ENIAC: 1946
Cost to build: $486,804.22
17,468 vacuum tubes, 5,000 additions/second (5 Kips)
30 feet x 50 feet, 30 tons
Cost to operate (electricity): $650/hr. (idling)

ENIAC Programming

IBM S360/67: 1967
Cost: $3,000,000
1,000,000 instructions/sec. (1 Mip)
512KB "core" memory ($1,000,000/MB)
352MB disk

VAX 11/780: circa 1980
Cost: $150,000
1 "VAX Mip"
1MB Ram
Xerox Alto: 1973
Cost: $32,000 (research)
1 Mip
Bitmap display
Mouse
“Microsoft Word”

Intel 8086 (x86): 1978
Cost: ~$350
5-10 MHz (~1Mip)
29,000 transistors

Moore’s Law: 1975

Microprocessors + Workstation Concept
8/12/1981 IBM introduces its Personal Computer, which uses Microsoft’s 16-bit operating system, Microsoft® MS-DOS® version 1.0, plus Microsoft BASIC, Microsoft COBOL, Microsoft Pascal, and other Microsoft products.

Pentium 4: 2000’s
Cost: $100’s
2 GHz
42,000,000 transistors

One Way to View Architecture as a Topic

What are we going to do with all those transistors?

or

How can we make programs run faster at the rate processor speeds are improving?
Course Overview

The Instruction Set: a Critical Interface

Instruction Set Architecture
(subset of Computer Architecture)

Levels of Representation
**Execution Cycle**

1. **Instruction Fetch**
   - Obtain instruction from program storage
2. **Instruction Decode**
   - Determine required actions and instruction size
3. **Operand Fetch**
   - Locate and obtain operand data
4. **Execute**
   - Compute result value or status
5. **Result Store**
   - Deposit results in storage for later use
6. **Next Instruction**
   - Determine successor instruction

**Machine Organization**

- Since 1946 all computers have had 5 components

- Machine (is not just a CPU)
  - Pentium III Chipset
  - Processor
  - Memory
  - Input
  - Output

- Where are We Going??
  - Single/multicycle
  - Datapaths
  - Arithmetic
  - Memory Systems
  - I/O

- A Machine (is not just a CPU)
  - Processor
  - Memory
  - I/O Devices
  - Busses
  - Controllers
  - Displays
  - Keyboards
  - Networks