



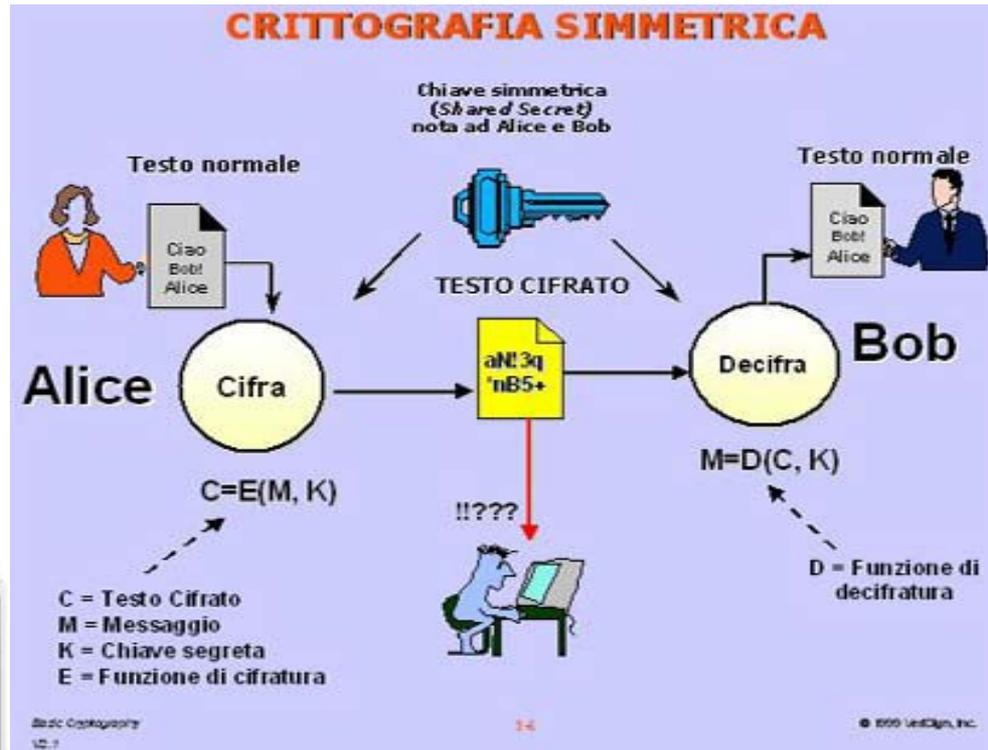
Nuovi algoritmi per il futuro: i matematici nel calcolo scientifico

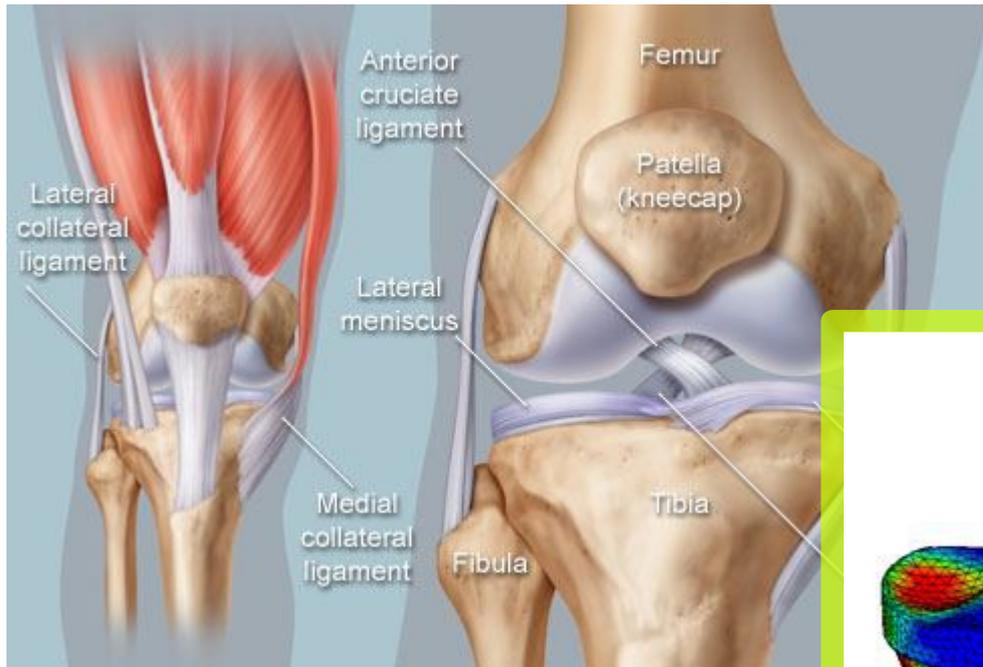
Matteo Semplice

*Dipartimento di
Matematica*

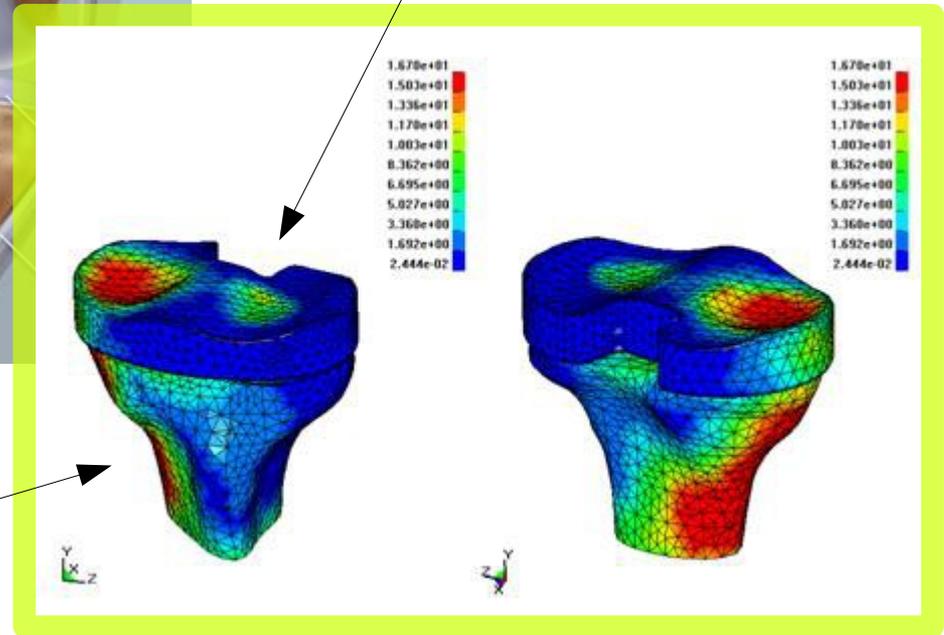


Algoritmi nella vita di tutti i giorni ... o quasi

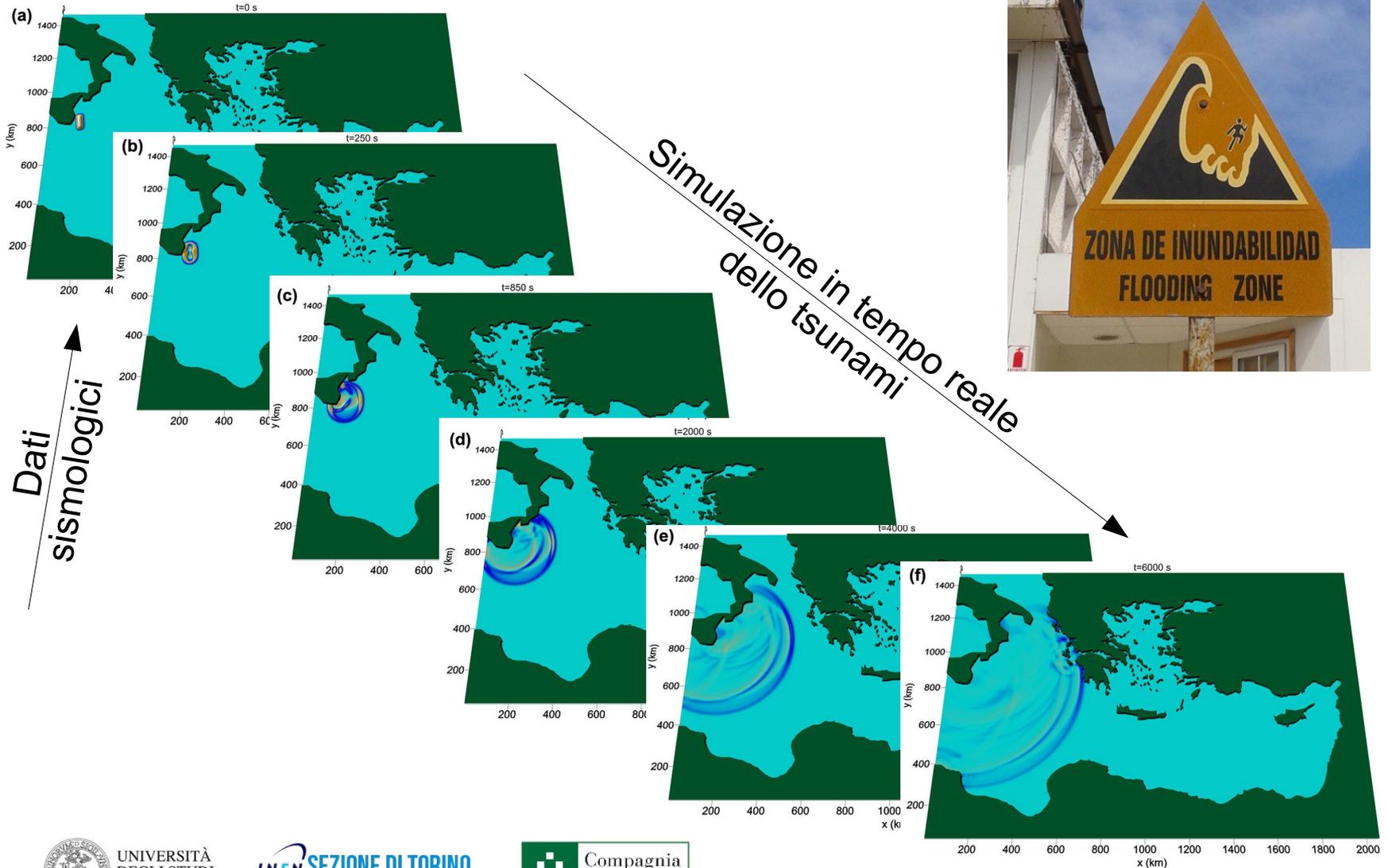




Protesi ipotizzata



Dati biometrici del paziente



Nel nostro simulatore il pilota in carne ed ossa guida un modello matematico della vettura su un modello matematico del circuito.

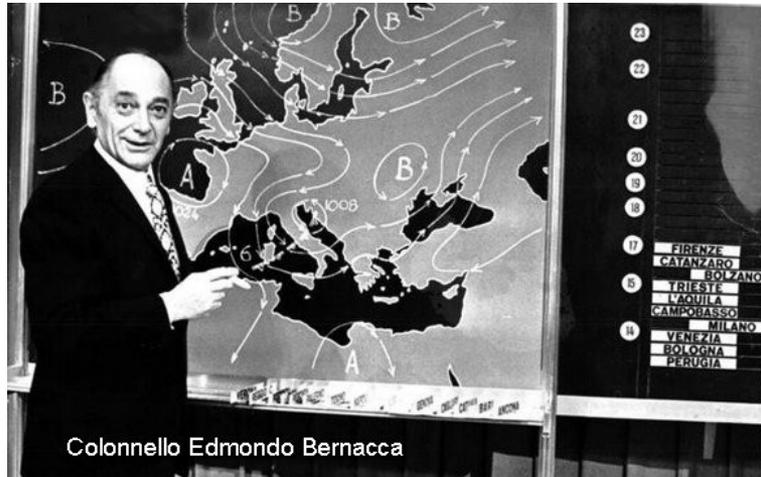
Lo sviluppo di una vettura da gara dura 9 mesi, di cui 8 passati al simulatore e 1 in galleria del vento

(CEO Dallara al Congresso SIMAI 2016)



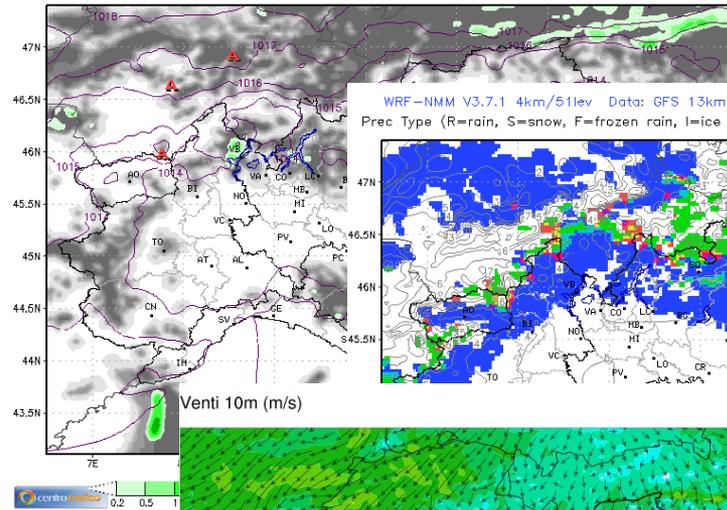
(<http://www.dallara.it/>)

Anni '80

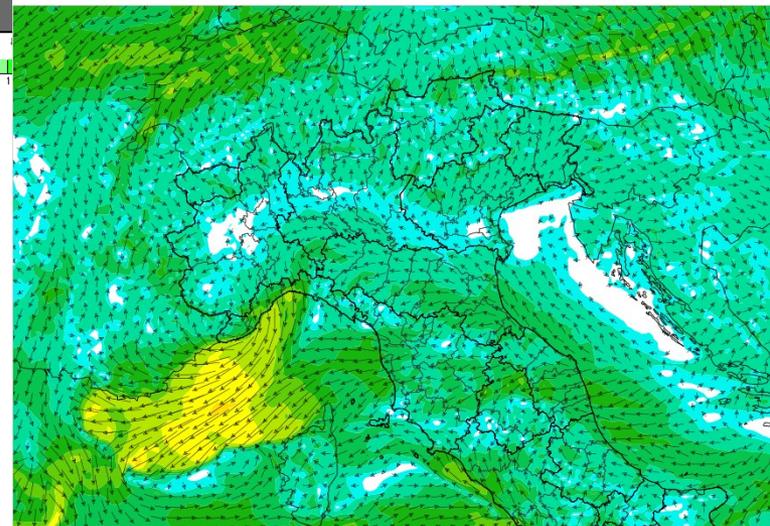
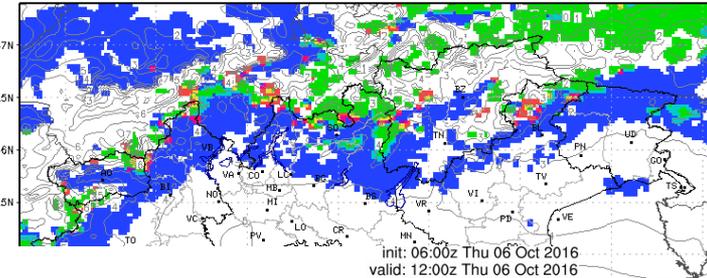


Anni 2000

WRF-NMM V3.7.1 4km/51lev Data: GFS 13km, SST 8km, 3DVAR Init: Thu 12Z 06-10-2016
Acc Prec (mm/3h), Cloud Cover & MSLP (hPa) Valid: Fri 09Z 07-10-2016



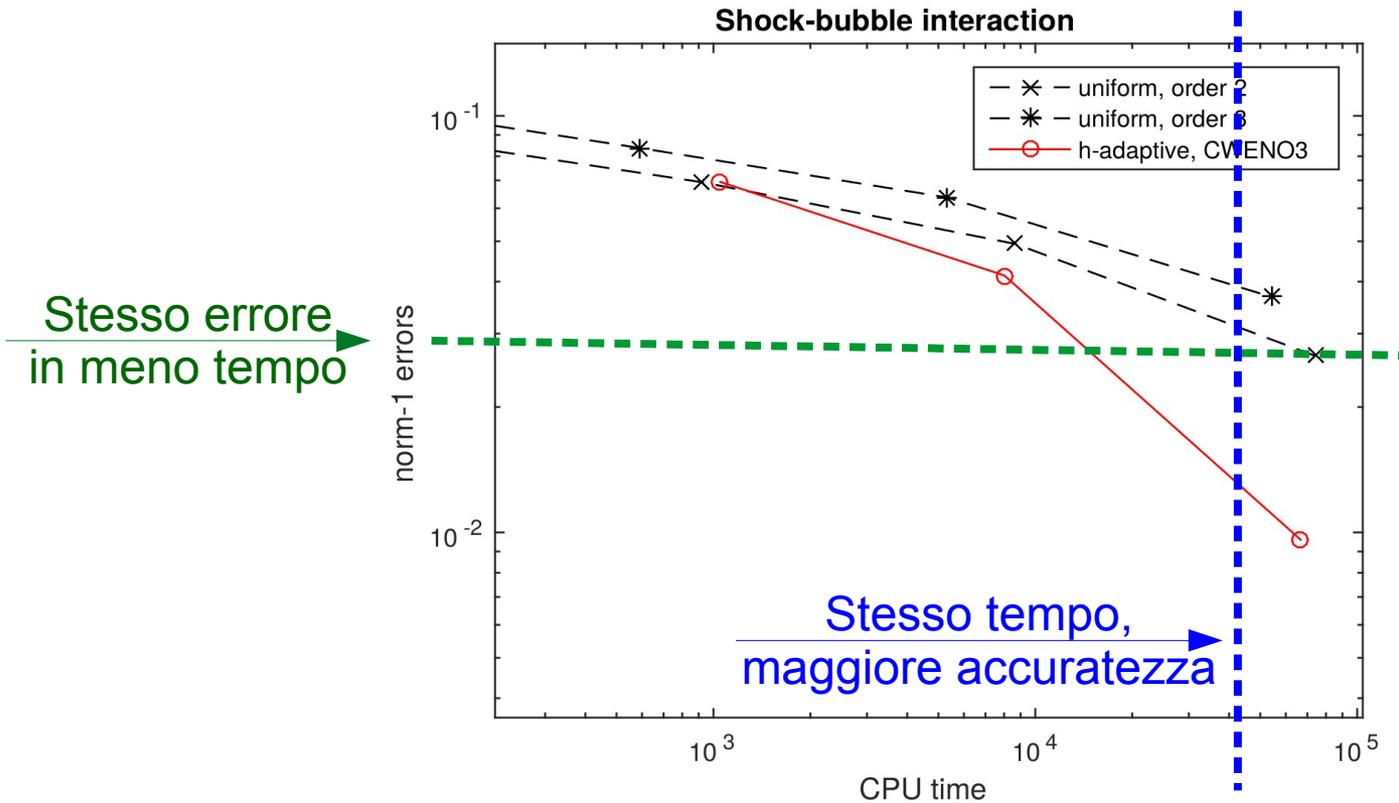
WRF-NMM V3.7.1 4km/51lev Data: GFS 13km, SST 8km, 3DVAR Init: Thu 12Z 06-10-2016
Prec Type (R=rain, S=snow, F=frozen rain, I=ice pellets) & 850hPa T Valid: Fri 00Z 07-10-2016



1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30



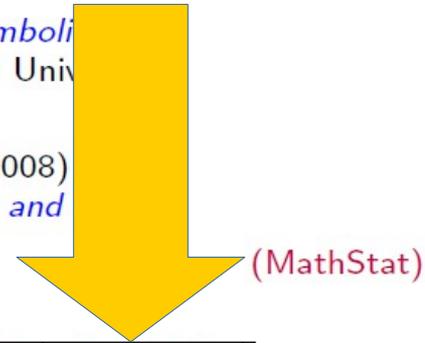
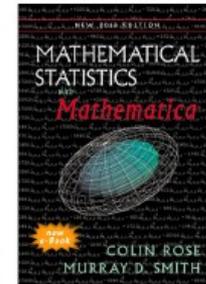
I matematici contribuiscono algoritmi
innovativi



M. Semplice, A. Coco and G. Russo - Adaptive Mesh Refinement for Hyperbolic Systems based on Third-Order Compact WENO Reconstruction - J. Sci. Comput.(2016)

(A&S) Andrews, D.F. and Stafford, J.E. (2000) *Symbolic computation for statistical inference*. Oxford University Press.

(Symbolic) Di Nardo, E., Guarino, G. and Senato, D. (2008) *unifying framework for k -statistics, polykays and multivariate generalizations*. Bernoulli.



<i>k</i> -statistics	A&S	MathStat	Symbolic
k_5	0.06	0.01	0.01
k_7	0.31	0.02	0.01
k_9	1.44	0.04	0.01
k_{11}	8.36	0.14	0.01
k_{14}	396.39	0.64	0.02
k_{16}	57982.4	2, 63	0.08
k_{18}	—	6.90	0.16
k_{20}	—	25.15	0.33
k_{22}	—	81.70	0.80
k_{24}	—	359.40	1.62
k_{26}	—	1581.05	2.51
k_{28}	—	6505.45	4.83

PC Pentium(R)4, Intel(R)

CPU 2.08 Ghz

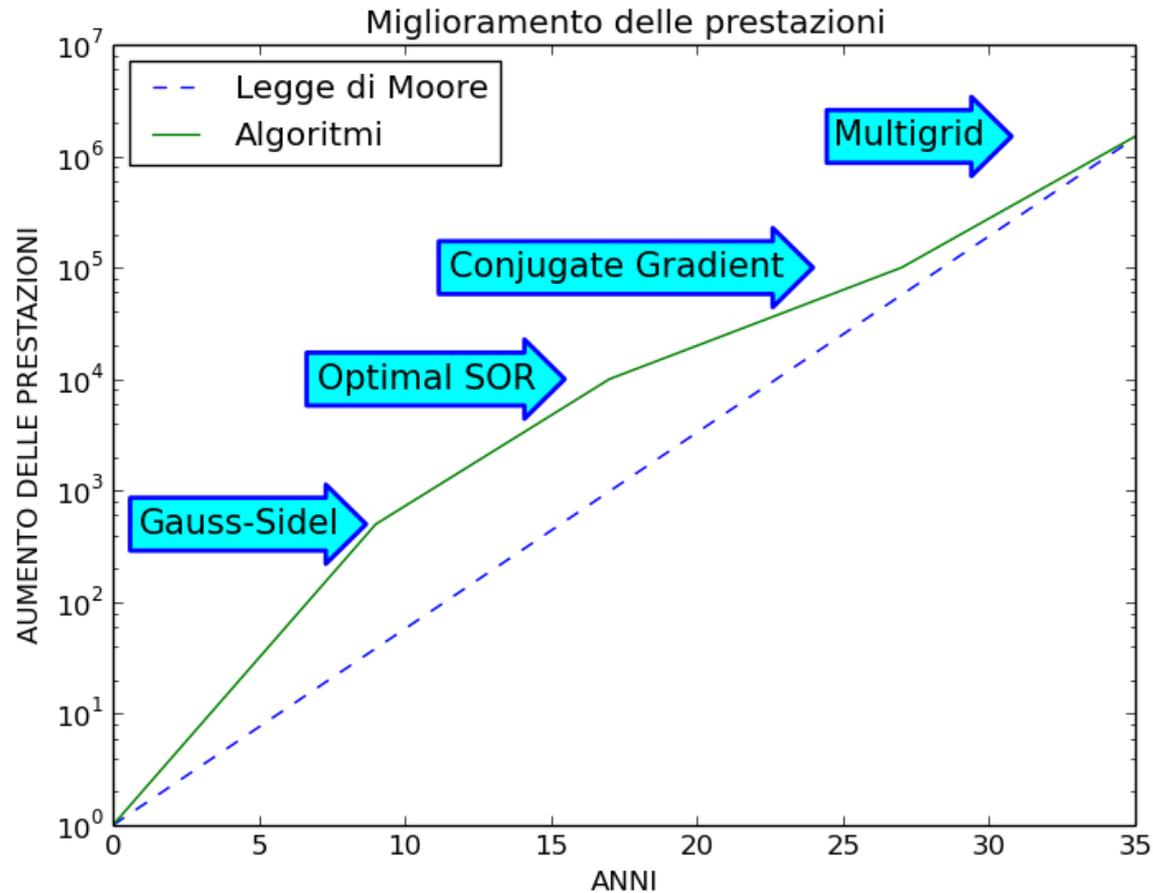
512MB Ram

Maple 10.0

Mathematica 4.2

Times in seconds

Algebra lineare vs legge di Moore



(USA President's IT advisory committee, 2005)

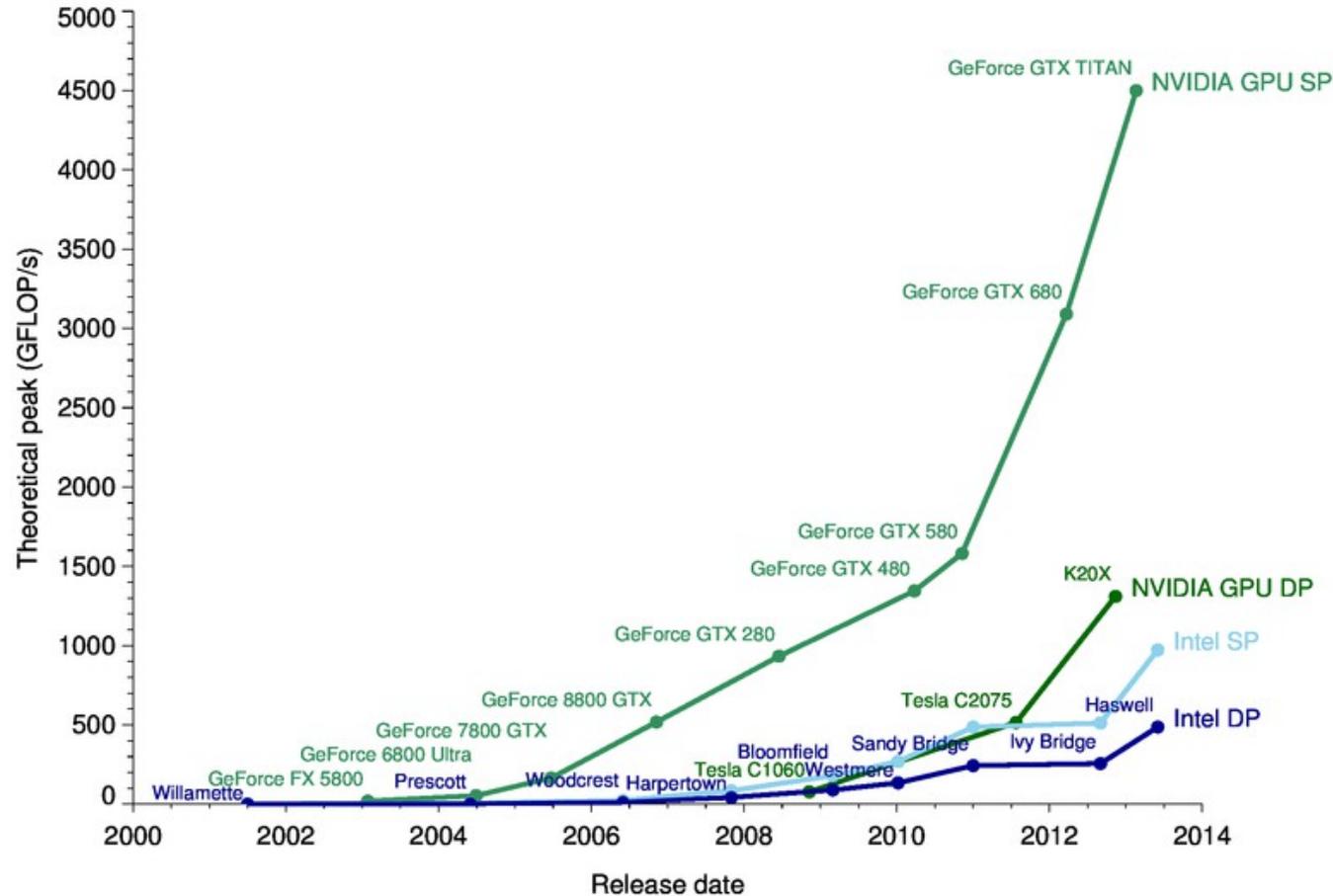


La simbiosi fra algoritmo e calcolatore

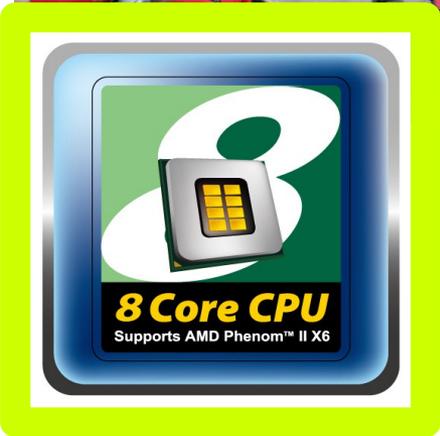
Seriale o parallelo?



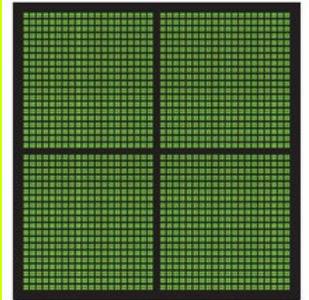
Schede grafiche: GFLOPS/s teorici



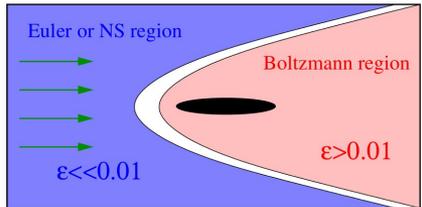
Indipendenti ma coordinati



Obbligatoriamente all'unisono



GPU
THOUSANDS OF CORES



Fast Spectral Scheme (FSS)

Naive question : Is it worth the pain ?



Efficient deterministic numerical scheme to solve Boltzmann equation in 7D

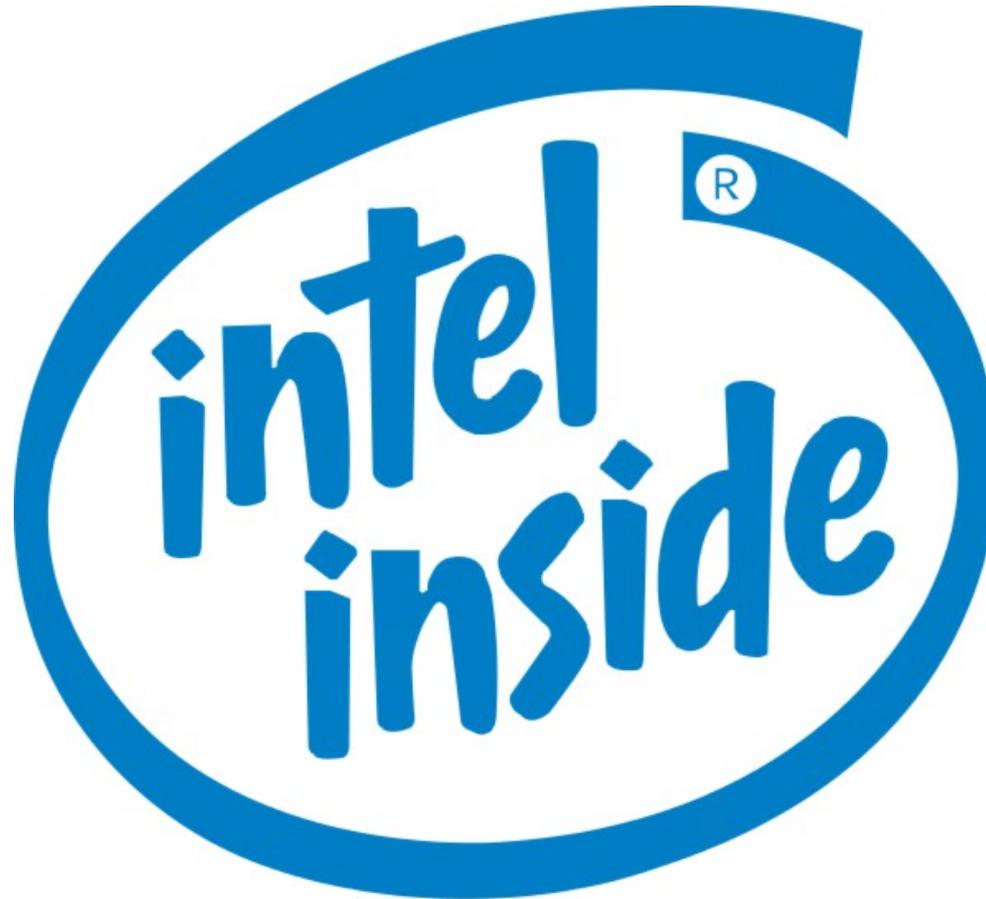
G. Dimarco², R. Loubère¹, J. Narski¹, T. Rey³

Cost $\sim O(AN \log_2 N)$ and brute force (N^2) , with $(N = 16^d, 32^d, 64^d, A = 8^{d-1})$

- 60% Nuova formula
- 40% Accelerazione con GPU

	Ratio	T(s)	T
13		0.005	0.066s
2		0.025	1.05s
2		0.12	16.8s
9×10^5		0.24	tomorrow (19h)
1.5×10^7		2.37	15/12/2017 (9800h)
7.9×10^8		22.72	21/03/2638(620y)

Grazie per l'attenzione!



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