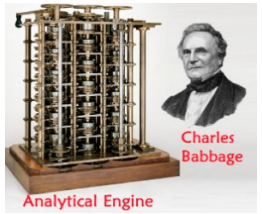
Setting the stage : a brief history

Ancient Era :

Ancient times, early cryptography(J. Cesar) , math tables

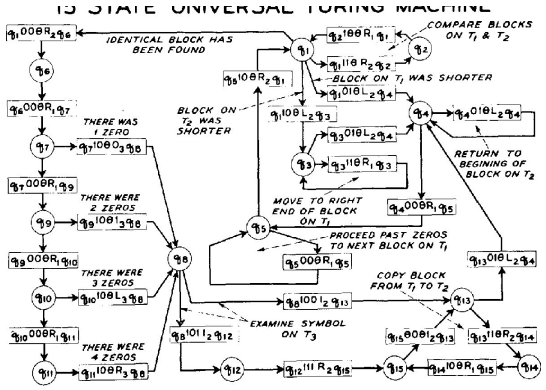
1837 : **Babbage (Cambridge UK)**: , mechanical analytical engine



1854: **Boole (Cork, Ireland),** Boolean logic

Modern Era :

=> 1937 : **Turing (Cambridge, UK & Princeton USA)**: universal finite state machine + unbounded tape/memory



=> 1939-1945 : **WW2,** Enigma, Colossus, Eniac

=> 1945 : **von Neumann (USA)**, *First Draft of a report on the EDVAC* (CPU, mem, I/O)

=>1953 : **Fermi-Pasta-Ulam (USA)** : the computer experiment, a new way of doing science

=> 1960s : the Business Machine

=> 1980s : the PC

=> 1990s : internet

=> 2010s : big tech

Modern computer architectures: evolution of hardware implementations

DATE	Logical Components	Memory	External Mem	Programming
1950	Vacuum Tubes	Experimental	Punched cards +Magnetic bands	Binary/Assembler
1959	Transistor	Magnetic cores (100bit /cm^2)	Cards, bands	First High level programming languages (e.g. Fortran)
1966	Integrated Circuits	Magnetic cores/ Rapid Disks	Cards, bands, disks	High level programming languages
1973	Microprocessor	DRAM Semiconductors (1024 bit /cm^2)	bands, disks, floppy	... adding graphical communications

Hardware : modern computer architectures

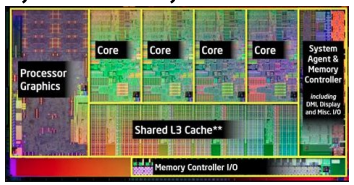
Despite huge amount of changes in scales the basic architecture remains similar since 1950s:

J. von Neumann architecture => CPU, Memory (data+program), I/O devices (storage, peripherals...), binary representation of numbers & Boolean logical operation.

Nowadays

1.- **CPUs** From valves to silicon transistors (Intel, AMD, NVIDIA) :

Multi-CPUs

MultiCore-CPUs : 

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GPUs for computing :

2. **Memory** from magnets to DRAM

3. **Storage** : from punched cards to internal storage, HardDrives and SolidStateDrives

4. From Individual machines to **distributed systems** - clusters connected via networks : **Cloud**, **HPC** (distributed storage, distributed computing, distributed memory)

cloud@VirtuaData
~ 15000 cores
~ 1PB storage

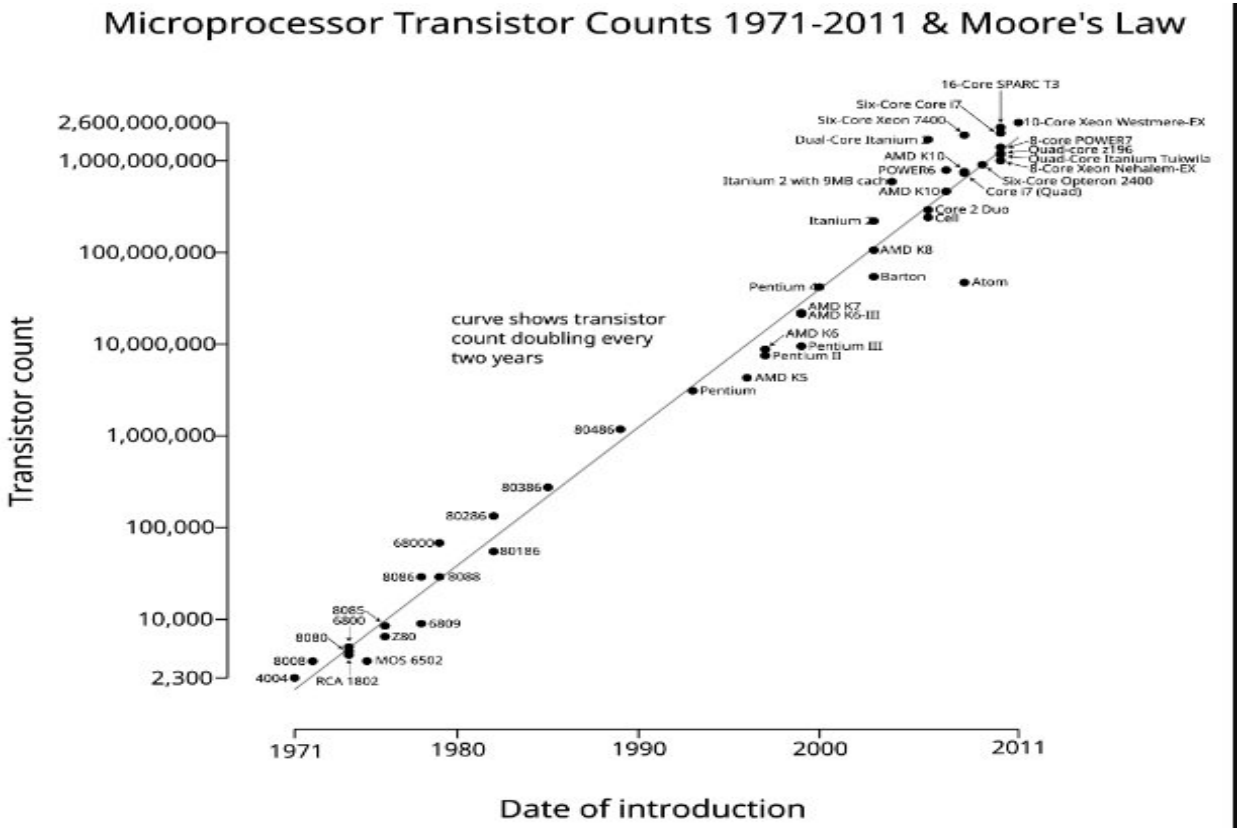
HPC Ruche
~ 10000 cores
~ 800 TFLOPs (GPUs double prec)

Hardware : Moore’s law - exponential growth trend

Moore’s Law : doubling of N transistors /surface

x 2 ~ every 2 years

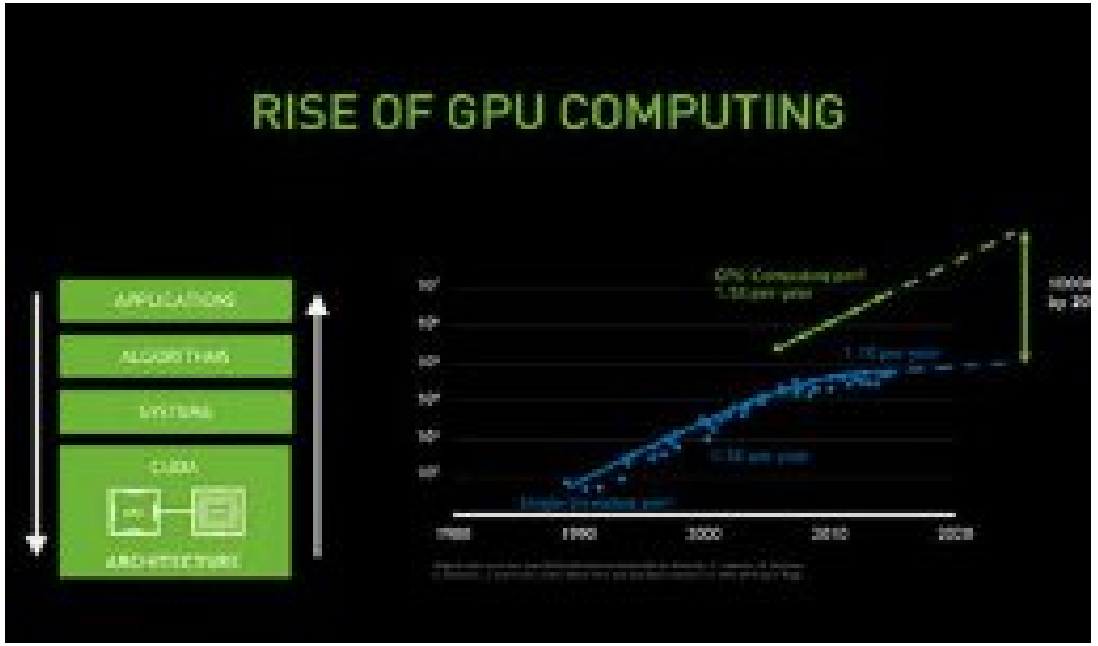
=> true until ~ 2015



a similar trend observed for memory (DRAM)

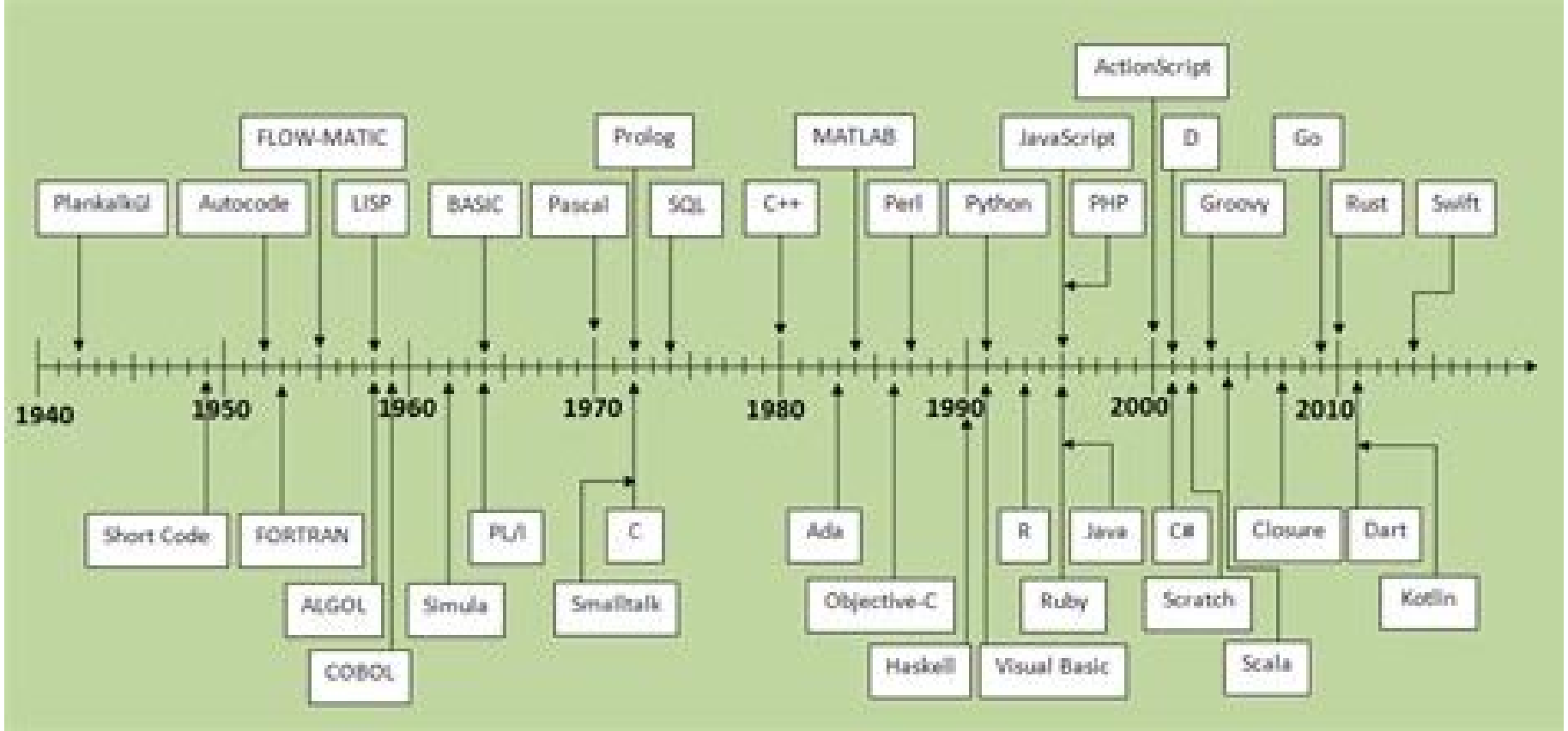
growth trend taken over by GPUs :

x 3 ~ every 2 years

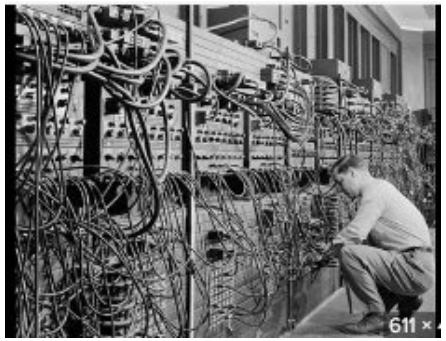


Software: operative systems and programming languages

Programming languages time-line



The “human” operating system



Some OS, relevant to us
=> 1969: UNIX (AT&T, Bell Labs)
=>1984 : Mac OS
=> 1985 : Microsoft Windows
=> 1991 : Linux

Software : high level programming languages paradigms

Programming paradigms

Imperative

Procedural programming :
(Fortran, C, ...)

Object oriented :
(Java, C++ ...)

Python
Rust
Scala
Javascript
Julia
OCaml
PHP
...

Declarative

Functional :
(Haskell,...)

Logic programming :
(Prolog, Datalog ...)

Database programming:
(SQL, SPARQL...)

Markup languages:
HTML,
XML,
...

Some useful references :

- **Histoire illustrée de l'informatique**, E. Lazard, P. Mounier-Kuhn, EDP science 2019
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- **Feynman lectures on computation**, *R. P. Feynman*, Westwiew Press, 1996
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- https://en.wikipedia.org/