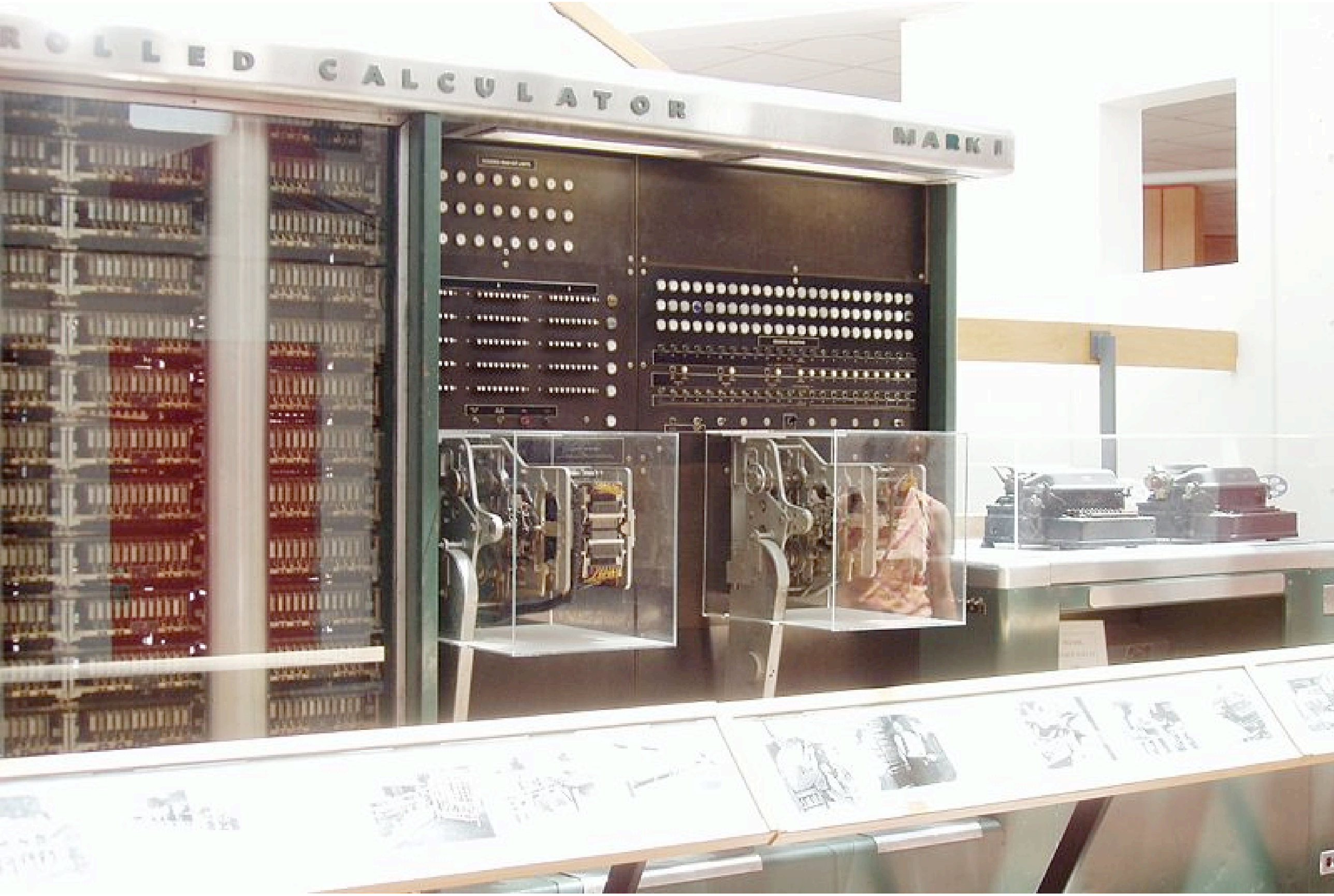
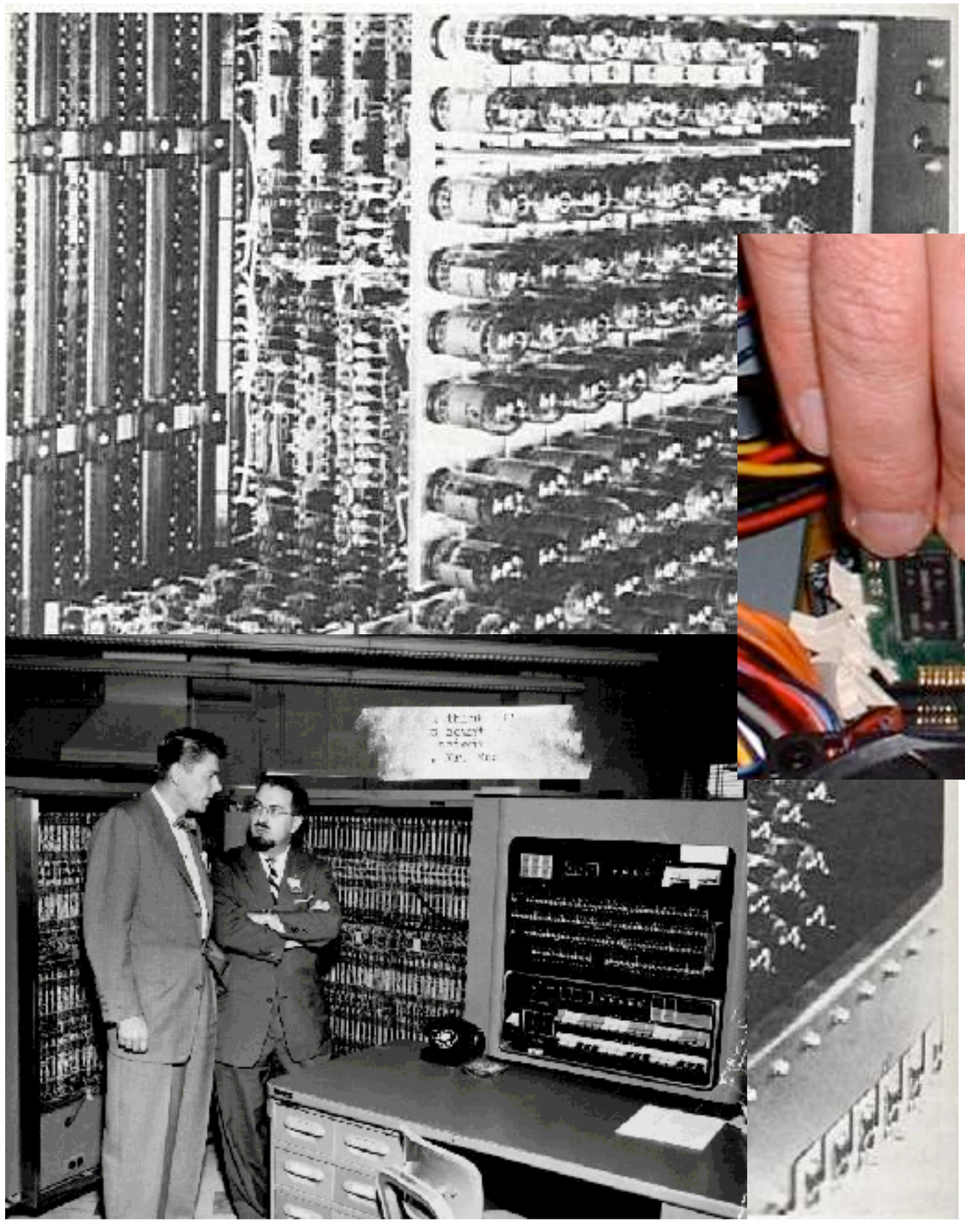
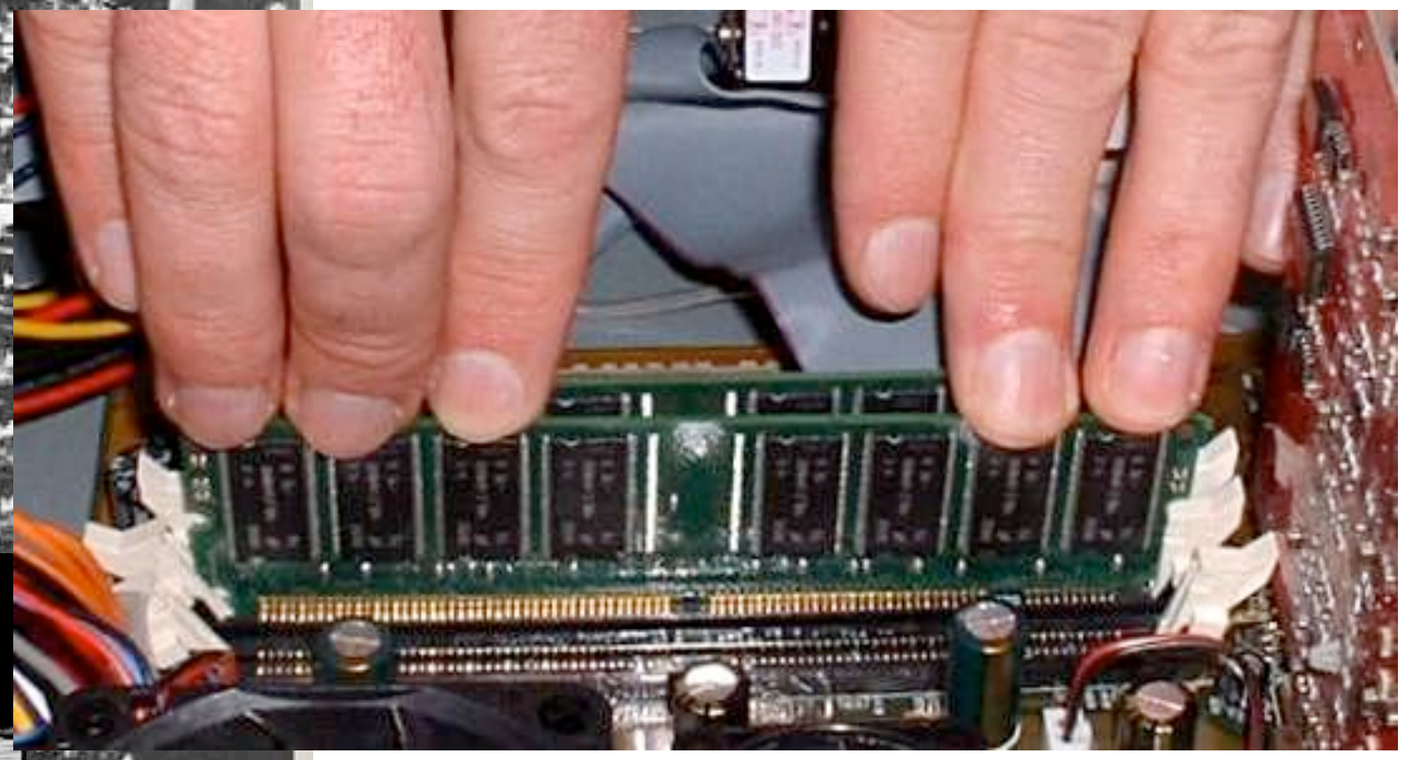
The Electronic Age

- electronically driven machines
- vacuum tubes (analog)
- logic circuits (digital)
- integrated circuit
- large-scale integrated circuit


CALCULATOR
MARK I



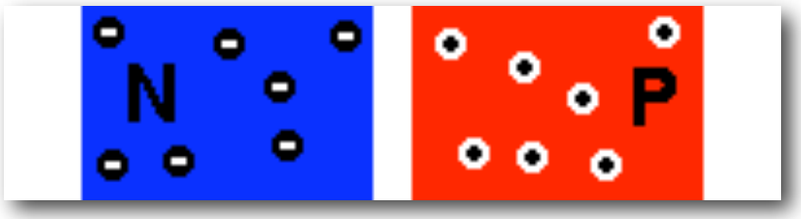
1.4K to 16 K

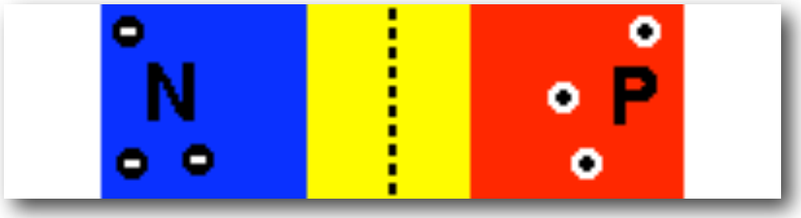


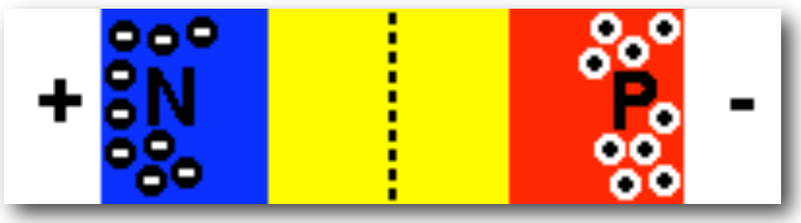
Appr. 100,000,000 times in capacity

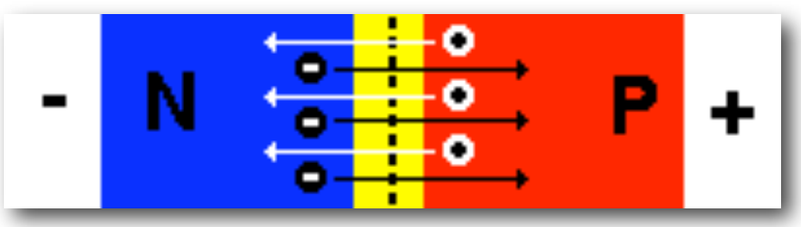
Silicon Crystal and Semiconductors

http://www.play-hookey.com/

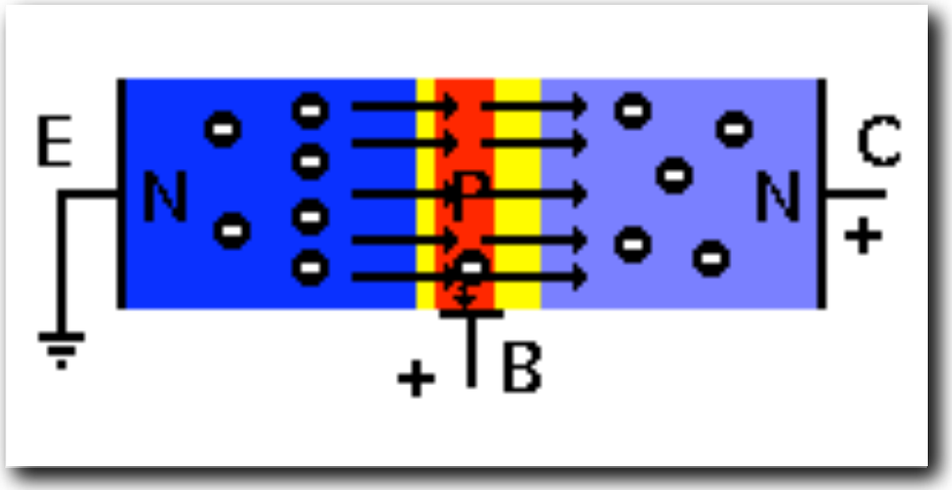


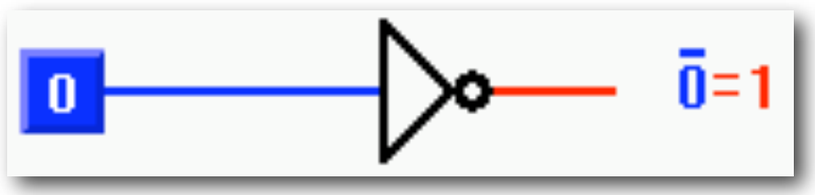




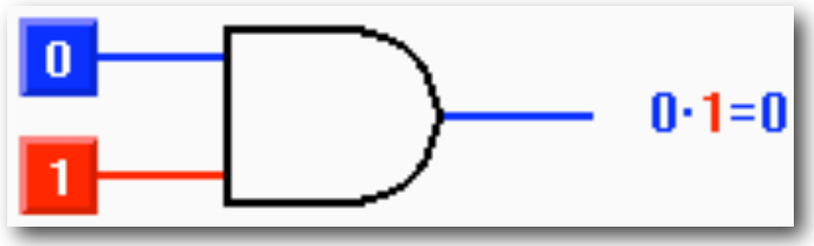


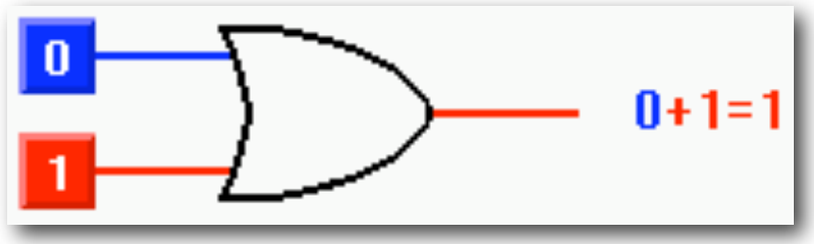
Transistors and NOT Gate

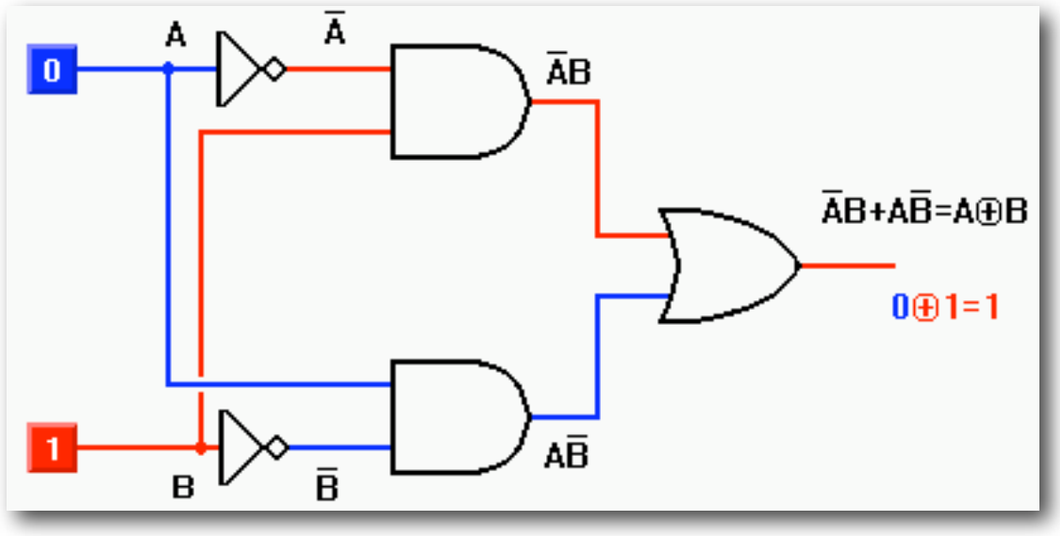




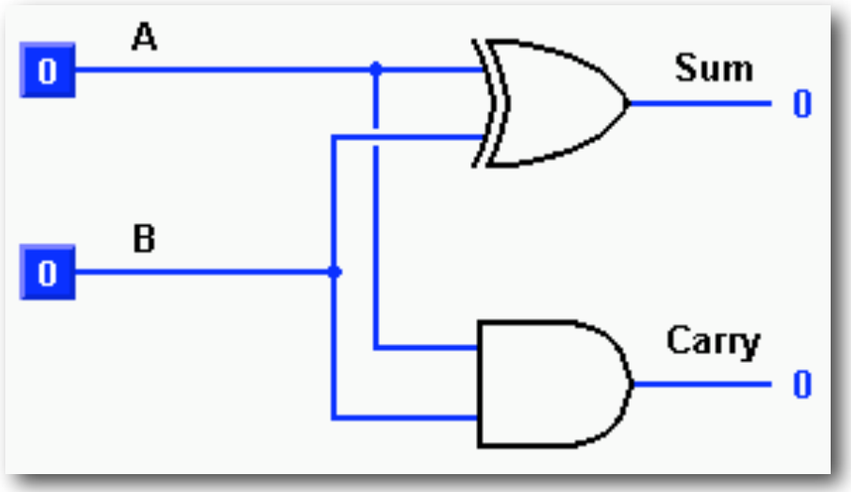
Diodes and AND/OR/XOR Gates







Binary Addition



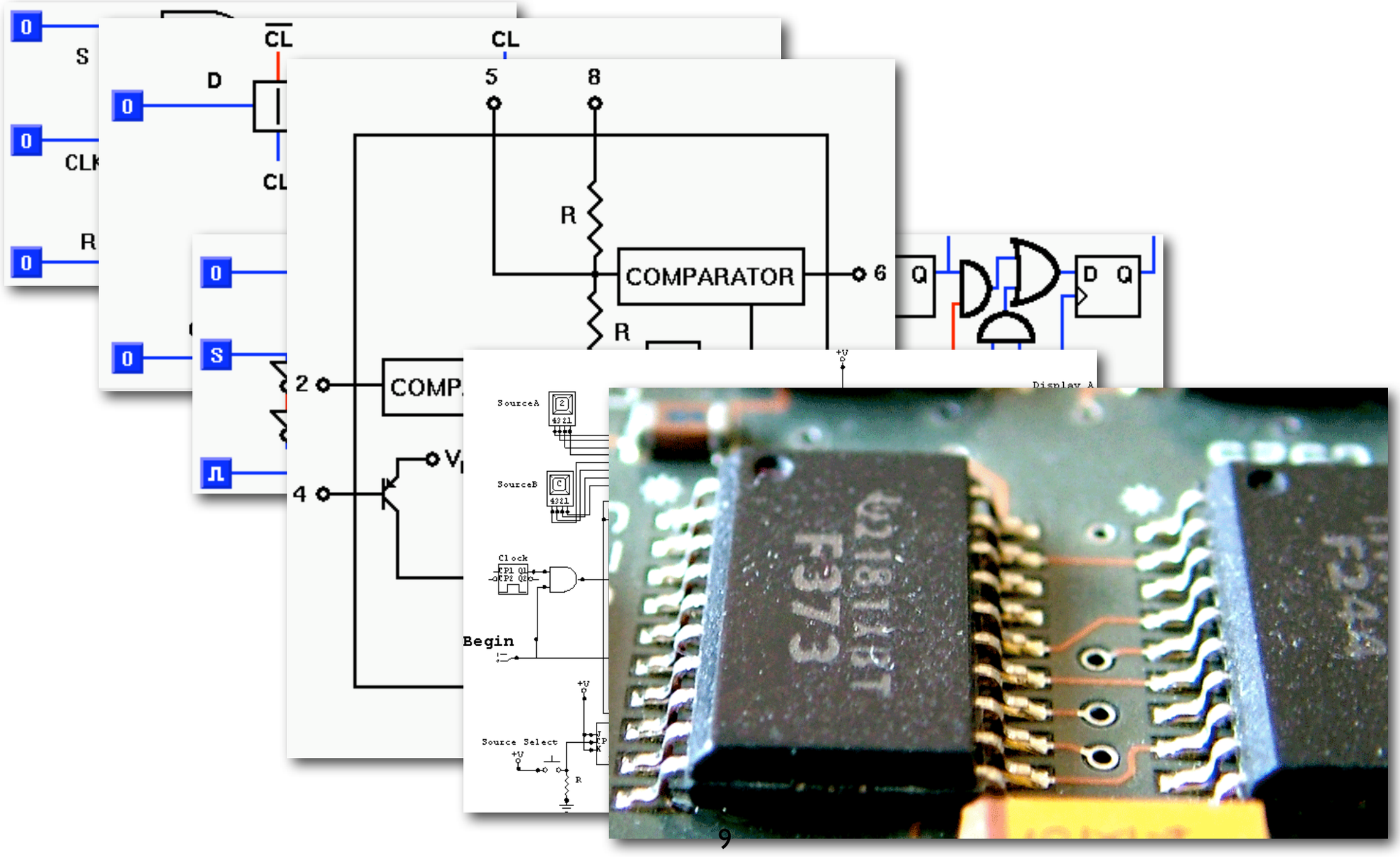
A	B	xl	xl
0	0	0	0
0	I	0	I
I	0	0	I
I	I	I	0

Plus a handful of theories...

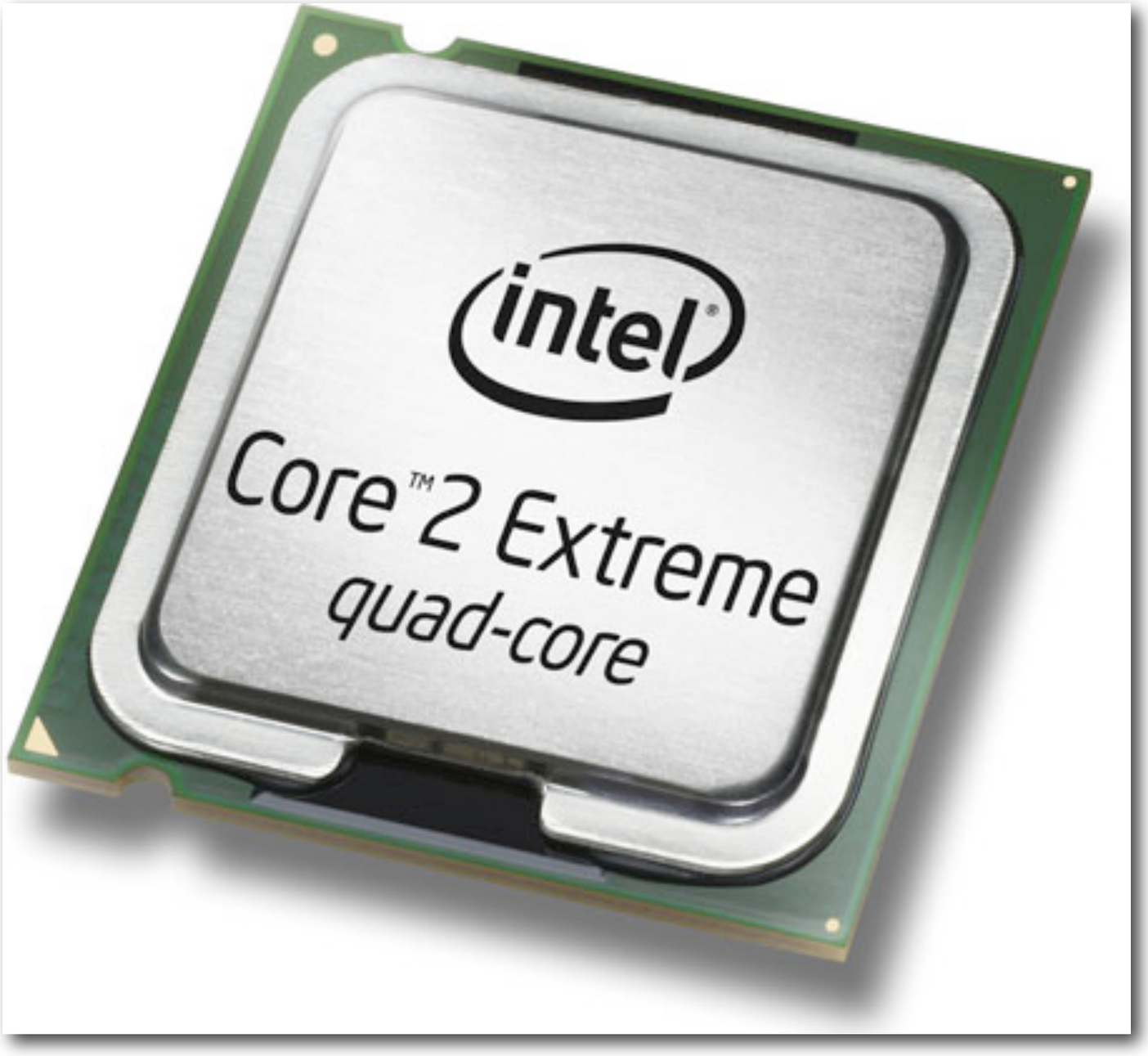
- De Morgan
  - $\overline{A \wedge B} = \overline{A} \vee \overline{B}$

A	B	$\overline{A}$	$\overline{B}$	$A \wedge B$	Left	Right
0	0	1	1	0	1	1
0	1	1	0	0	1	1
1	0	0	1	0	1	1
1	1	0	0	1	0	0

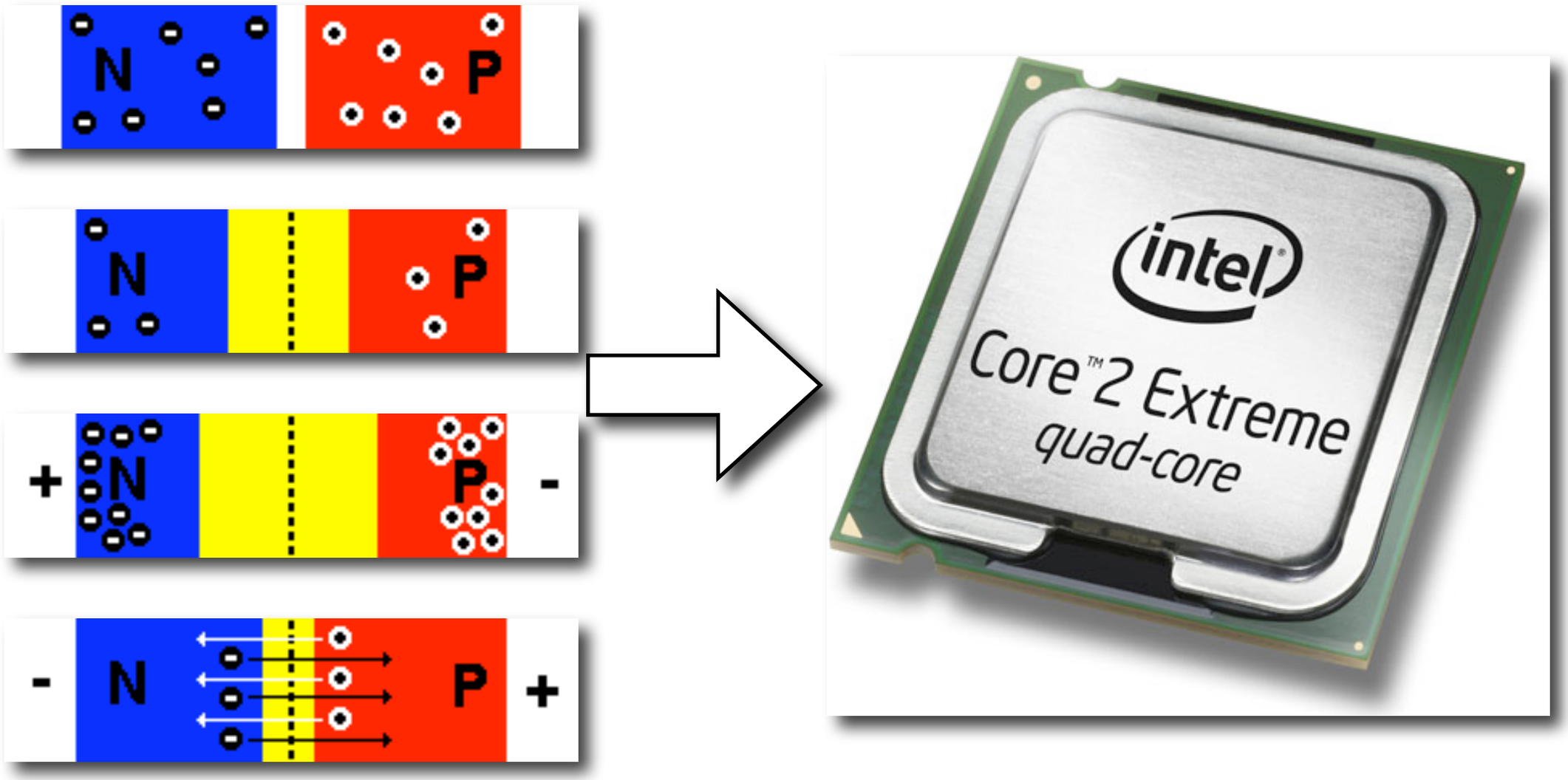
And a long, long journey...



TA-DA !



TA-DA !



The Evolution

Year	Clock Speed (MHz)	Instruction Rate (MIPS)
1992	200	200 (400)
1993.5	300	300 (600)
1995	400	800 (1600)
1996.5	500	1000 (2000)
1998	600	2400 (3600)
1999.5	700	2800 (4200)
2000	1000	?

Computer v.s. Human Brain

	Computer	Human Brain
Computational Units	1 CPU, 10^8 gates	10^{11} neurons
Storage Units	10^{11} bits RAM 10^{12} bits disk	10^{11} neurons 10^{14} synapses
Cycle time	10^{-9} sec	10^{-3} sec
Bandwidth	10^{10} bits/sec	10^{14} bits/sec
Memory updates/sec	10^9	10^{14}