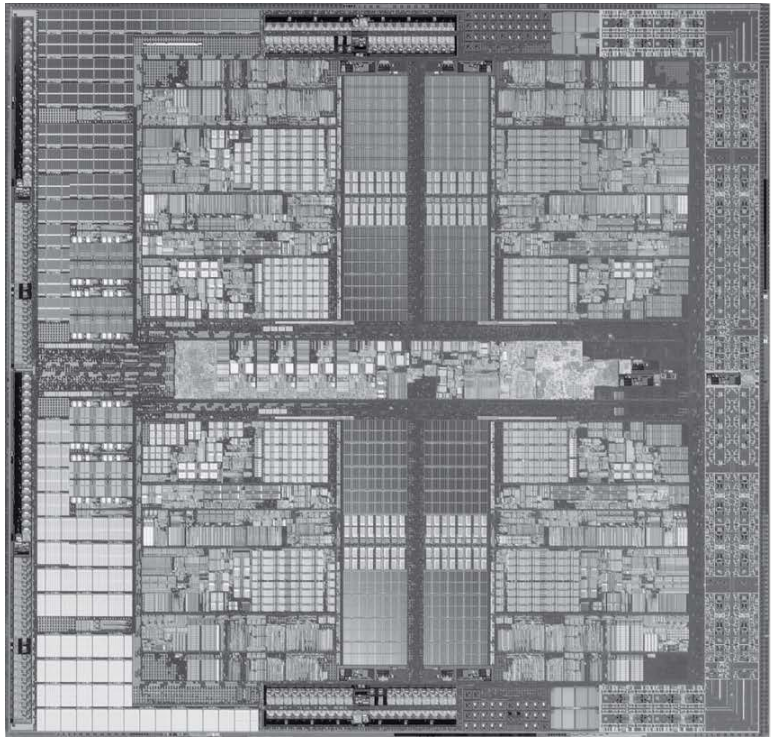
limit for cooling

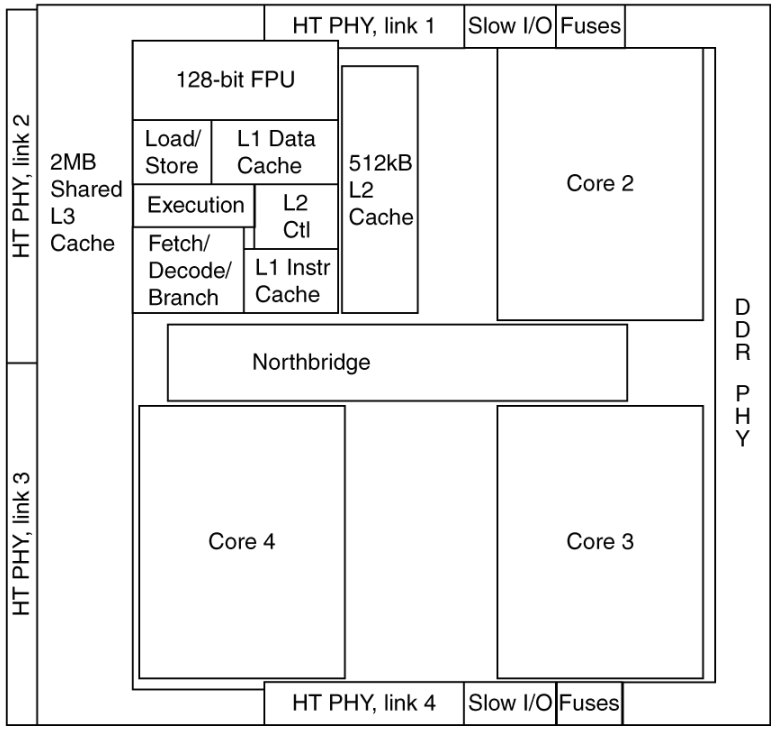


Use multiprocessor per chip

Focus on increase throughput

Inside the Processor





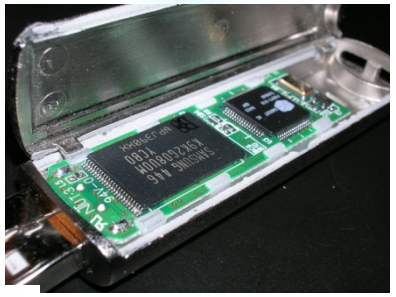
MULTIPROCESSOR

- To reduce confusion between the words processor and microprocessor, companies refer to processors as "**cores**,"
  - "quadcore" microprocessor is a chip that contains four processors or four cores.
- The official plan of record for many companies is to **double the number of cores** about every two years (Moore's Law)

- programmers need to rewrite their programs to take advantage of multiple processors = harder
  - Program need to be correct.
  - Program need to be divided, so each processor has roughly the same amount to do at the same time.
    - Scheduling
    - Load balancing
    - Time for synchronization
    - Overhead for communication

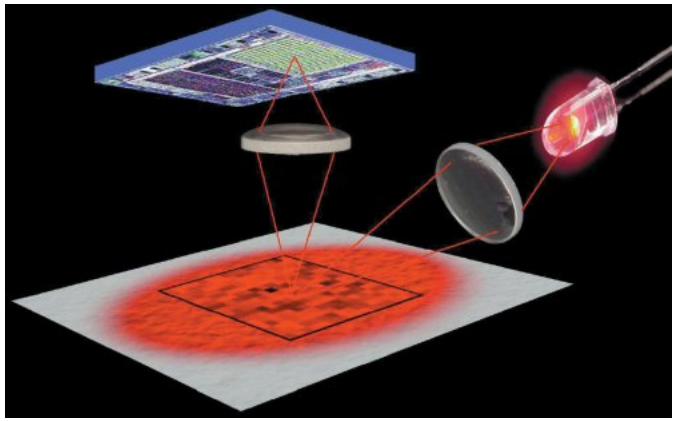
A Safe Place for Data

- Volatile main memory
  - Loses instructions and data when power off
- Non-volatile secondary memory
  - Magnetic disk
  - Flash memory
  - Optical disk (CDROM, DVD)



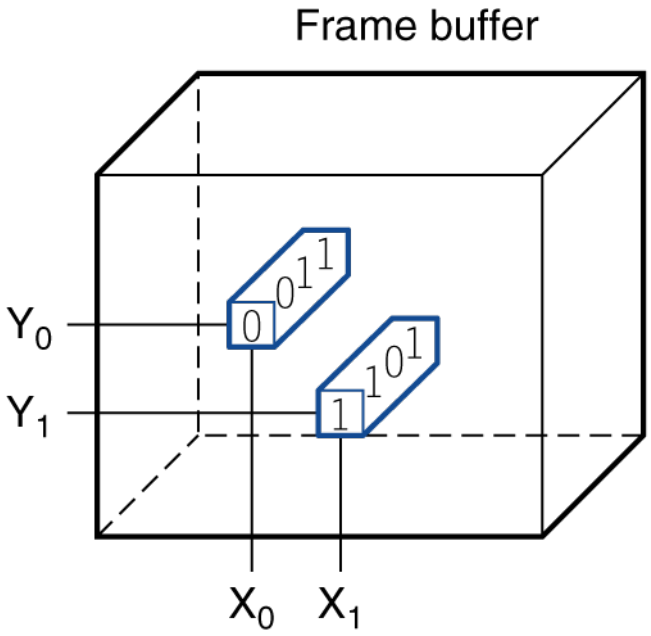
Anatomy of a Mouse

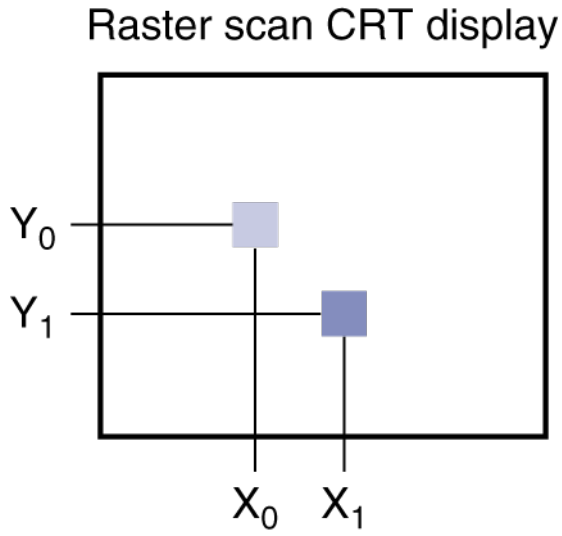
- Optical mouse
  - LED illuminates desktop
  - Small low-res camera
  - Basic image processor
    - Looks for x, y movement
  - Buttons & wheel
- Supersedes roller-ball mechanical mouse



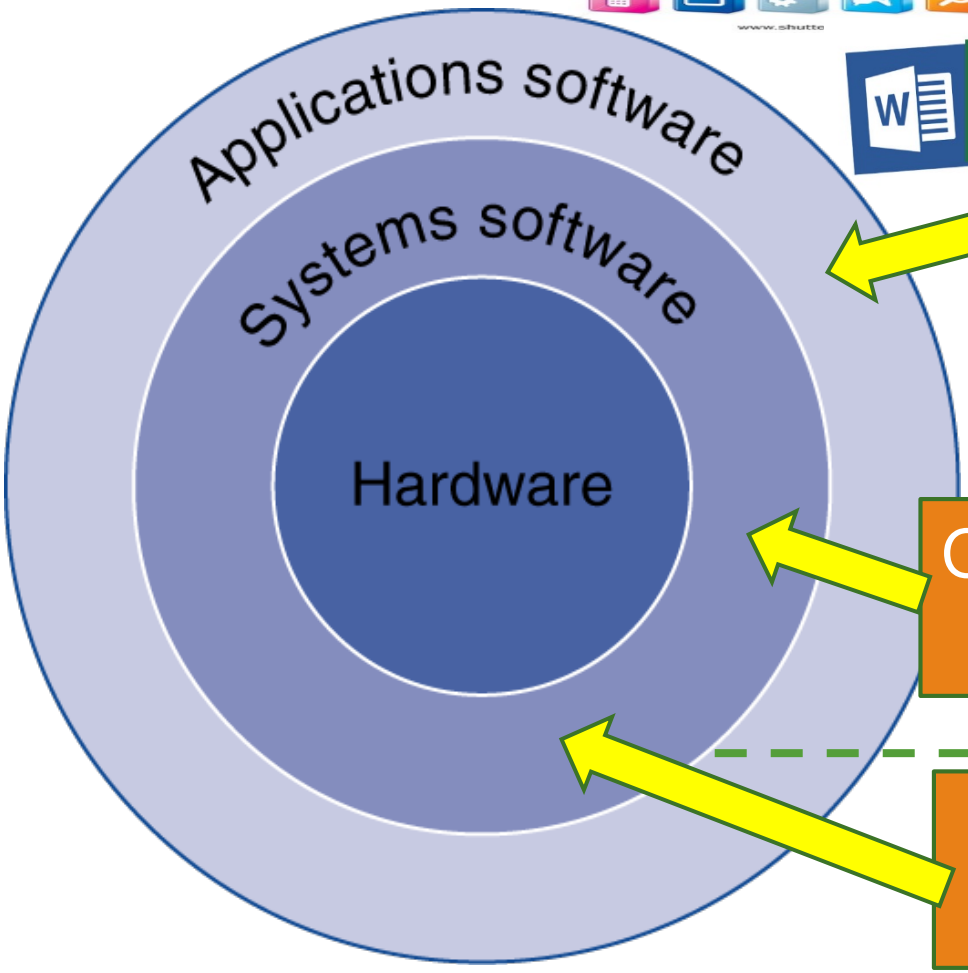
Monitor


acer


Frame buffer
Y0
Y1
X0
X1
0
1


Raster scan CRT display
Y0
Y1
X0
X1

Software



Input-Output

Storage-Memory

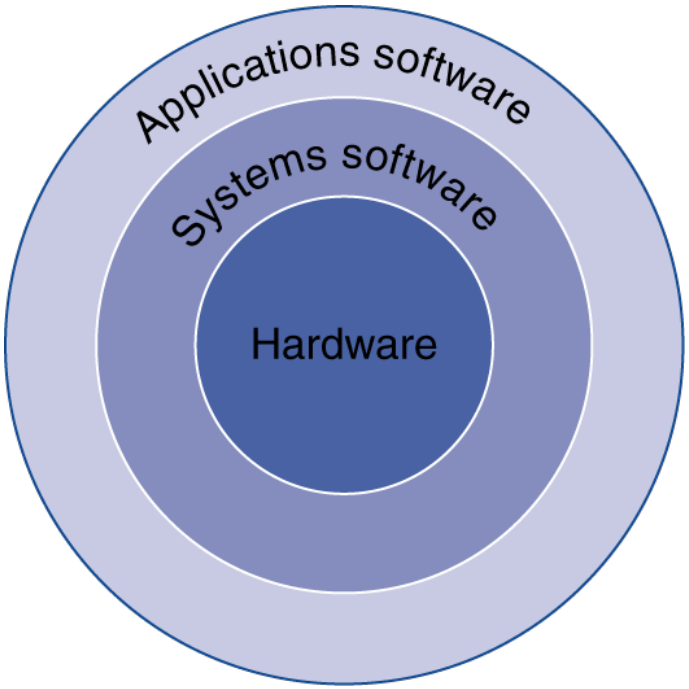
Sharing Computer

Simultaneously

Operating System

Compiler

Translate High-LL to Low-LL



High-level language program (in C)

```
swap(int v[], int k)
{int temp;
   temp = v[k];
   v[k] = v[k+1];
   v[k+1] = temp;
}
```

Compiler

Assembly language program (for MIPS)

```
swap:
      muli $2, $5,4
      add  $2, $4,$2
      lw   $15, 0($2)
      lw   $16, 4($2)
      sw   $16, 0($2)
      sw   $15, 4($2)
      jr   $31
```

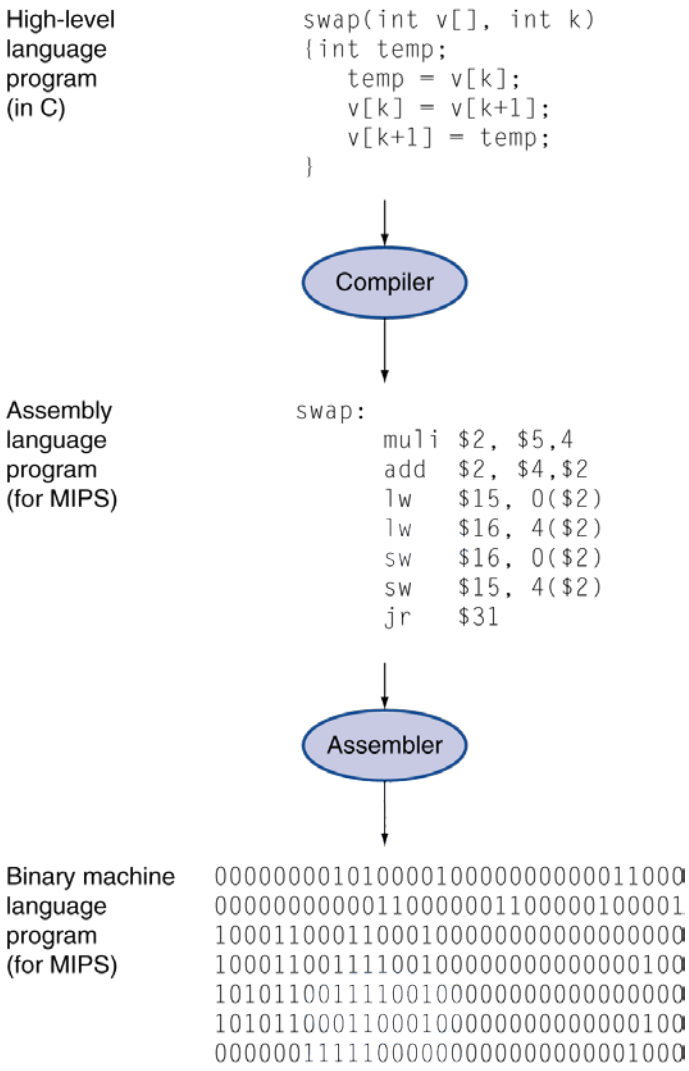
Assembler

Binary machine language program (for MIPS)

```
00000000101000010000000000011000
00000000000011000000110000100001
10001100011000100000000000000000
10001100111100100000000000000100
10101100111100100000000000000000
10101100011000100000000000000100
00000011111000000000000000001000
```

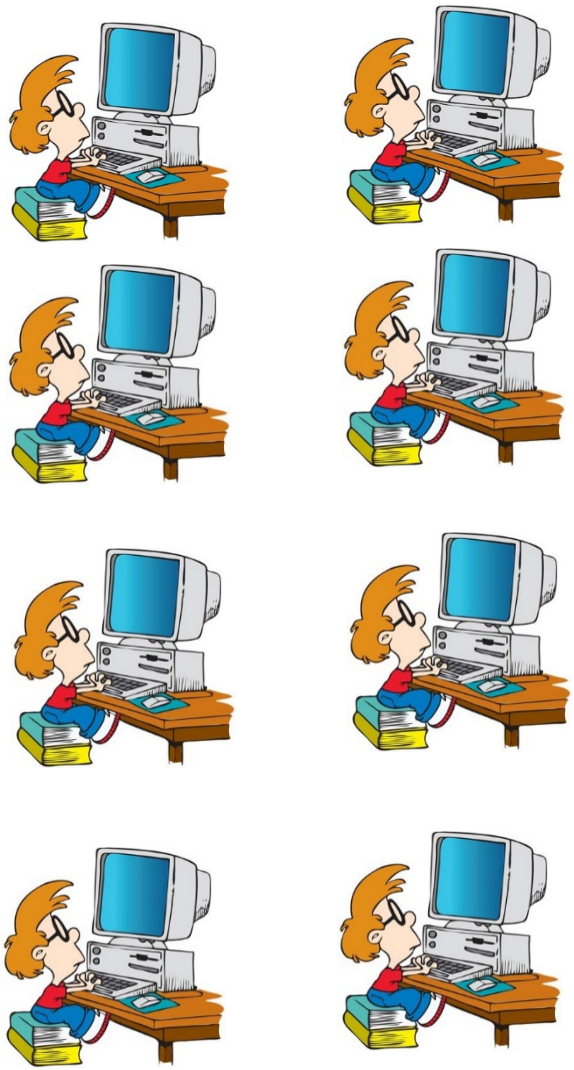
Levels of Program Code

- High-level language
  - Level of abstraction closer to problem domain
  - Provides for productivity and portability
- Assembly language
  - Textual representation of instructions
- Hardware representation
  - Binary digits (bits)
  - Encoded instructions and data



Network

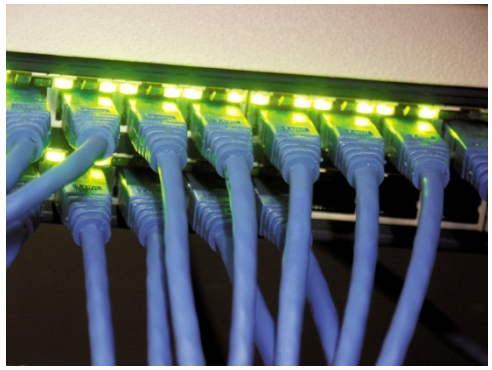
VS



Parallel Computing

Networks

- Communication and resource sharing
- Local area network (LAN): Ethernet
  - Within a building
- Wide area network (WAN: the Internet
- Wireless network: WiFi, Bluetooth



Classes of Computers

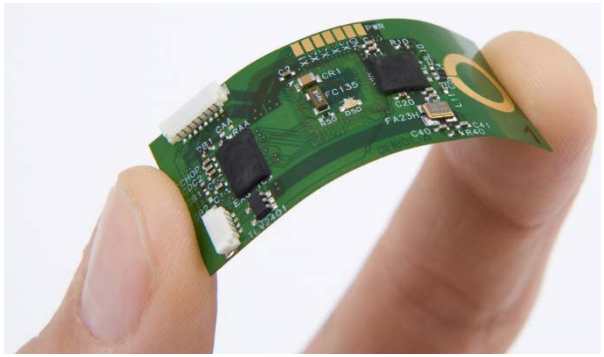
Personal Computer

Good performance for single user

Server computers, Data Center

Usually access by network

Large Workload (computing + input-output capacity)

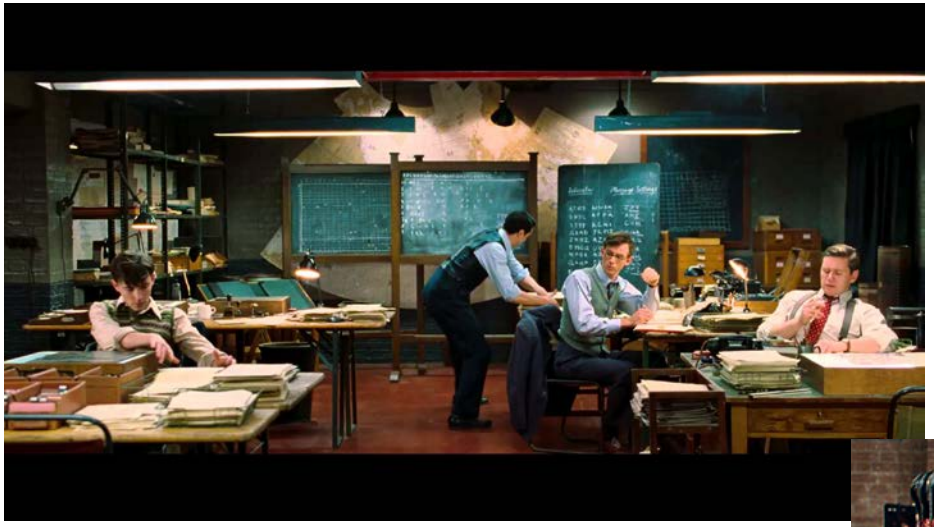


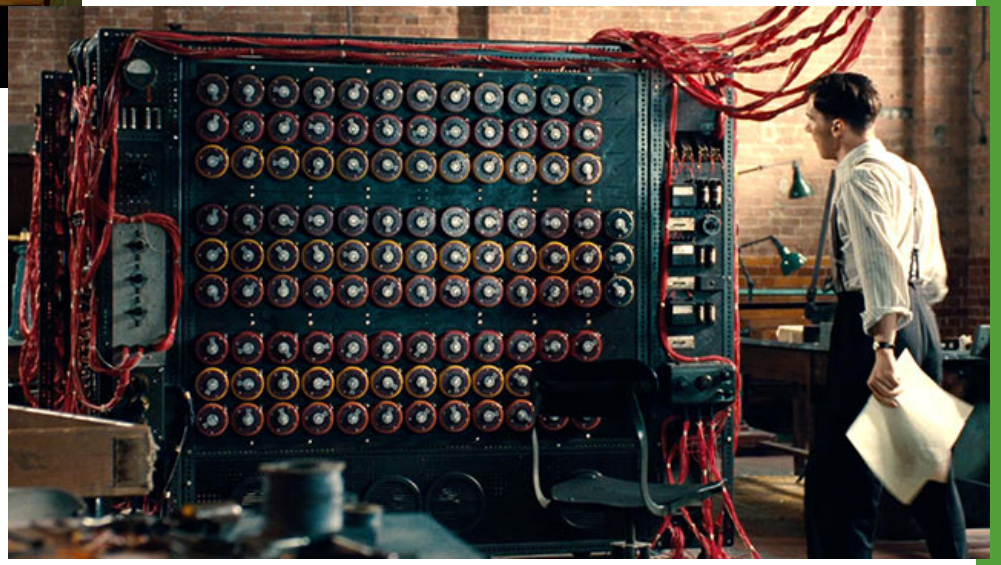
Embedding System

Microprocessor designed for one application

The Computer Revolution

- Computer History
- Kids React to Old Computers



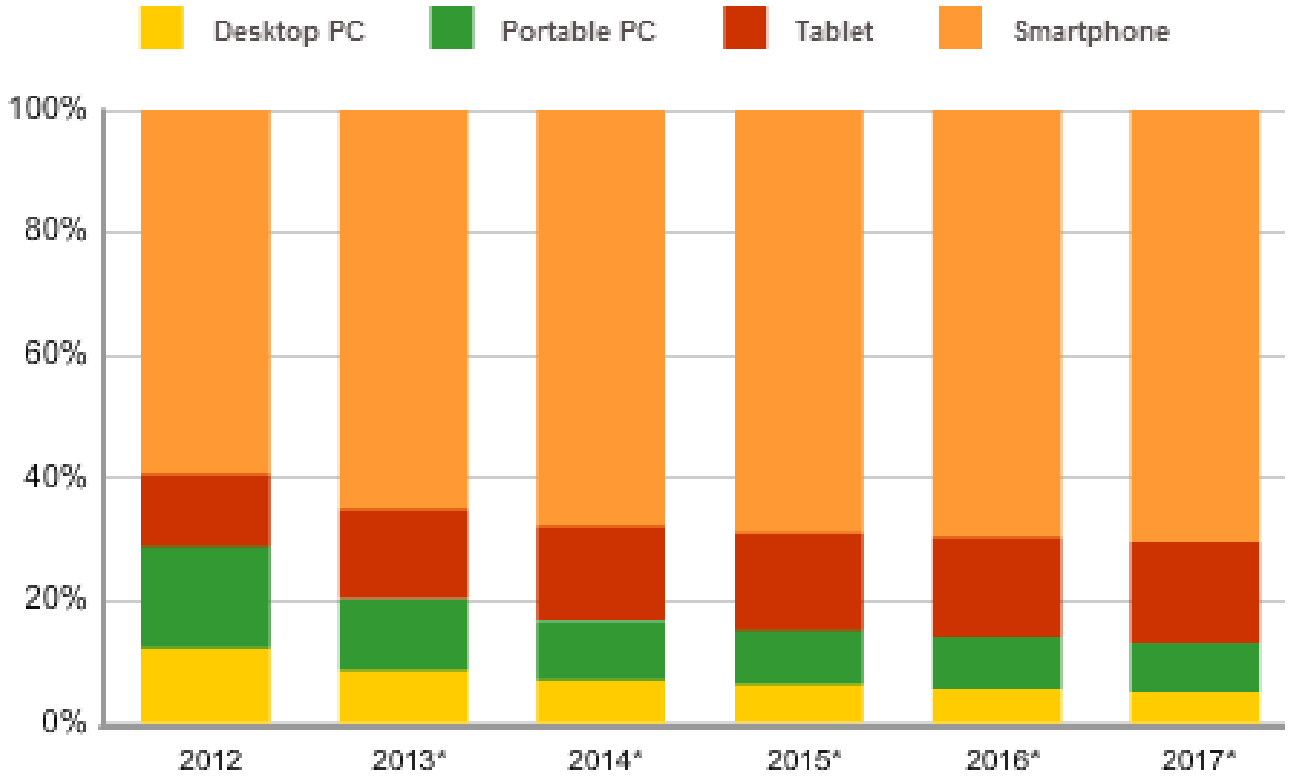


The Computer Revolution

- Makes novel applications feasible
  - Computers in automobiles
  - Cell phones
  - Human genome project, Medical
  - World Wide Web
  - Search Engines
  - Military
- Computers are pervasive
- The new bionics that let us run, climb and dance

IDC
Analyze the Future

Worldwide Smart Connected Device Forecast*
Market Share by Product Category, 2012-2017



http://www.forbes.com/sites/louiscolumbus/2013/09/12/idc-87-of-connected-devices-by-2017-will-be-tablets-and-smartphones/