

Data Science for Actuaries (ACT6100)

Arthur Charpentier

Rappels # 4.6 (Convex Optimization)

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Floating-point Arithmetic

To study **computational time**, consider basic operations.

See **floating point operations (FLOP)** on wikipedia

A 3GHz processor can carry out 300 billions of flops (300 GFLOPS)

- ▶ operations $a + b$, $a - b$, ab , a/b (where $a, b \in \mathbb{R}$) = 1 flop
- ▶ addition $\mathbf{a} + \mathbf{b}$ (where $\mathbf{a}, \mathbf{b} \in \mathbb{R}^n$) = n flops
- ▶ inner product $\mathbf{a}^\top \mathbf{b}$ (where $\mathbf{a}, \mathbf{b} \in \mathbb{R}^n$) = $2n$ flops
- ▶ matrix product \mathbf{AB} ($m \times n$ and $n \times p$ matrices) = $2mnp$ flops
- ▶ solving $\mathbf{Ax} = \mathbf{b}$ in \mathbb{R}^n = (generally) n^3 flops
(for triangular matrix $\mathbf{A} = n^2$ flops)
(for orthogonal matrix $\mathbf{A} = 2n^2$ flops)
(for definite positive matrix $\mathbf{A} = 2n^2$ flops - via Cholesky
 $\mathbf{A} = \mathbf{LL}^\top$, solve $\mathbf{Ly} = \mathbf{b}$ and then $\mathbf{L}^\top \mathbf{x} = \mathbf{y}$)
- ▶ solving a least square problem = np^2 flops