

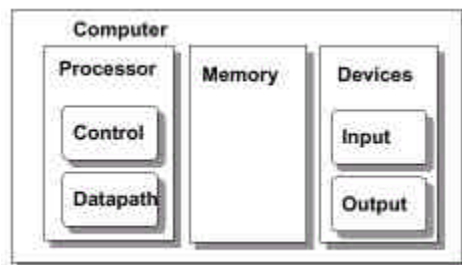
August 27

- Books?
- Email?
- Accounts?

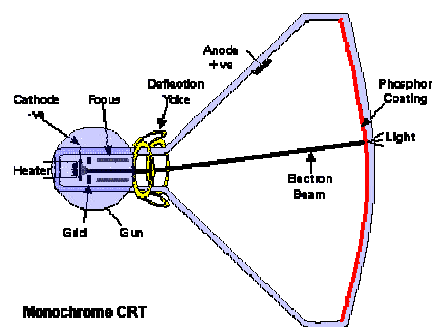
What does a computer look like?

- Tape drives?
- Big box with lots of lights?
- Display with huge letters?
- Little box with no lights?
- Lump in the cable?

5 Classic Computer Components



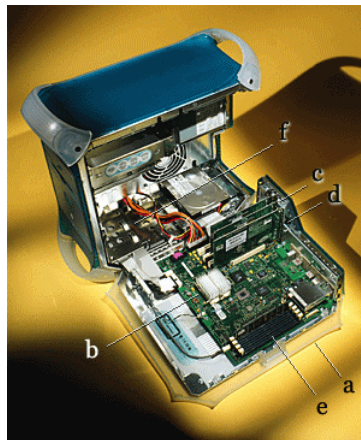
Display



Mouse

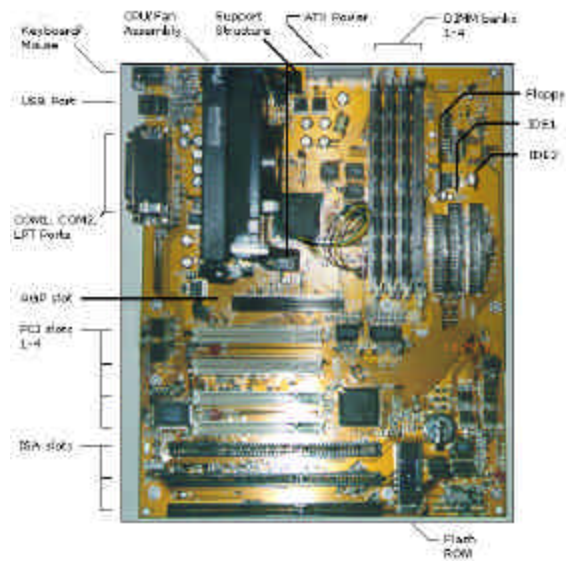


Inside the case



- b. Processor
- c. PCI slots
- e. Memory slots

Motherboard



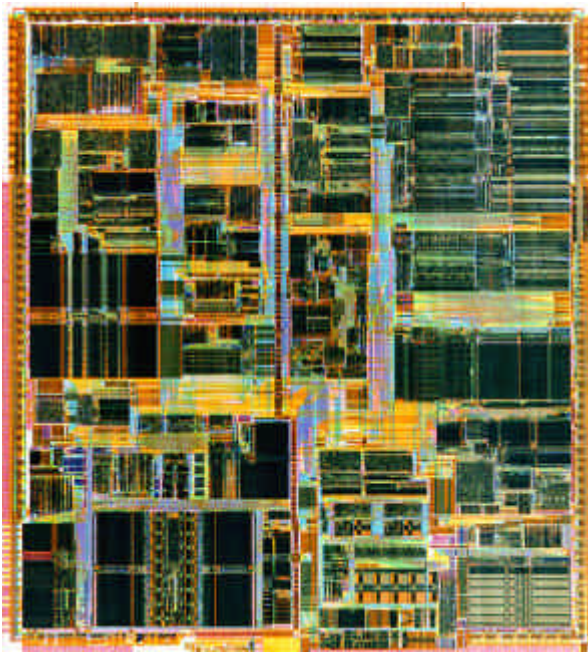
Memory



- RAM
- DRAM
- SRAM
- ROM
- Volatile / Non-Volatile
- Magnetic

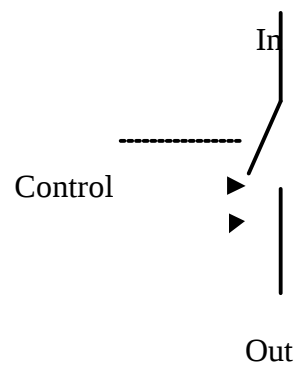
Processor

Pentium III Xeon



You only need switches and wires!

- Relays
- Vacuum tubes
- Transistors
- Integrated Circuits
- VLSI
- Nanotubes?
- Quantum Effect Devices?



Hard Drive

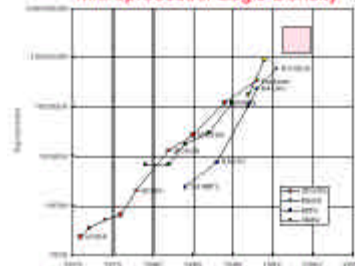


Improving Technology

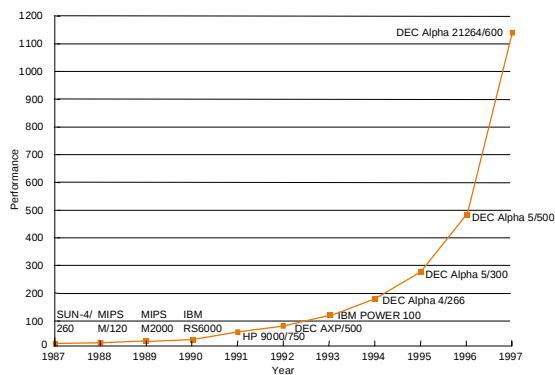
DRAM chip capacity

DRAM	
Year	Size
1980	64 Kb
1983	256 Kb
1986	1 Mb
1989	4 Mb
1992	16 Mb
1996	64 Mb
1999	256 Mb
2002	1 Gb

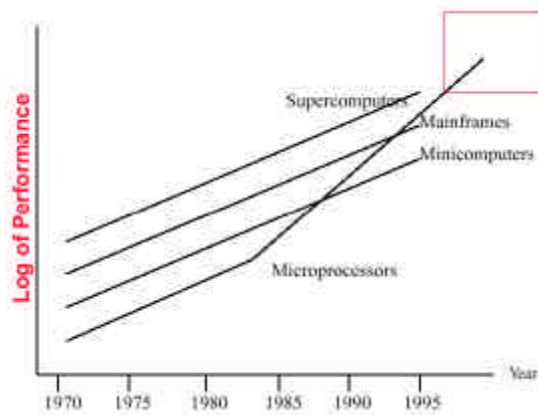
Microprocessor Logic Density



Performance Increase



Performance Trends



Abstraction: C to ASM

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

C compiler

Assembly

```
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
```

Abstraction: ASM to Binary

Assembly

```
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

```
000000001010000100000000000011000  
00000000100011100001100000100001  
10001100011000100000000000000000  
10001100111100100000000000000100  
10101100111100100000000000000000  
10101100011000100000000000000100  
00000011111000000000000000001000
```

Binary

Instruction Set Architecture

... the attributes of a [computing] system as seen by the programmer, *i.e.* the conceptual structure and functional behavior, as distinct from the organization of the data flows and controls, the logic design, and the physical implementation.

– Amdahl, Blaaw, and Brooks, 1964

- 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*

Modern instruction set architectures:

- 80x86/Pentium/K6, PowerPC, DEC Alpha, MIPS, SPARC, HP

Where we are headed

- Overview of C
- Performance issues (Chapter 2) *vocabulary and motivation*
- A specific instruction set architecture (Chapter 3)
Why MIPS? Why not Intel?
- Arithmetic and how to build an ALU (Chapter 4)
- Pipelining to improve performance (Chapter 6)
briefly
Memory: caches and virtual memory (Chapter 7)
- **Key to a good grade: reading the book!**