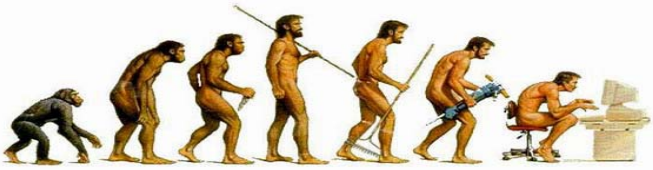
Evolution of the Computer



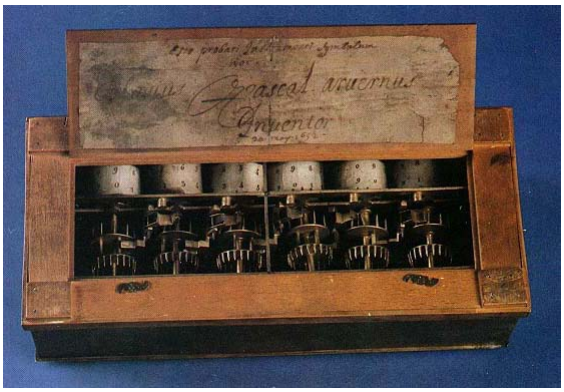
Janaka Harambearachchi
(Engineer/Systems Development)

Zeroth Generation- Mechanical

1. Blaise Pascal -1642
   - Mechanical calculator only perform + -
2. Von Leibiniz -1672
   - Mechanical four function calculator
3. Charles Babage-1834
   1. Difference engine – output is on punched card
   2. Analytical engine – general purpose / four components – mill , memory , i & o / programmable (Ada- first programmer)
4. Aiken - 1940

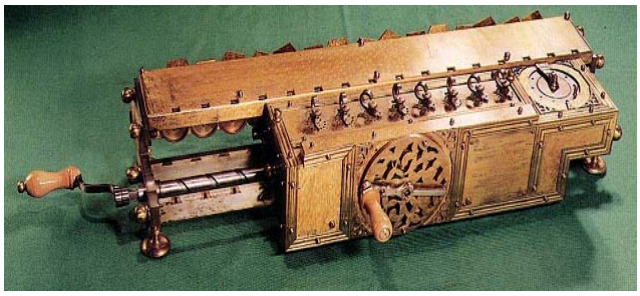
   Mark 1 - Electro mechanical computer

Blaise Pascal -1642
Mechanical calculator only perform + -



The Pascal Automatic Calculator - observe the gears and cylinders which rotated to display the numerical result

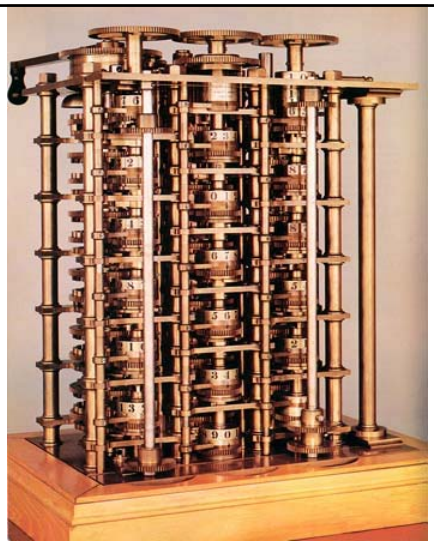
Von Leibiniz -1672
Mechanical four function calculator



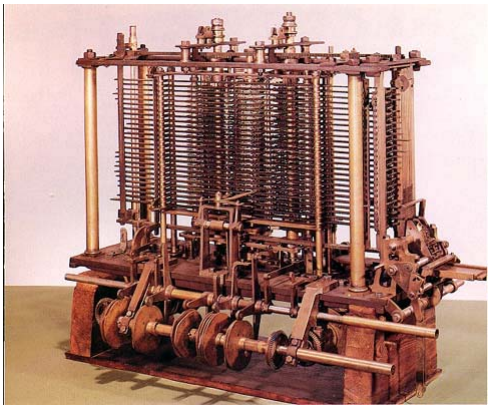
Leibniz Calculator

Difference engine:

- •Polynomial evaluation by finite differences
- •automatic tables
- •engrave plates
- •powered by a steam engine
- •15 digit numbers
- •he never completed it



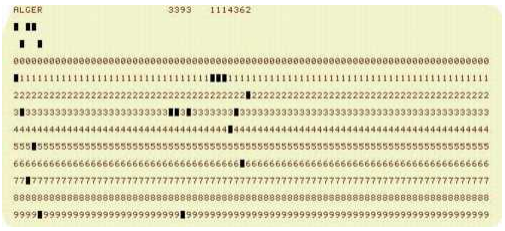
Babbage's Difference Engine

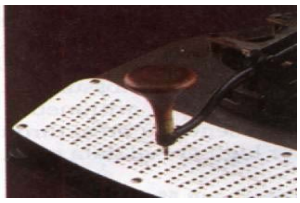


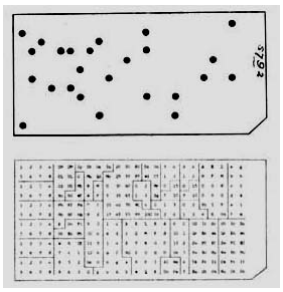
The Analytical Engine

Designed during the 1830s Parts remarkably similar to modern-day computers.

- **•The "store"**
- **•The "mill"**
- **•Punch cards.**



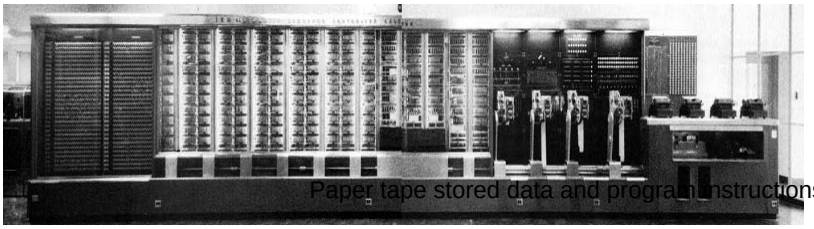




Early punch cards

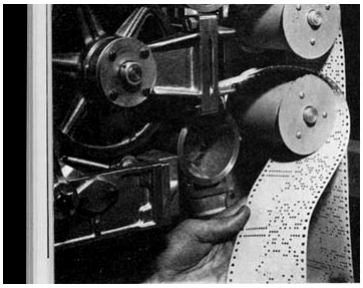
Aiken - 1940

Mark 1 - Electro mechanical computer



Paper tape stored data and program instructions

Paper tape stored data and program instructions



First Generation – Vacuum tubes

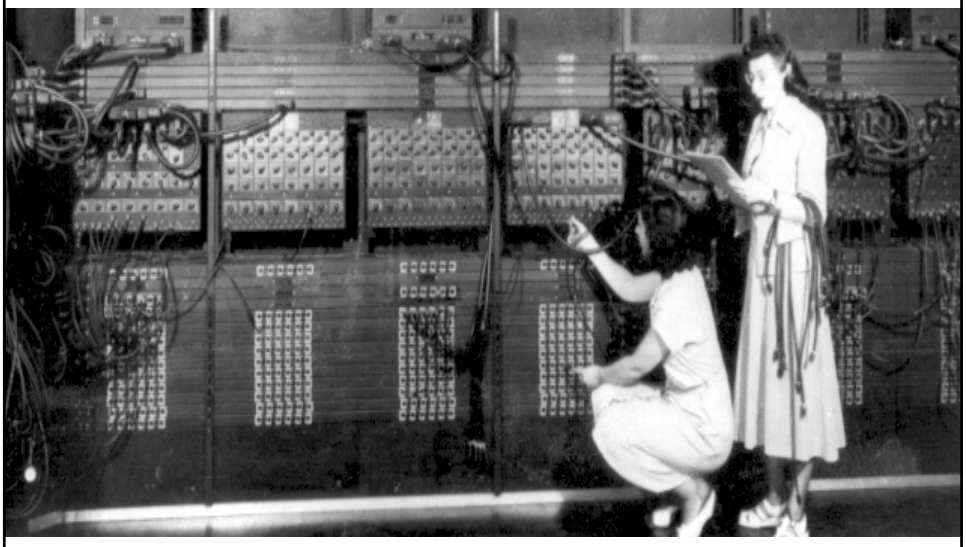
1 ENIAC

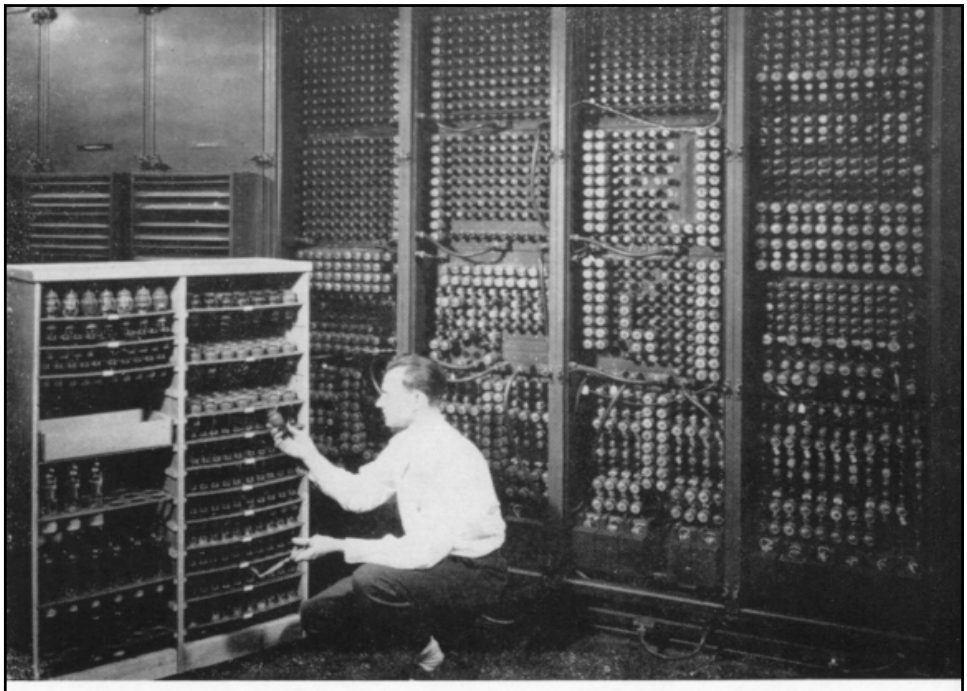
1. Electronic Numerical Integrator And Computer
2. Eckert and Mauchy of University of Pennsylvania
3. Trajectory tables for weapons
4. Started 1943 and Finished 1946
5. Too late for war effort Used until 1955

ENIAC features

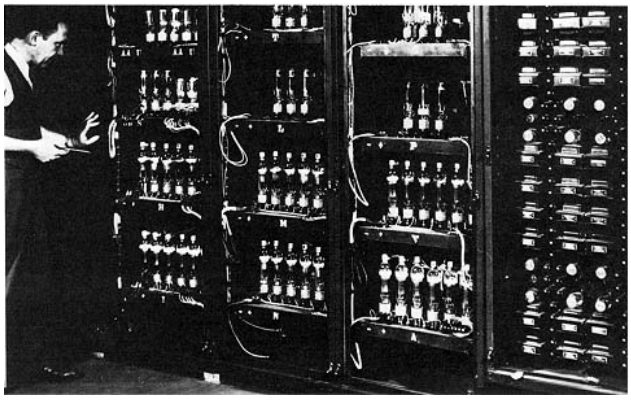
1. Decimal (not binary)
2. 20 accumulators of 10 digits
3. Programmed manually by switches
4. 18,000 vacuum tubes
5. 30 tons
6. 15,000 square feet
7. 140 kW power consumption
8. 5,000 additions per second

Electronic Numerical Integrator and Computer (ENIAC)

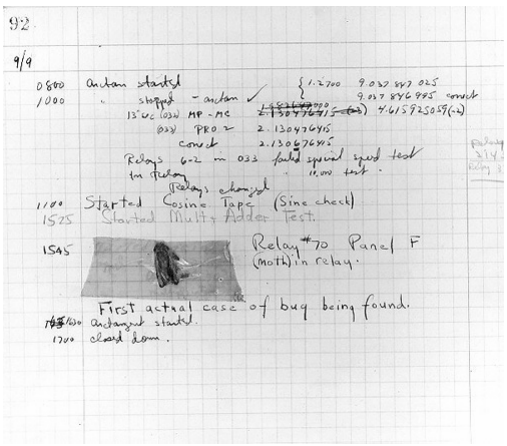




Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.



ENIAC Rear view (note vacuum tubes).



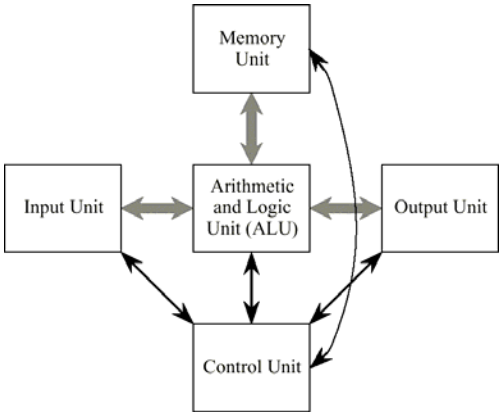
1945: The "Bug" is Born

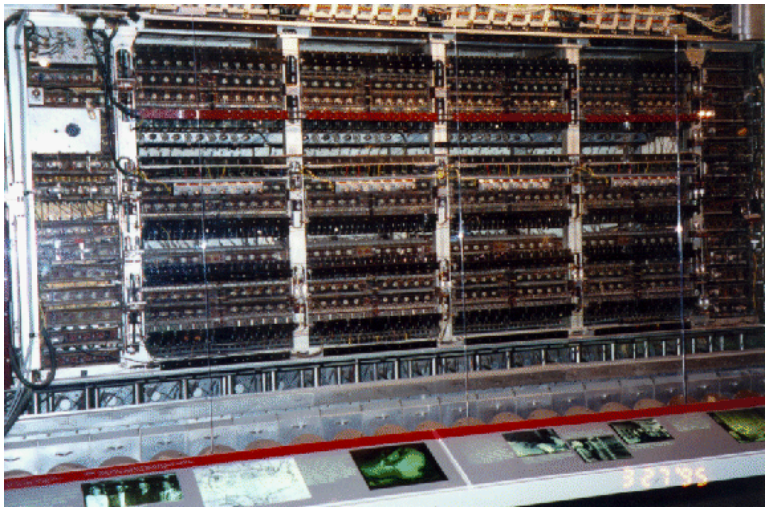
2 IAS computer - Princeton University's Institute of Advanced Studies (1952)

1. Von Neumann - ***Stored Program concept*** - Main memory storing both programs and data
2. ALU operating on ***binary data***
3. Control unit interpreting instructions from memory and executing
4. Input and output equipment operated by control unit

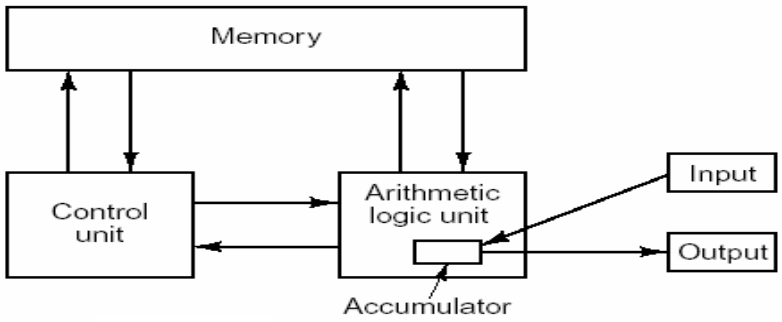
The von Neumann model consists of five major components:

(1) input unit; (2) output unit; (3) arithmetic logic unit; (4) memory unit; (5) control unit.





IAS Computer



The original von Neumann machine.

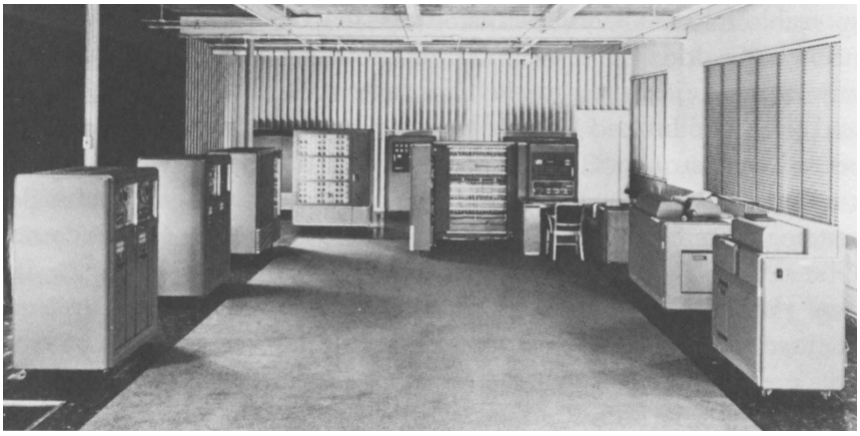
IAS - details

- 1000 x 40 bit words
  - Binary number
  - 2 x 20 bit instructions
- Set of registers (storage in CPU)
  - Memory Buffer Register
  - Memory Address Register
  - Instruction Register
  - Instruction Buffer Register
  - Program Counter
  - Accumulator
  - Multiplier Quotient

Commercial Computers

- 1947 - Eckert-Mauchly Computer Corporation
  - UNIVAC I (Universal Automatic Computer)
  - US Bureau of Census 1950 calculations
- IBM
  - Punched-card processing equipment
  - 701 is IBM's first stored program computer (1953)
  - Scientific calculations

The First General-Purpose Computer for *Commercial Use*: Universal Automatic Computer (UNIVAC).



The IBM 701 (1952) was IBM's first production computer.
It was designed primarily for scientific calculation

Second Generation - Transistor

Transistor was Invented 1947 at Bell Labs
William Shockley et al.

- Replaced vacuum tubes
- Smaller
- Cheaper
- Less heat dissipation
- Solid State device
- Made from Silicon (Sand)

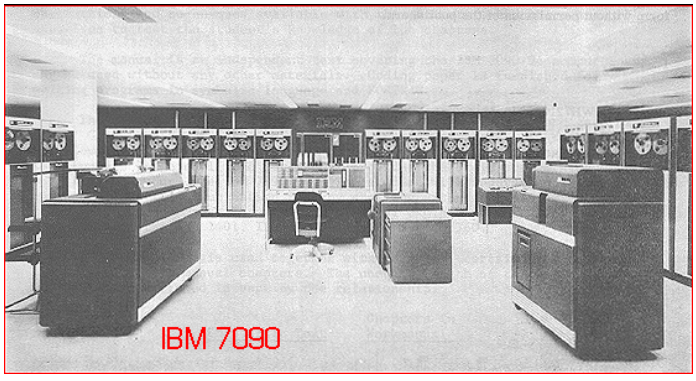
Digital Equipment Corporation (DEC)

PDP-1 of DEC (Programmed Data Processor 1)

- 4K memory
- VDU – **spacewar** first computer game

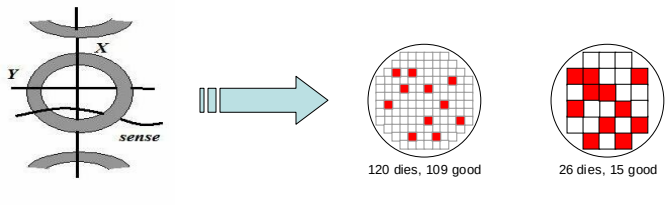
IBM 7000 series

The 7090 is a transistorized version of the IBM 709 which was a very popular high end computer in the early 1960s. The 7090 had 32Kbytes of 36-bit core memory and a hardware floating point unit. **Fortran** was its most popular language, but it supported many others.



Third Generation - IC

From Magnetic Memory to Semiconductor Memory



1. **IBM 360** - *First "family" of Computers*
2. **PDP 8** by DEC - *First Mini computer*

- IBM 360
  - First planned "family" of computers
  - Similar or identical instruction sets
  - Similar or identical O/S
  - Increasing speed
  - Increasing number of I/O ports (i.e. more terminals)
  - Increased memory size
  - Increased cost
  - multiprogramming

IBM 360 family

Property	Model 30	Model 40	Model 50	Model 65
Relative performance	1	3.5	10	21
Cycle time (nsec)	1000	625	500	250
Maximum memory (KB)	64	256	256	512
Bytes fetched per cycle	1	2	4	16
Maximum number of data channels	3	3	4	6

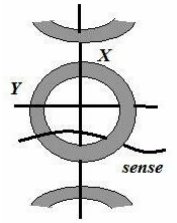
The initial offering of the IBM 360 product line.

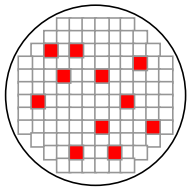
PDP 8 by DEC -
First Mini computer

The DEC PDP-12

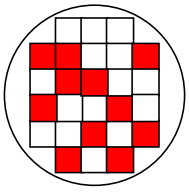
Magnetic Memory and Semiconductor Memory

1970 Fairchild
Size of a single core i.e. 1 bit of magnetic core storage
Holds 256 bits
Non-destructive read
Much faster than core
Capacity approximately doubles each year





120 dies, 109 good



26 dies, 15 good

Fourth generation - VLSI

1. CPU in a chip - **microprocessor**

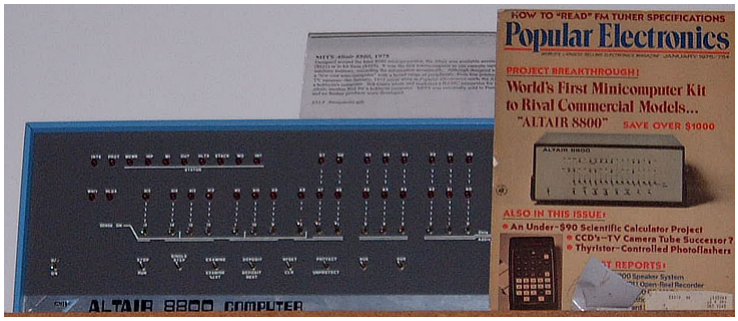
2. Personal computers
   1. IBM PC
   2. Apple
   3. commodore

3. Intel (integrated electronics)

MITS Altair 8800

The Altair 8800, from Micro Instrumentation Telemetry Systems (MITS) is considered by many to be the first mass produced personal computer, although they were called micro-computers in those days.

- The Altair 8800, the first PC



MITS Altair 8800

Announced: March 1975

Price: US $395 as a kit
US $495 assembled

CPU: Intel 8080, 2.0 MHz

RAM: 256 bytes, 64K max

Display: front panel LEDs

Controls: front panel switches

Expansion: card-cage with 16 card slots

Storage: external Cassette or 8" floppy drive

OS: CP/M, BASIC

IBM Personal Computer

Model: 5150
Released: September 1981
Price: US $3000
CPU: Intel 8088, 4.77MHz
RAM: 16K, 640K max
Display: 80 X 24 text
Storage: optional 160KB 5.25-inch disk drives
Ports: cassette & keyboard only
internal expansion slots
OS: IBM PC-DOS Version 1.0

The original IBM Personal Computer (PC)

History of Microprocessors

CPU IN A CHIP

Intel family of Chips

1. IN 1968 ROBERT **NOYCE** AND GORDON **MOORE** started INTEL (integrated Electronics) to make memory chips.

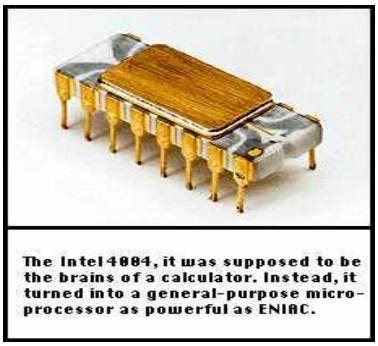
2. 1971 - **4004**
   1. ***First microprocessor***
   2. *All CPU components on a single chip*
   3. *4 bit*

3. Followed in 1972 by 8008
   1. *8 bit*

4004

In 1971, Busicom, a Japanese company, wanted a chip for a new calculator. With incredible o verkill, Intel built the world's first general-purpose microprocessor. Then it bought back the rights for $60,000.

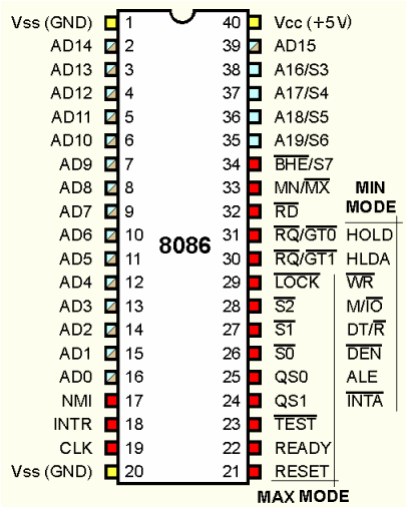
The 4-bit 4004 ran at 108 kHz and contained 2300 transistors

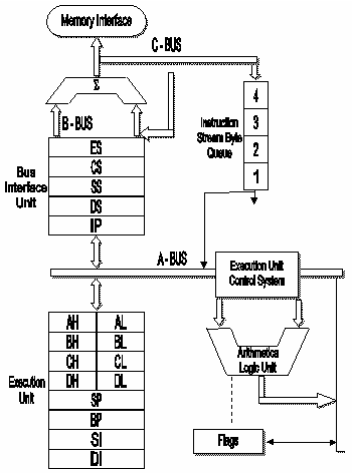


The Intel 4004, it was supposed to be the brains of a calculator. Instead, it turned into a general-purpose microprocessor as powerful as ENIAC.

- 1974 - 8080
  - Intel's first general purpose microprocessor
  - Both designed for specific applications
  - Used in first microcomputer Altair
- At the same time
  - Motorola 6800
  - Zilog 80

- Intel 8086
  - 16 bit
  - 20 bit address bus
- Intel 8088
  - 16 bit but external data bus 8 bit
- IBM PC
  - 8088 up
  - 16 K memory
  - 5 expansion slots for I/O cards





Microprocessor evolution

Chip	Date	MHz	Transistors	Memory	Notes
4004	4/1971	0.108	2,300	640	First microprocessor on a chip
8008	4/1972	0.108	3,500	16 KB	First 8-bit microprocessor
8080	4/1974	2	6,000	64 KB	First general-purpose CPU on a chip
8086	6/1978	5-10	29,000	1 MB	First 16-bit CPU on a chip
8088	6/1979	5-8	29,000	1 MB	Used in IBM PC
80286	2/1982	8-12	134,000	16 MB	Memory protection present
80386	10/1985	16-33	275,000	4 GB	First 32-bit CPU
80486	4/1989	25-100	1.2M	4 GB	Built-in 8K cache memory
Pentium	3/1993	60-233	3.1M	4 GB	Two pipelines; later models had MMX
Pentium Pro	3/1995	150-200	5.5M	4 GB	Two levels of cache built in
Pentium II	5/1997	233-400	7.5M	4 GB	Pentium Pro plus MMX

Moore's Law

Formulated by GordonMoore of IntelCorporation, it says (roughly) that chip density doubles every eighteen months. This means that memory sizes, processor power, etc. all follow the same curve.

"the doubling of transistors every couple of years, has been maintained, and still holds true today"

	Year of Introduction	Transistors
4004	1971	2,250
8008	1972	2,500
8080	1974	5,000
8086	1978	29,000
286	1982	120,000
Intel386™ processor	1985	275,000
Intel486™ processor	1989	1,180,000
Intel® Pentium® processor	1993	3,100,000
Intel® Pentium® II processor	1997	7,500,000
Intel® Pentium® III processor	1999	24,000,000
Intel® Pentium® 4 processor	2000	42,000,000
Intel® Itanium® processor	2002	220,000,000
Intel® Itanium® 2 processor	2003	410,000,000