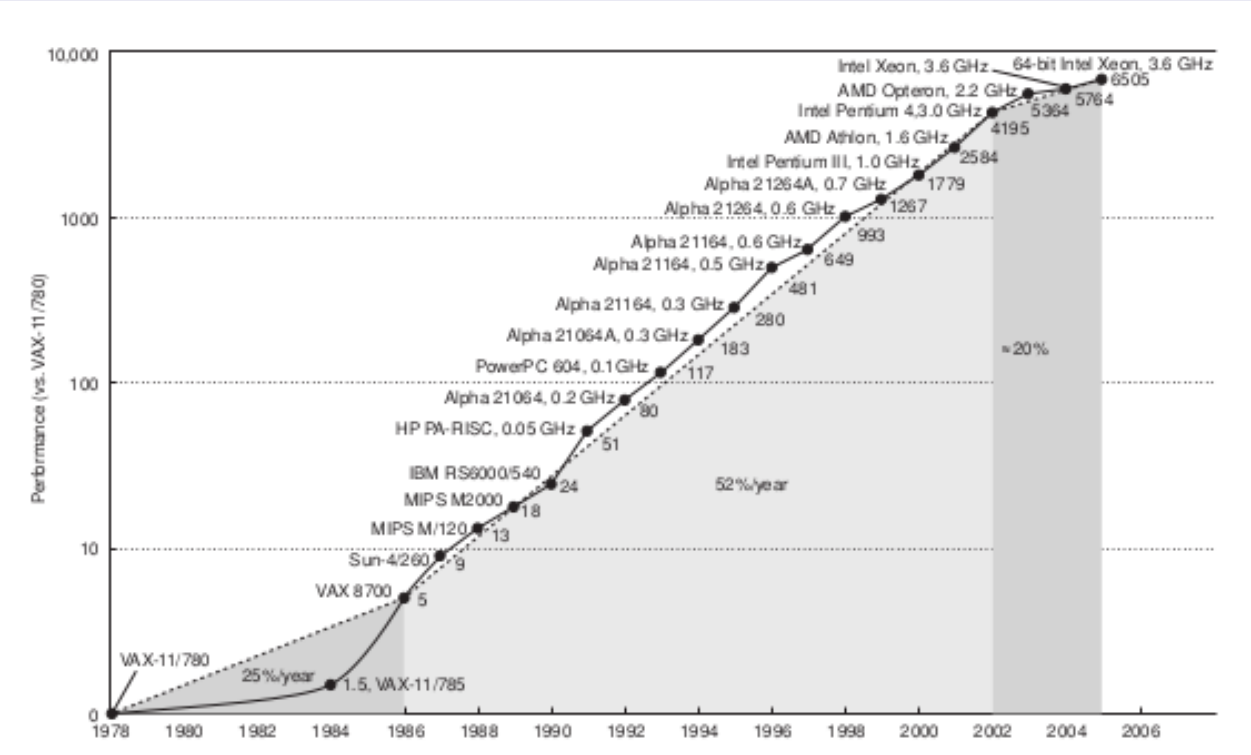
Intéraction Logiciel Architecture

Les performances et leur mesure

Henri-Pierre Charles & Frédéric Rousseau

Metrics Moore

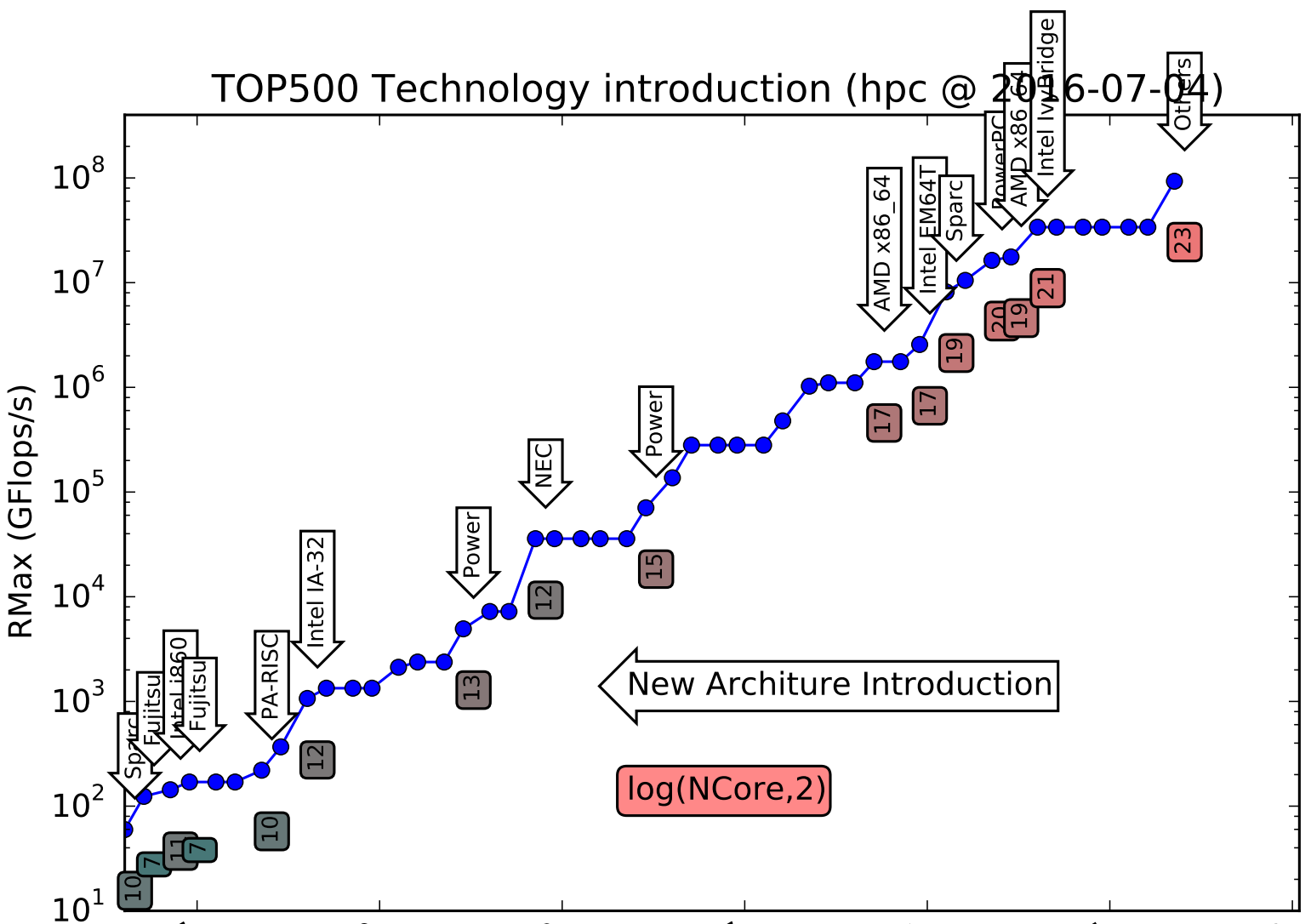
La loi de Moore



Growth in processor performance since the mid-1980s. This chart plots performance relative to the VAX 11/780 as measured by the SPECint benchmarks [Hennessy]

Metrics Top500

Evolution du TOP500



1. Motivation
   - Metrics Moore
   - Metrics Top500
2. Pourquoi
   - Metrics How to Measure Performance ?
   - Vocabulaire : Cycle par seconds / Flops
   - Vocabulaire Peak / Sustained
   - Vocabulaire Lois
   - Vocabulaire Speedup
   - Amdahl2
   - Vocabulaire Amdahl
3. Comment
   - Comment gprof
   - Comment PerfCounter
   - Comment JTAG
   - Comment gdb

Metrics How to Measure Performance ?

What scale ?

- Application level (TPS, Frame/s, .../)
- Run to completion
- Method level
- Instruction level

Tools

- Wall clock
- `gettimeofday`
- Performance counters

Full application or function call ?

- Cold start / warmup
- Statistic / multiple calls
- How many calls

Vocabulaire : Cycle par seconds / Flops

Units

Mips	Million operation per second
Flops	Floating point operation per second `http://www.top500.org`
Flops/Watt	Floating point operation per watt per second `http://www.green500.org`
IPC	: Instructions per Cycle

How to mesure

- Analytique (wall clock)
- Instrumentation
  - "Portable" (`gettimeofday()`)
  - Hardware (hardware performance counter)

Vocabulaire Peak / Sustained

Notions

Peak performance : maximal theoretical performance, assuming no bubble

Sustain performance : real acheived performance, on a real benchmark

Cost

- What is the percentage you're ready to lose ? 90% 95% ?
- How many are you ready to pay (time, money) to minimise this loss ?

`http://www.top500.org`

Vocabulaire Lois

- Moore `http://en.wikipedia.org/wiki/Moore's_law`
- Amdahl `http://en.wikipedia.org/wiki/Amdahl's_law`
- Memory bound `http://en.wikipedia.org/wiki/IO_bound`
- CPU bound `http://en.wikipedia.org/wiki/CPU_bound`

Vocabulaire Speedup

Notion

Speedup $S = 100 * \frac{T_{seq}}{T_{opt}}$

Can be between

- 1 and N processor
- 1 and vectorized
- non optimized versus optimized version

Mesure Quality what are the execution conditions : data set, computer workload, reproducibly, ...

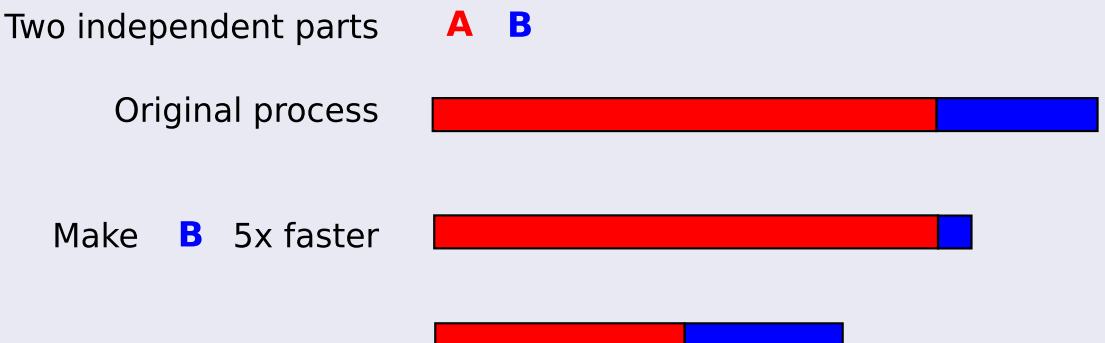
Computer science has to use “human science” tools & methodology

Amdahl2

Argumentation

Assume that a task has two independent parts, A and B. B takes roughly 25% of the time of the whole computation. By working very hard, one may be able to make this part 5 times faster, but this only reduces the time for the whole computation by a little. In contrast, one may need to perform less work to make part A be twice as fast. This will make the computation much faster than by optimizing part B, even though B's speed-up is greater by ratio, (5x versus 2x)

Illustration

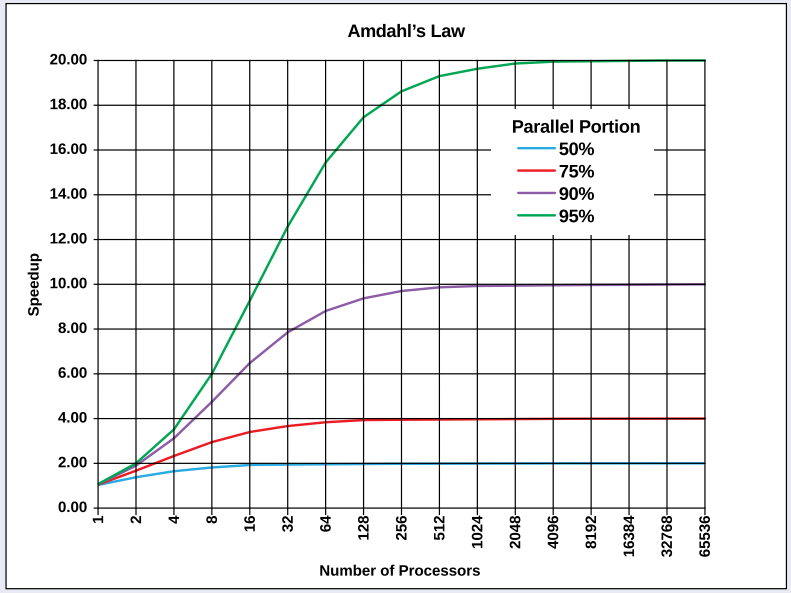


Vocabulaire Amdahl

Argumentation

The speedup of a program using multiple processors in parallel computing is limited by the sequential fraction of the program. For example, if 95% of the program can be parallelized, the theoretical maximum speedup using parallel computing would be 20x as shown in the diagram, no matter how many processors are used.

Illustration



Comment gprof

Argumentation

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Illustration

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