INSTITUT NATIONAL
DE RECHERCHE
EN INFORMATIQUE
ET EN AUTOMATIQUE

centre de recherche
SACLAY - ÎLE-DE-FRANCE

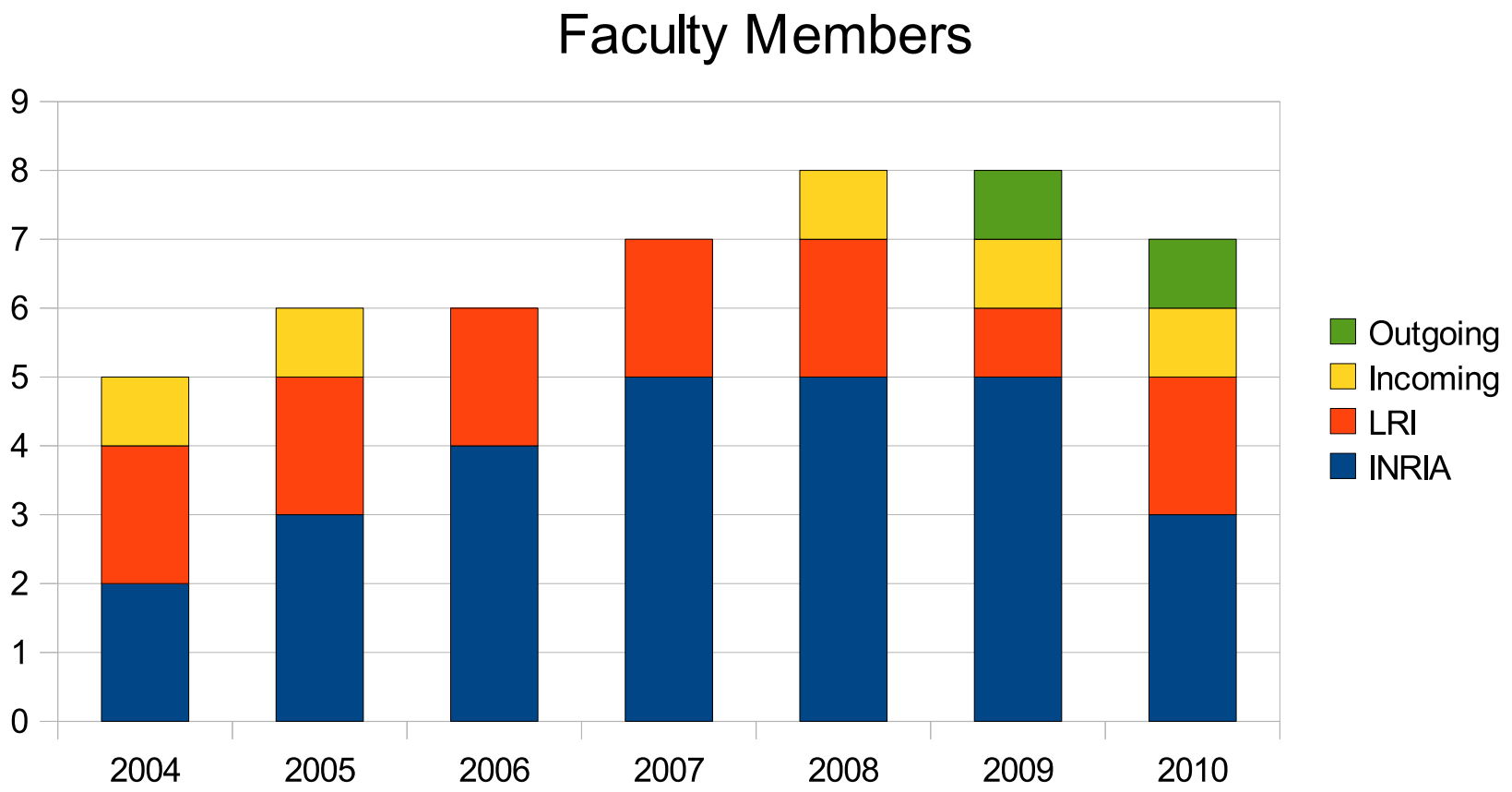
Équipe Alchemy

Responsable: Olivier Temam
Presentation: Albert Cohen

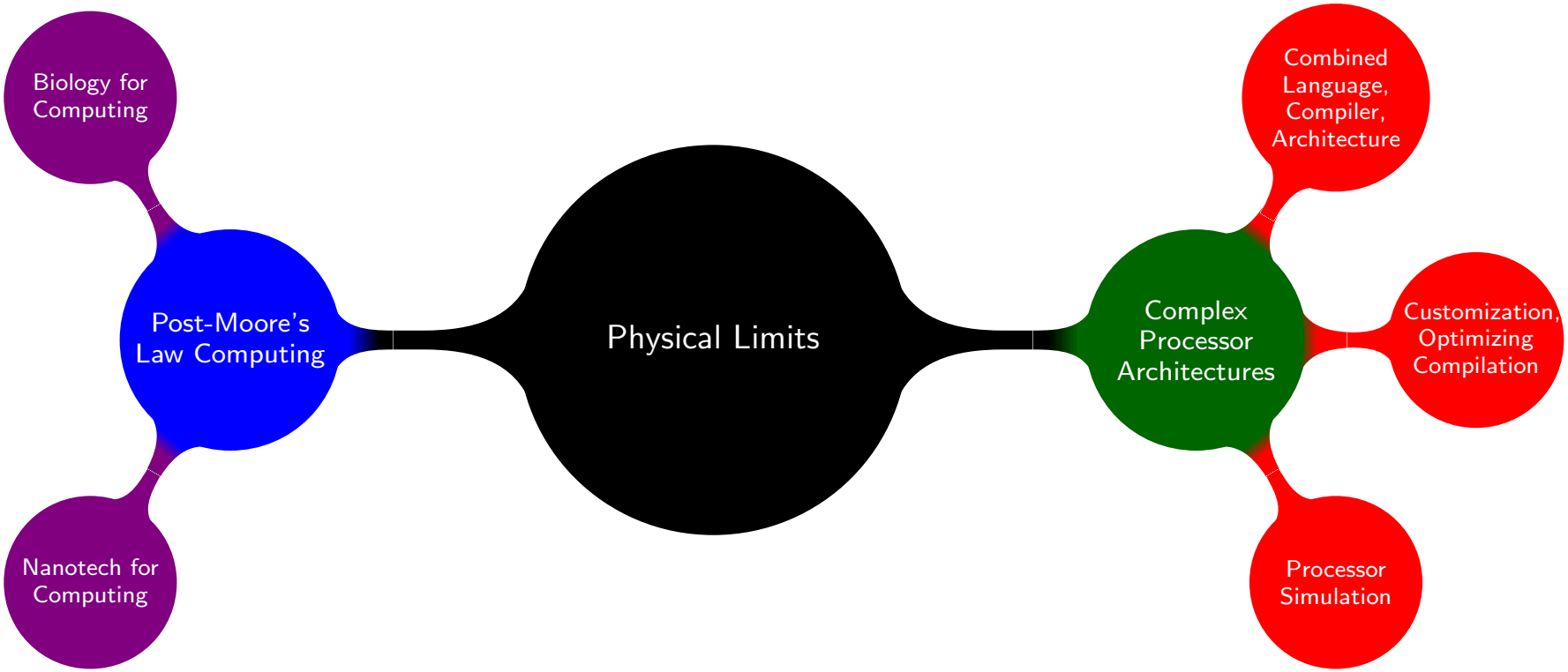
Accord INRIA Université Paris-Sud 11

Alchemy in a Nutshell: People

Currently 27: 6 faculty, 14 PhD students, 3 postdocs, 2 engineers, 2 interns



Alchemy in a Nutshell: Research

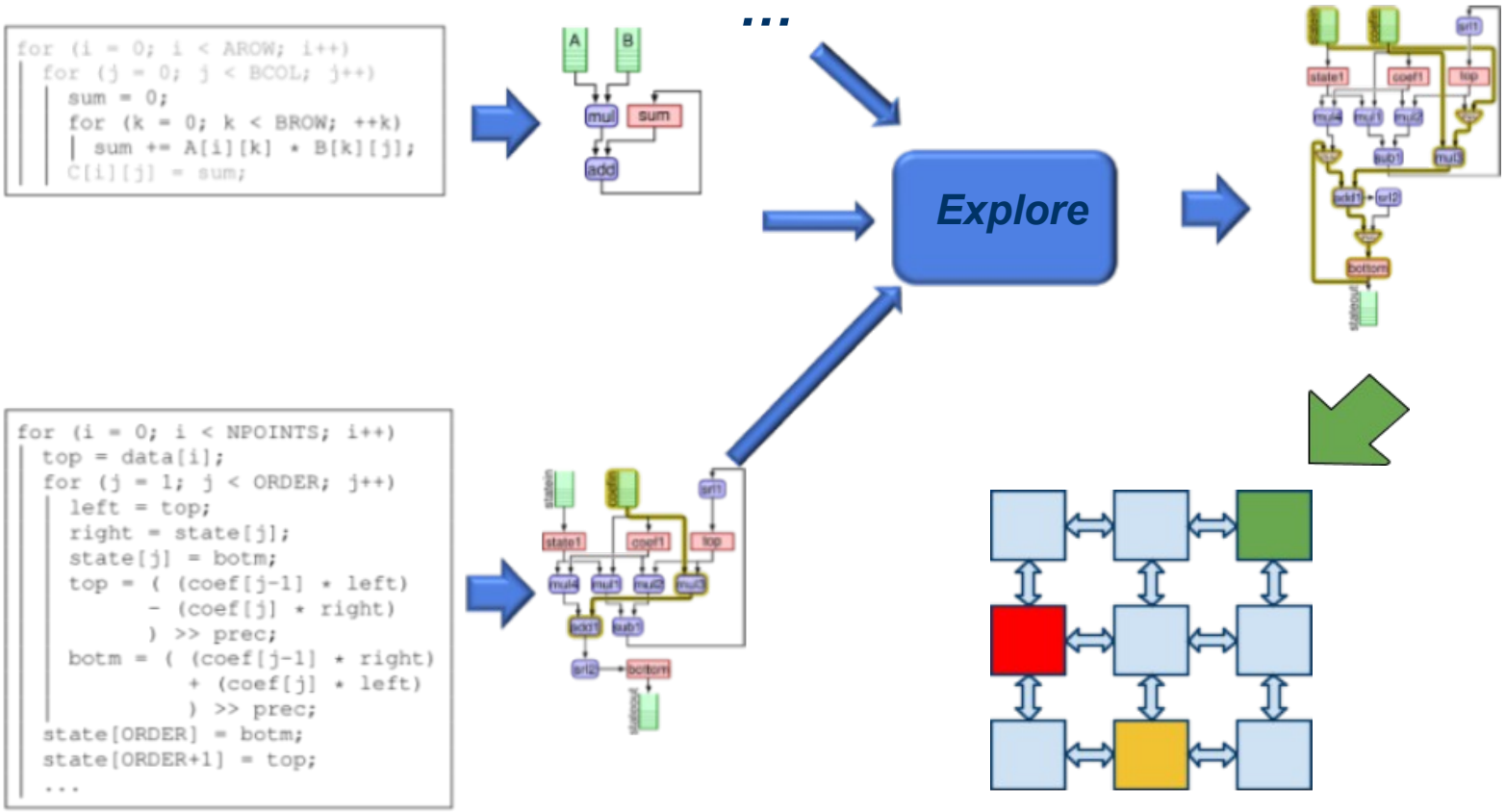


Long term

Short term
+ Major research platform investment

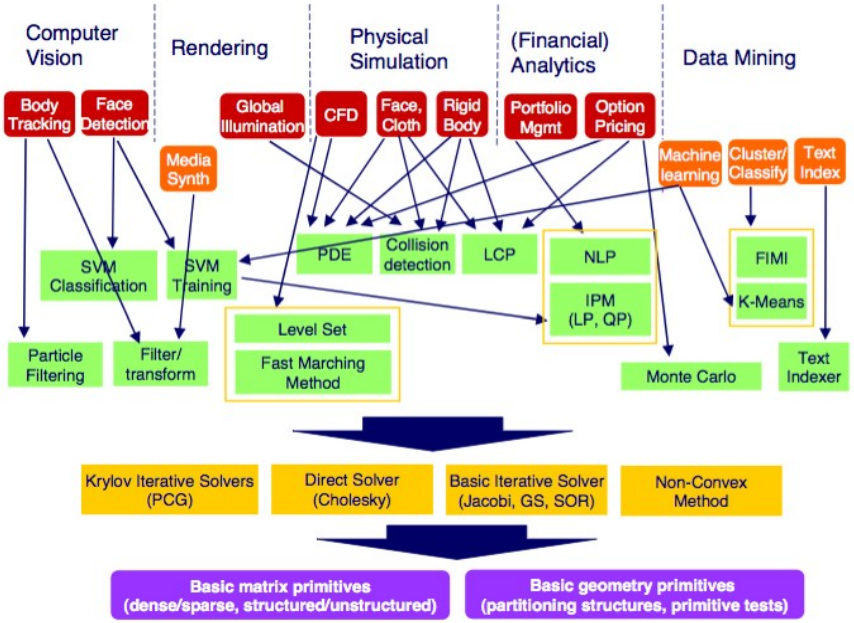
An Industry Collaboration Highlight

Generation of hardware accelerators through automatic customization



A Multi-Disciplinary Research Success

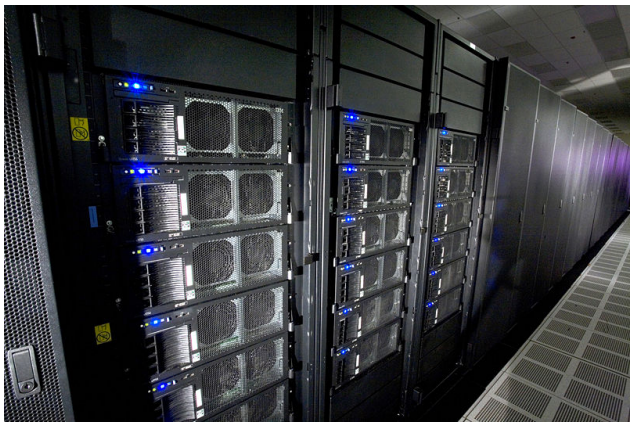
Neuromorphic computer architectures, artificial neural networks



Memristor

Collaboration with Hugues Berry
Assistant Professor in Biology in Cergy → INRIA Research Scientist

INRIA + Paris-Sud Successes



PetaQCD: with IN2P3, petaflop lattice quantum chromodynamics on heterogeneous architectures

n-Synchronous Kahn Networks: with Marc Pouzet and Louis Mandel from LRI (and the PROVAL team), from correctness by construction to correctness and high-performance by construction

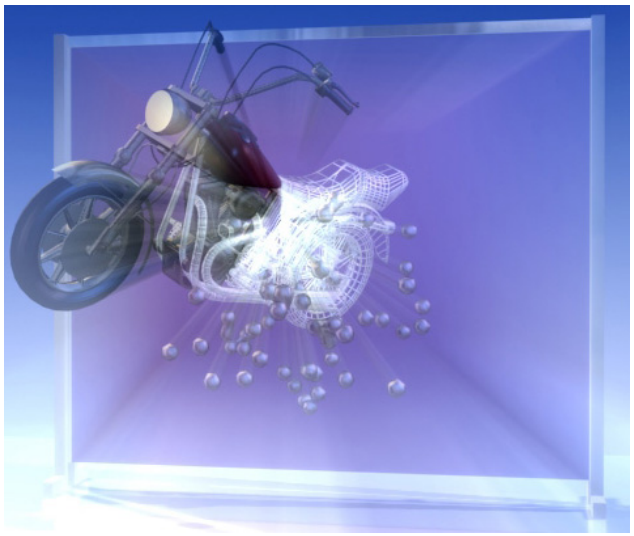
Many More Successes

- Polyhedral model for automatic parallelization: with Ohio State U., IBM Research, Reservoir Labs

- GNU Compiler Collection (GCC), joint research and effective transfers to a GCC near you: with École des Mines, U. Edinburgh, IBM Research, AMD, NXP, STMicroelectronics, RedHat, ARC, since 2003
- UNISIM, modular processor simulation platform: with Princeton, CEA LIST, Thales RT...

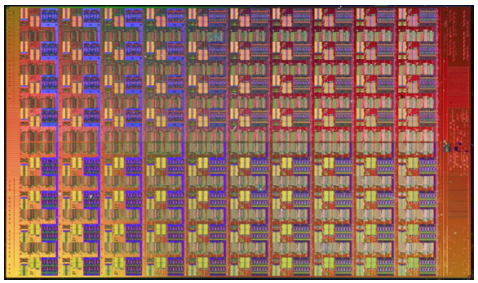
- From 600 K€ to 900 K€ yearly budget

Zoom on Volkscomputing

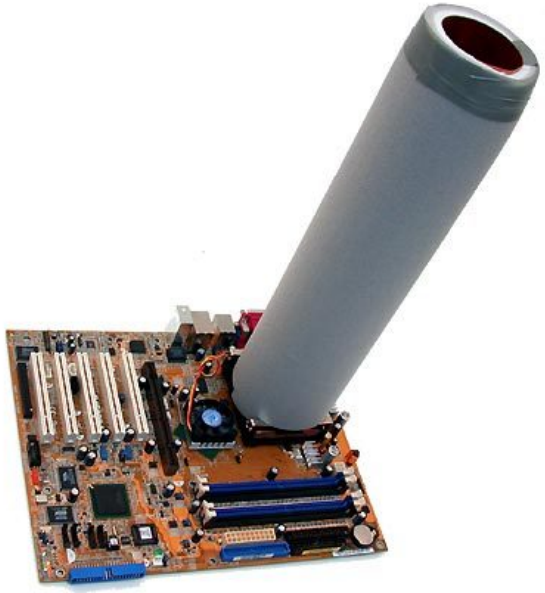


Any supercomputing lessons for the rest of us?

Do Not Blame the Computer Architects



Parallelism



Power

Heterogeneity

- Not (always) the architects' fault: they fight with technology as well
- The physics of computing (or its formal abstractions) does not offer equal opportunities to all computational problems
- Huge productivity regression for most developers

Sould Programmers Really Think in Parallel?

Computational tasks amount to

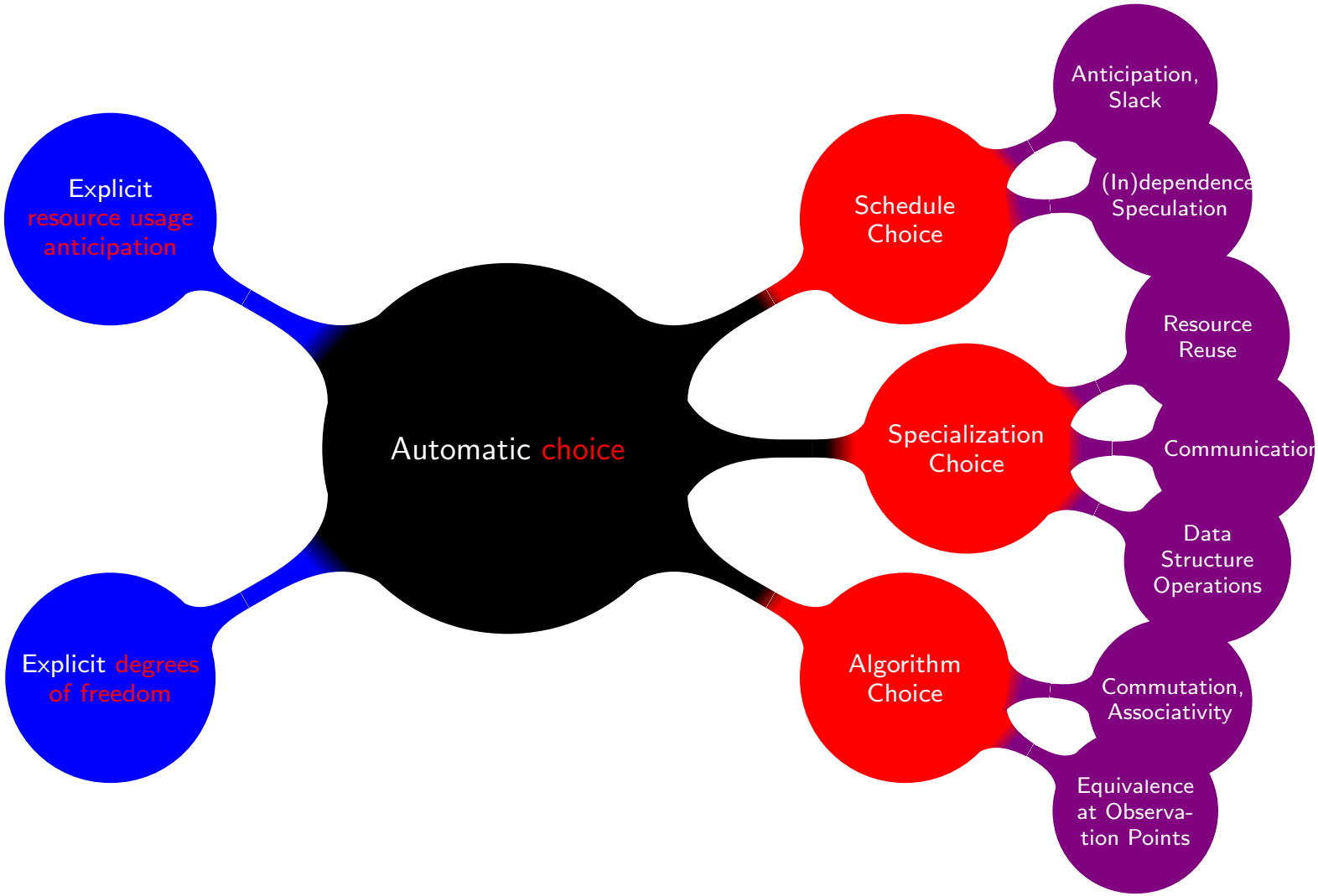
- evaluating a function
- loading and storing information

Parallelism, distribution, specialization, power management are only target-dependent optimizations

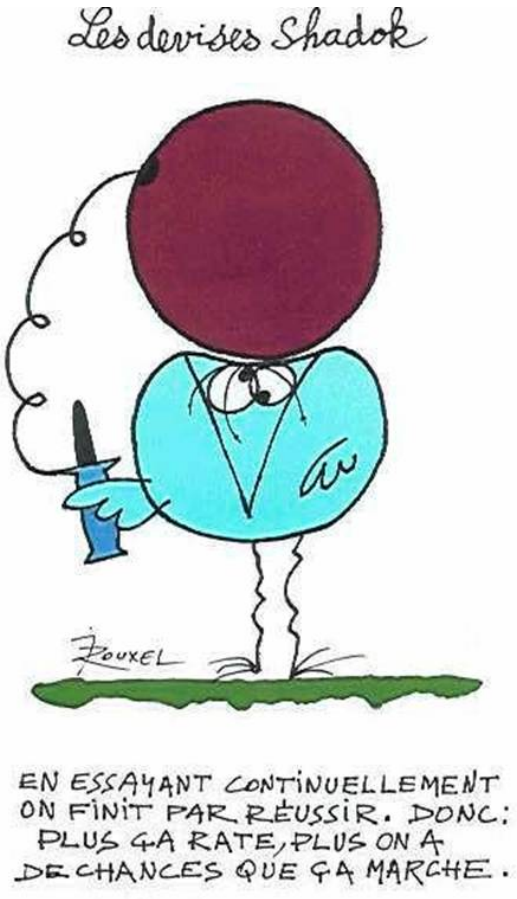
The answer is **No**! But programmers can help the tools

Are You Advocating for Automatic Parallelization?

- Yes, but tools should not reverse engineer the programmer's mind
- Importance of implicit, non-functional, static semantics



Choice is Good, but Too Many Choices Do Not Help!



Principle of iterative, feedback-directed optimization

By continuously trying, we finally succeed. Therefore: the more it fails, the more it has chances to work.

And we are even trying to be smarter than the Shadoks: machine learning compilers, adaptive runtimes

Alchemy Researchers at (Collaborative) Work

Pumping we like, and pumping we do, although sometimes in vain (multi-evaluations, project deliverables, evading bureaucratic regulations)

Yet some people at the Ministry of Research believe we would pump faster if engaged into a pumper's competition

Alchemy Researchers Fighting for their PES[1,2]

[1] *Prime d'Excellence Scientifique*
[2] *Prime d'Enseignement et de Subordination*

PES $\neq$ PEDR
PES = deep misunderstanding of the nature of academic research
PES = contradiction with University-EPST partnership

What is the PES encouraging?

Taking risks?
Address deeper challenges?
Sharing resources and charges?
Sound, trustworthy work environment?