Teratec Hackathon

Awards Ceremony

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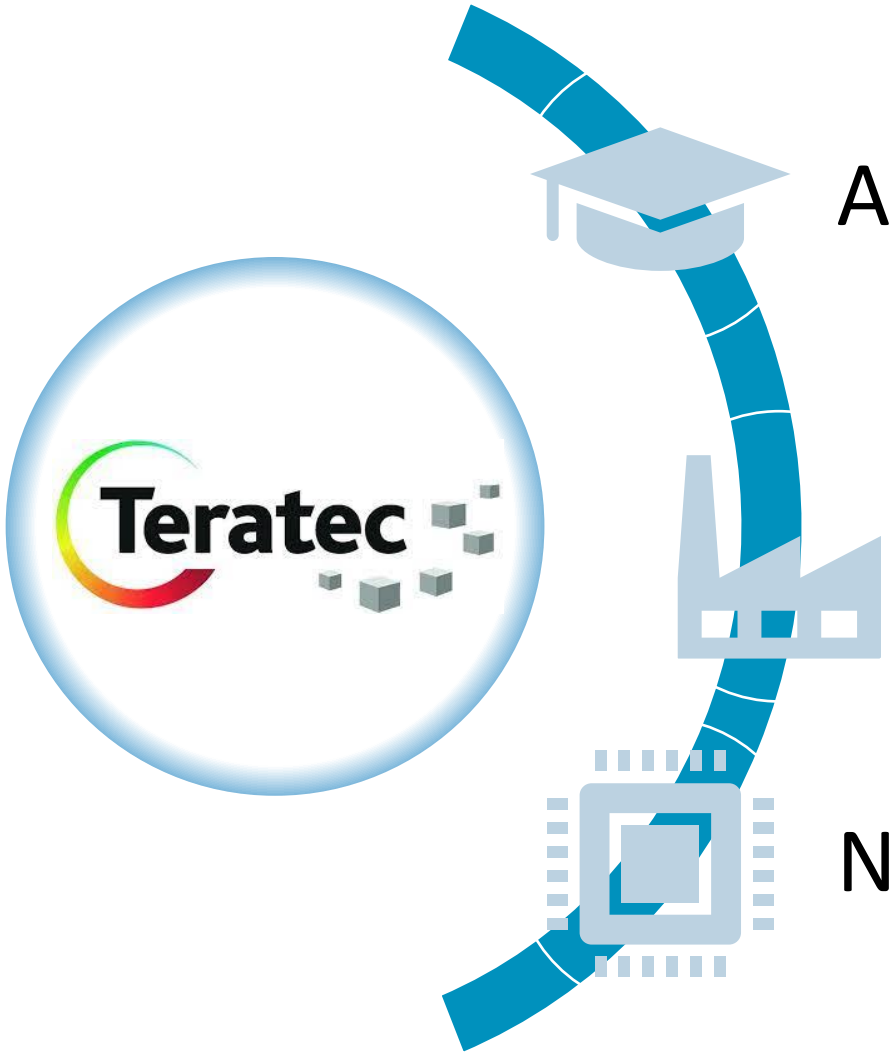
1st June 2023

1st Edition of the Teratec Hackathon



Academic

Industry

Numeric

Stencil code

Cluster-in-a-Box

CGG - Stencils

What did they do ?

Math functions calls (pow)

OpenMP parallelization

Limit number of divisions

Vectorization (Neon, SVE)

Compiler Flags

Compiler optimization remarks

Tools : MAP, MAQAO

Remove unnecessary matrix copies

Reordering & unrolling loops

Cache blocking

Intrinsics

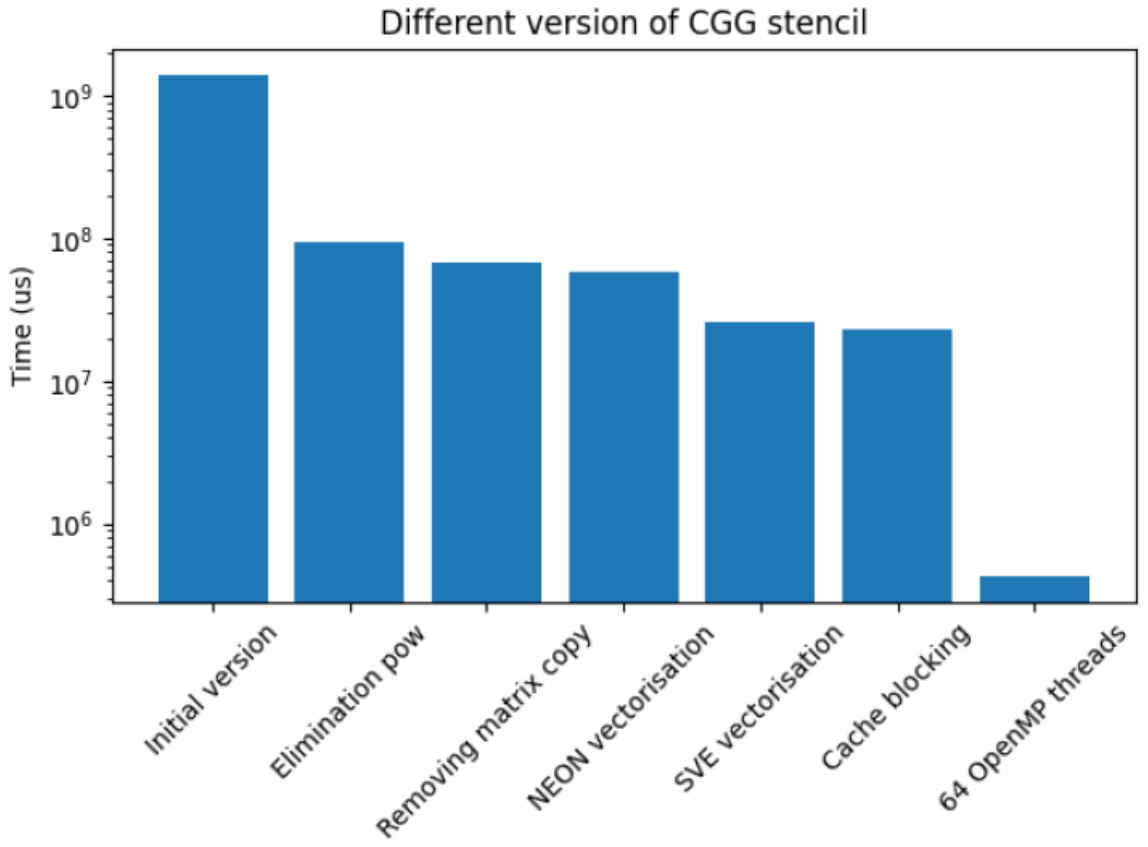


FIGURE 6 – Histogram of the different optimized versions

Best speed-up
7176x

EDF – Code_Saturne

What did they do ?

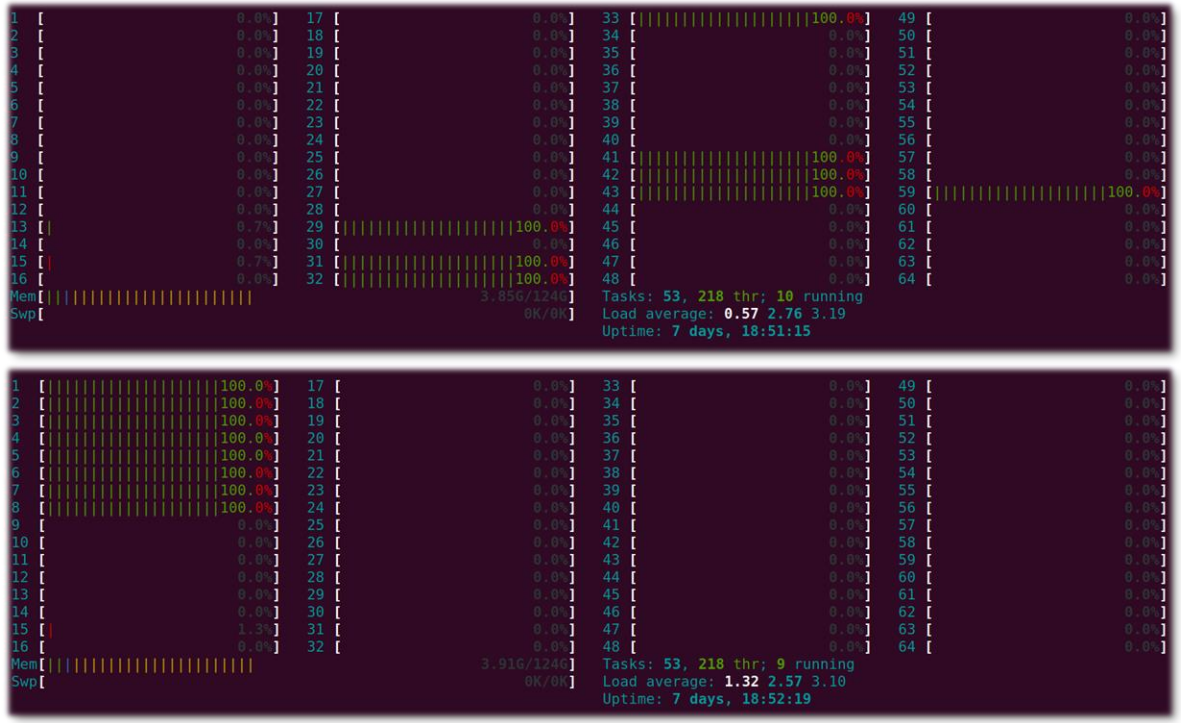
Configuration & Compilation

arm COMPILER

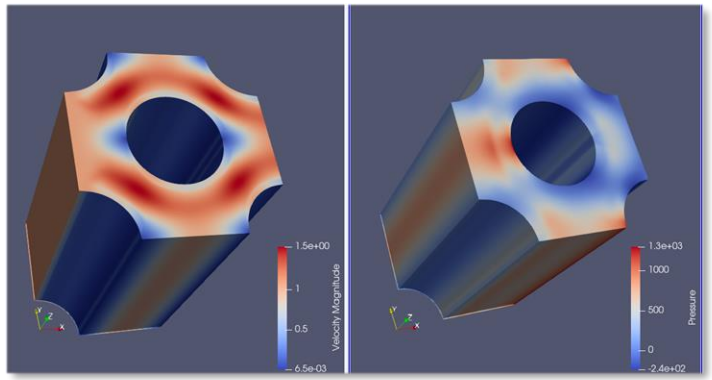
GCC

NVIDIA

OpenMP, MPI & Placement, Binding



Visualisation & Validation

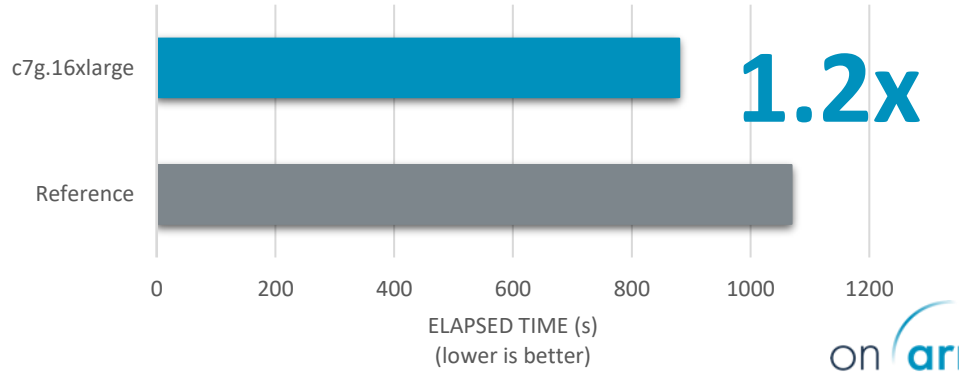


Tools : Debugging & Profiling

Linaro Forge – MAP & DDT

MAQAO

Benchmark & Scalability



on arm

And most importantly

We found the source of all our problems …

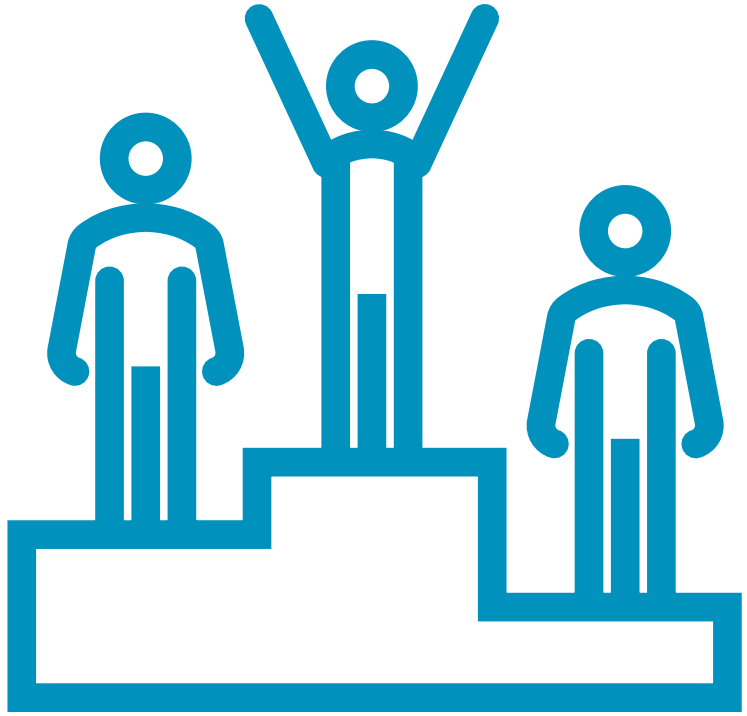
"Either the intrinsic calls we did were not the best ones or **the compiler did not understand what we wanted to do.**"

A fantastic 1st Edition

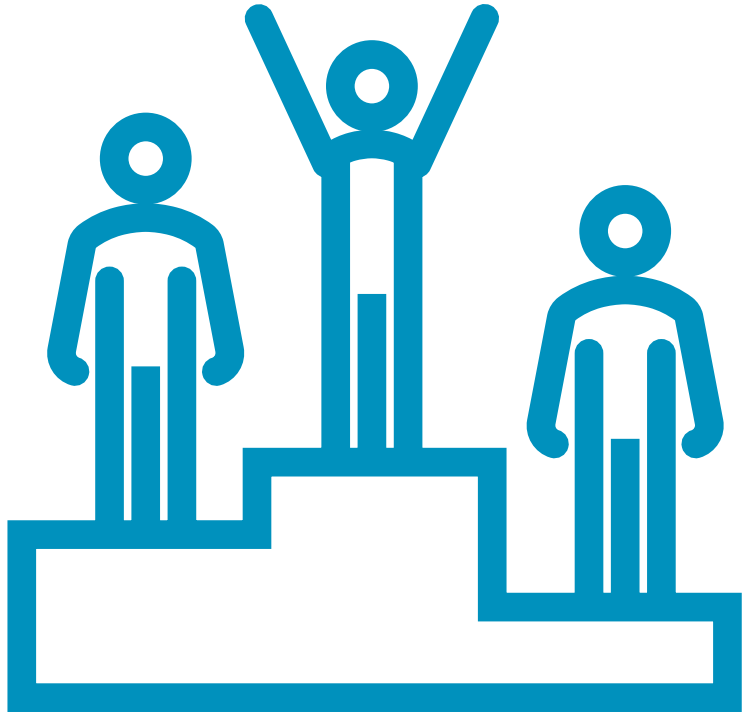
“This hackathon was the opportunity for us to test an architecture we never explored before. But before all, it challenged our skills, and forced us to reconsider our weaknesses. While most members of the team are experienced programmers, we had to use a lot of different tools to speedup our analysis process. Tools we overlooked before, or did not take the time to learn. This is especially true for Code Saturne. **We really appreciate the effort put in by the organizing committee, for the quality of the infrastructure provided, and especially for the difficulty and variety of the problems we had to solve.**

We strongly believe this challenge was of value, and hope that our efforts presented here will be appreciated.”

Winner is …



Winner is …

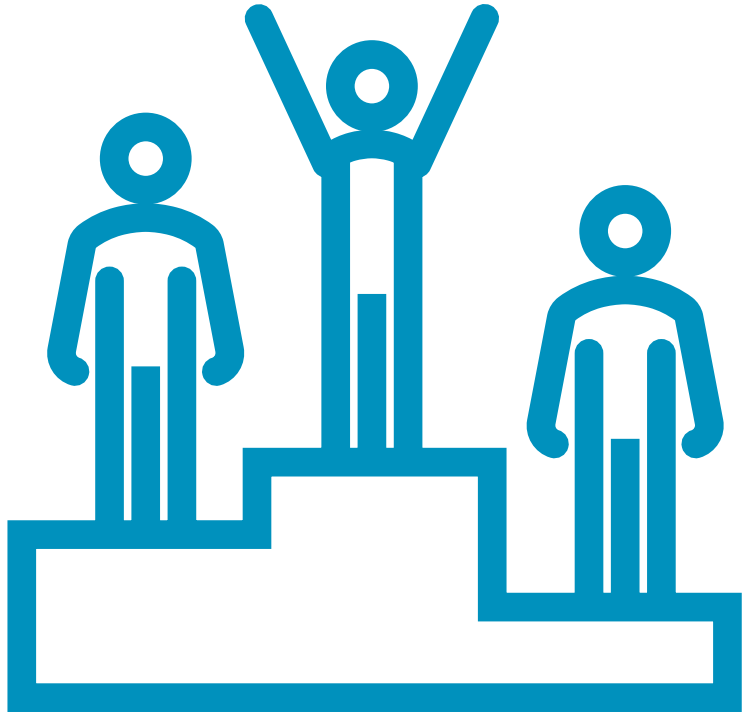


université de BORDEAUX

BORDEAUX INP Enseirb-Matmeca

UNIVERSITÉ DE REIMS CHAMPAGNE-ARDENNE

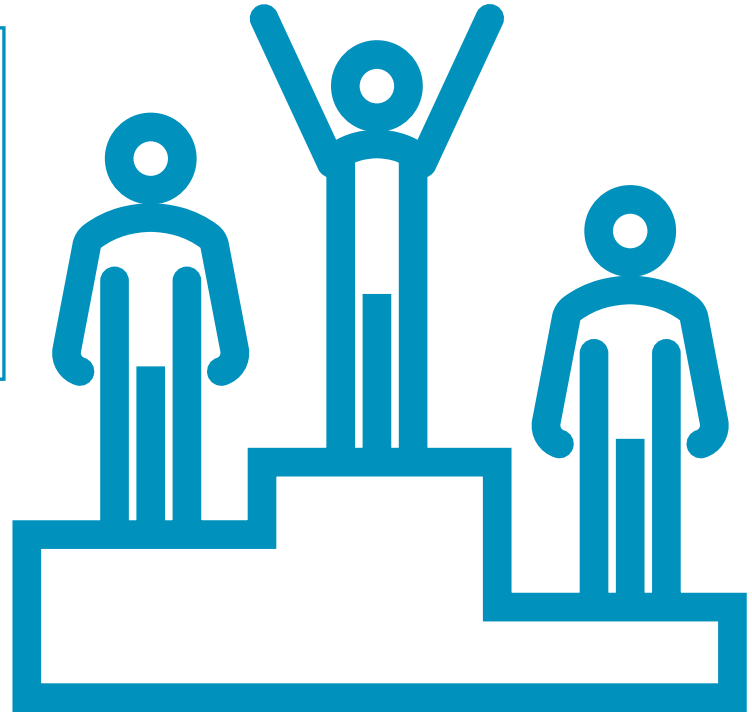
Winner is …



Team 9
Jeremy Musset
Massine Benmammar
Gautier Koubalou Lokou
Maximilian Janisch

Winner is …

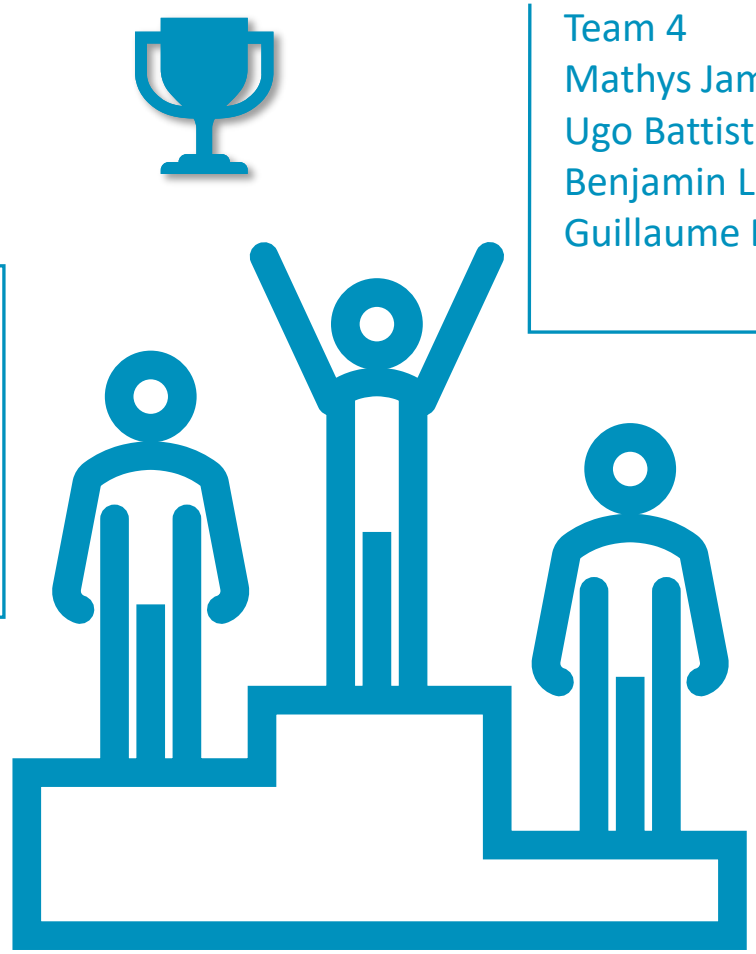
Team 10
Candice Astier
Gabriel Dos Santos
François-Xavier Mordant
Fiona Santoro



Team 8
Nicolas Dias
Sirata Kone
Chustpa William Yeumo Barwende
Alexis Laplanche

Team 9
Jeremy Musset
Massine Benmammar
Gautier Koubalou Lokou
Maximilian Janisch

Winner is …



Team 4
Mathys Jam
Ugo Battiston
Benjamin Lozes
Guillaume Bigand

Team 10
Candice Astier
Gabriel Dos Santos
François-Xavier Mordant
Fiona Santoro

Team 8
Nicolas Dias
Sirata Kone
Chustpa William Yeumo Barwende
Alexis Laplanche

Team 9
Jeremy Musset
Massine Benmammar
Gautier Koubalou Lokou
Maximilian Janisch

Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה

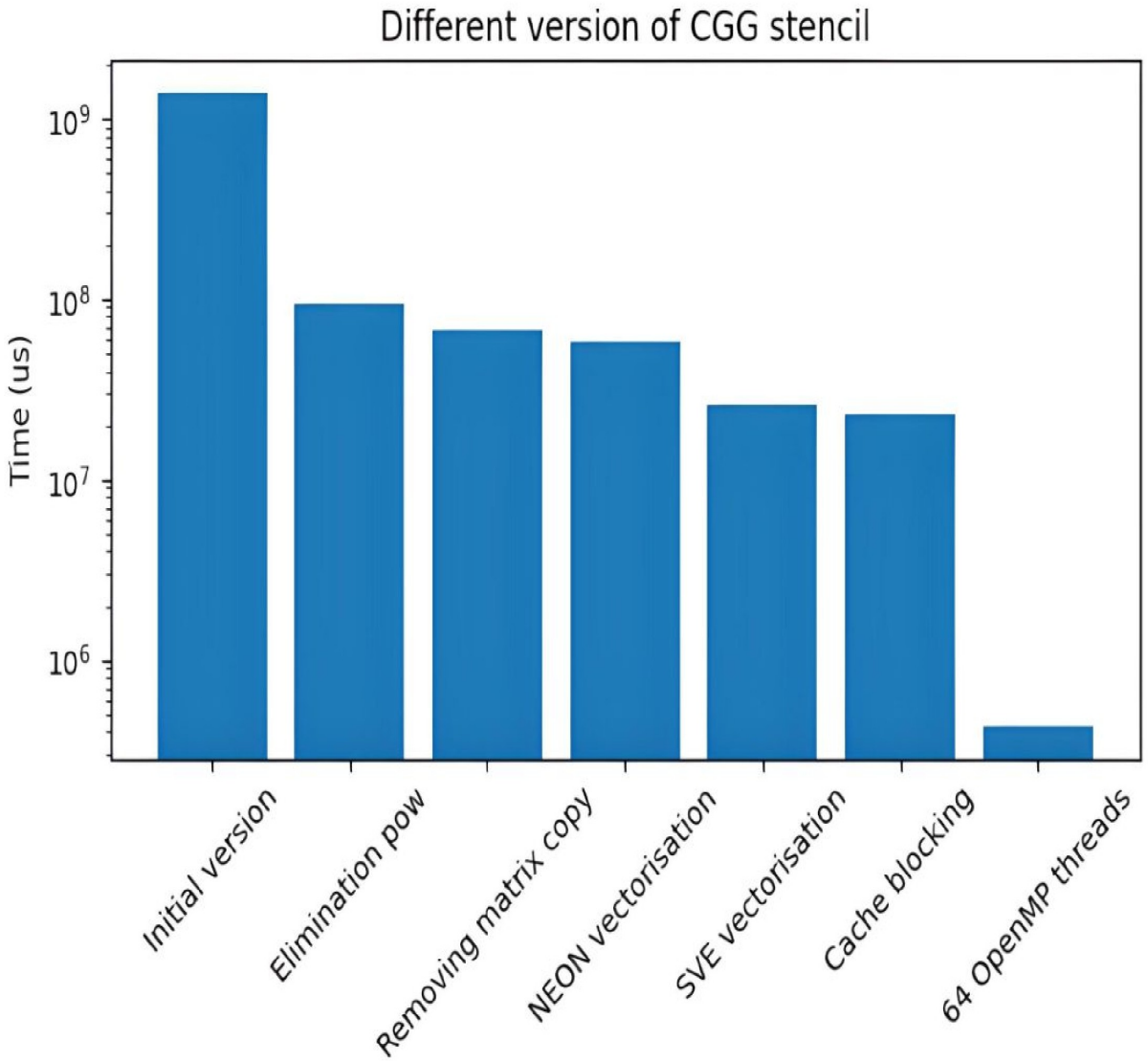
Hackathon Teratec

Winning Team

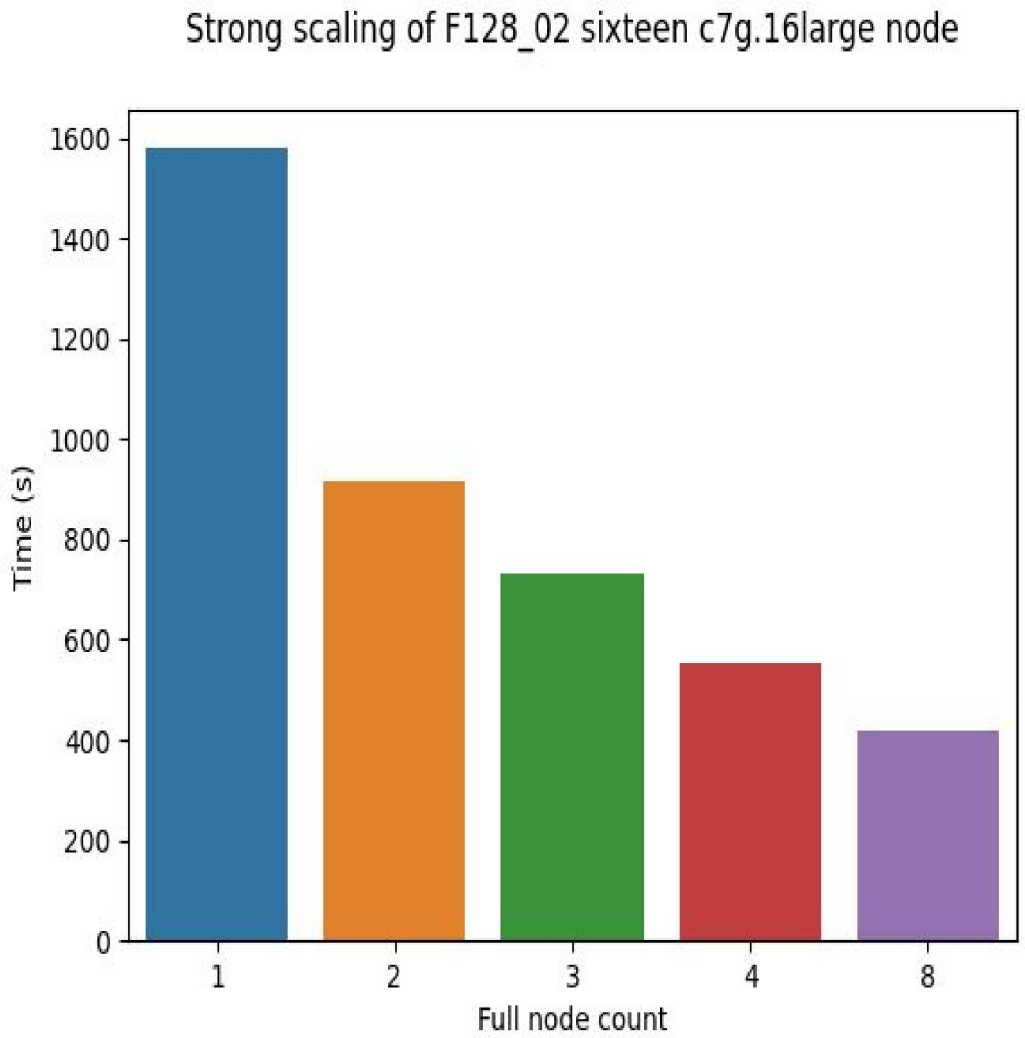
université PARIS-SACLAY

Stencil CGG

- Many optimization opportunities on a small kernel



Code Saturne



Podium

1st
Benjamin Lozes
Guillaume Bigand
Ugo Battiston
Mathys Jam

2nd
François-Xavier Mordant
Gabriel Dos Santos
Fiona Santoro
Candice Astier

3rd
Sirata Kone
Nicolas Dias
Alexis Laplanche
William Yeumo Barkwende

Réseaux des Masters en Calcul Haute Performance, Simulation

https://www.master-chps.fr/

Structuration nationale

- 5 sites
- 100+ étudiants
- Diplômes reconnus (Master, Ingénieur)
- Appuyée sur des mesocentres
- Ouvert à la formation initiale, continue, alternance

Objectifs

- Prépaper les spécialistes en HPC de demain
- Définition d'un socle de compétences communes
- Partage d'expérience

Actions communes

- Séminaires
- Plateforme de stages / offre d'emploi
- Coopération pédagogique
- Hackathon

R&D IN FIGURES

9 R&D centres in France and abroad | **40 nationalities**

2,100 patents

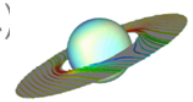
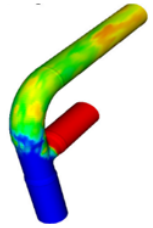
11 pétaflops of computing capacity

20 joint **laboratoires**

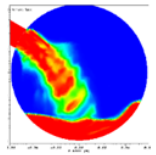
Codes developed at EDF R&D

… a know-how in the state of international art and accessible by all thanks to the Open Source !

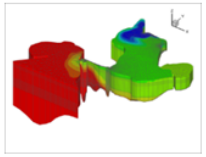
- *Code_Saturne ((i.e. SALOME-CFD)*
  - general usage single phase CFD, plus specific physics
  - property of EDF, open source (GPL)
  - http://www.code-saturne.org

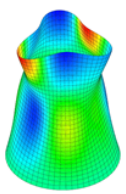
- NEPTUNE_CFD '*(i.e. SALOME-CFD)*
  - multiphase CFD, esp. water/steam
  - property of EDF/CEA/AREVA/IRSN



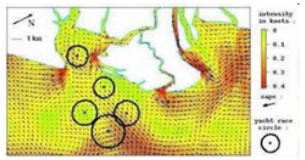
- SYRTHES
  - thermal diffusion in solid and radiative transfer
  - property of EDF, open source (GPL)
  - https://www.edf.fr/groupe-edf/inventer-l-avenir-de-l-energie/r-d-un-savoir-faire-mondial/nos-offres/codes-de-calcul/syrthes



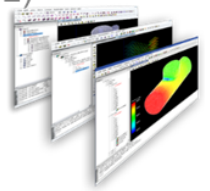
- *Code_Aster (i.e. SALOME-MECA)*
  - general usage structure mechanics
  - property of EDF, open source (GPL)
  - http://www.code-aster.org



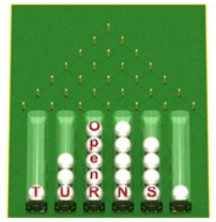
- TELEMAC system *(i.e. SALOME-Hydrau)*
  - free surface flows
  - Many partners, mostly open source (GPL, LGPL)
  - http://www.opentelemac.org



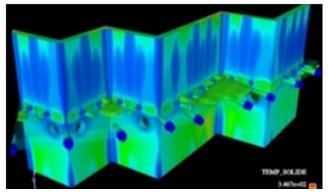
- SALOME platform
  - integration platform (CAD, meshing, post-processing, code coupling)
  - property of EDF/CEA/OpenCascade, open source (LGPL)
  - http://www.salome-platform.org



- Open TURNS
  - tool for uncertainty treatment and reliability analysis
  - property of EDF/CEA/Phimeca, open source (LGPL)
  - http://trac.openturns.org

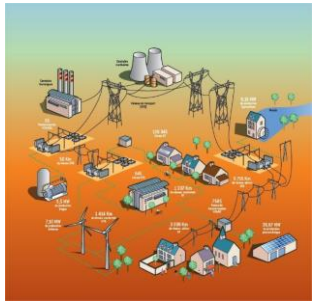


- and many others…
  - Neutronics, electromagnetism
  - Component codes, system codes
  - Optimization codes,…




Main domains of HPC applications (both Physical Simulation and Data Analysis)

ENERGY PRODUCTION (Nuclear, Renewable, Hydraulic, Thermal, Environment)

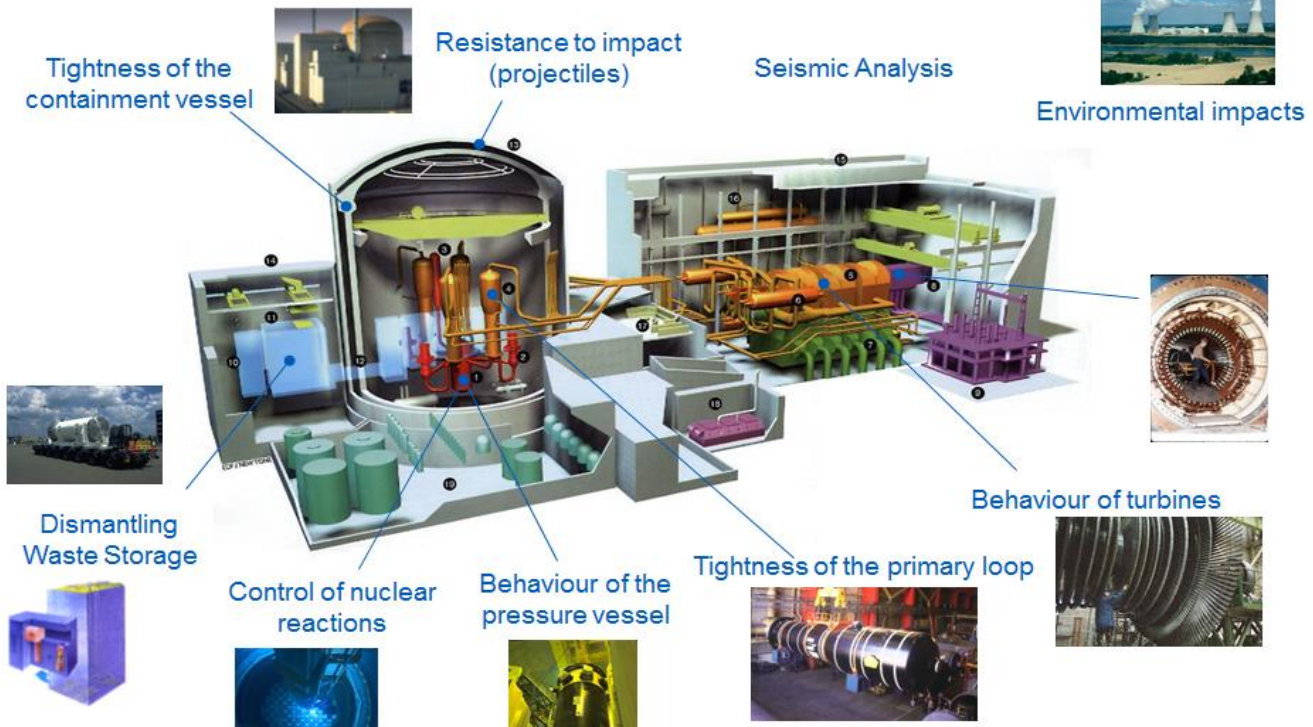


Network / Smarties (smart-grids, smart-cities)

Marketing

Energy Management

Nuclear : a particular domain



- Guarantee safety
- Improve performances/costs
- Maintain assets
- Face unexpected events
- Ageing issues…

Benefits of the HPC :

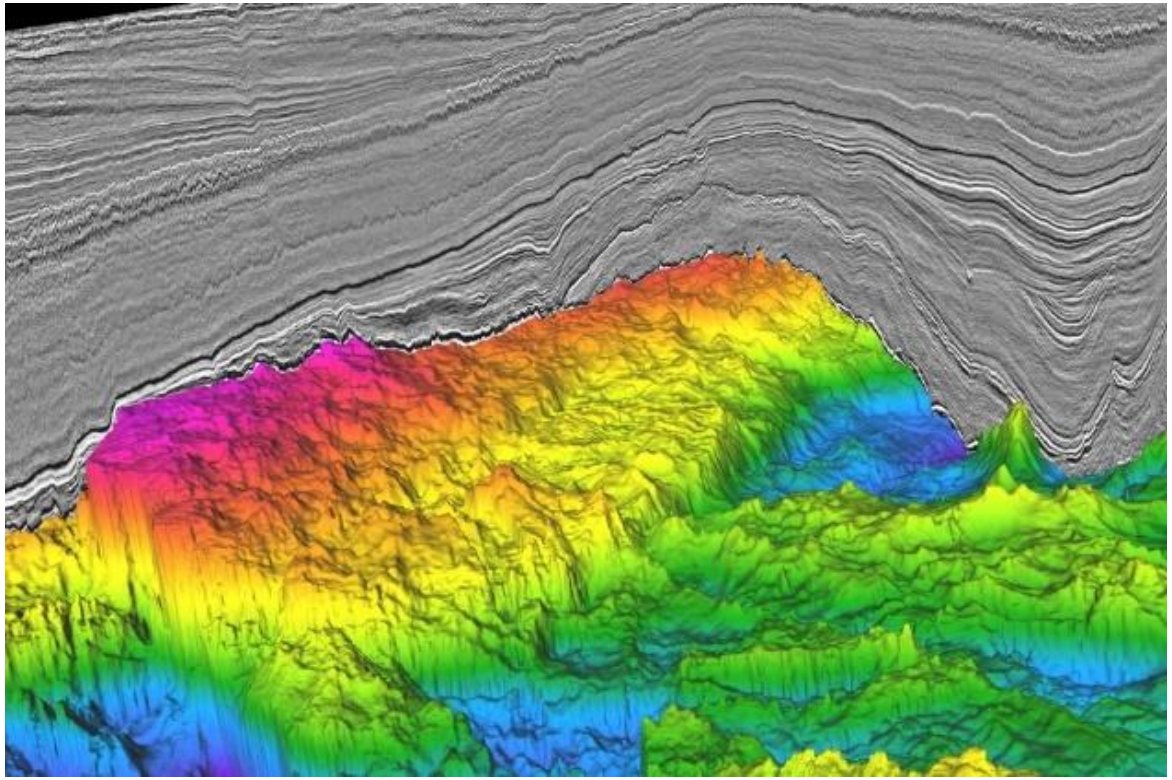
- ✓ Less simplifying assumptions
- ✓ More information
- ✓ More calculation scenarios
- ✓ Take into account incertainties

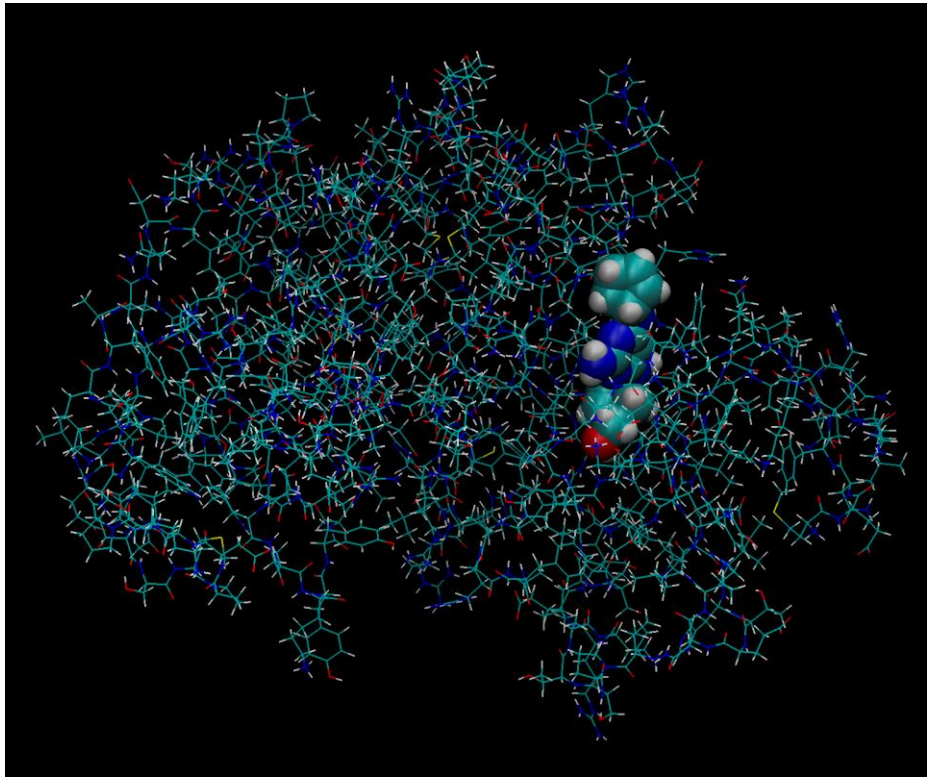
Teratec Hackathon - CGG

cgg.com

CGG – HPC & Cloud Solutions business

- HPC applied to geoscience, biochemistry and so on…

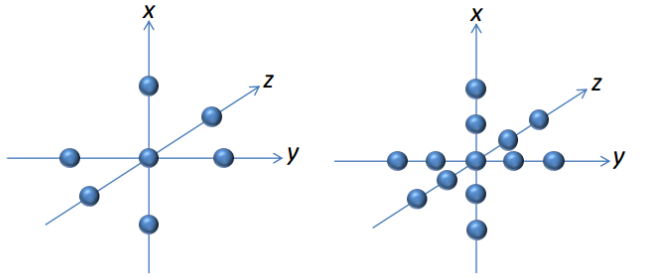




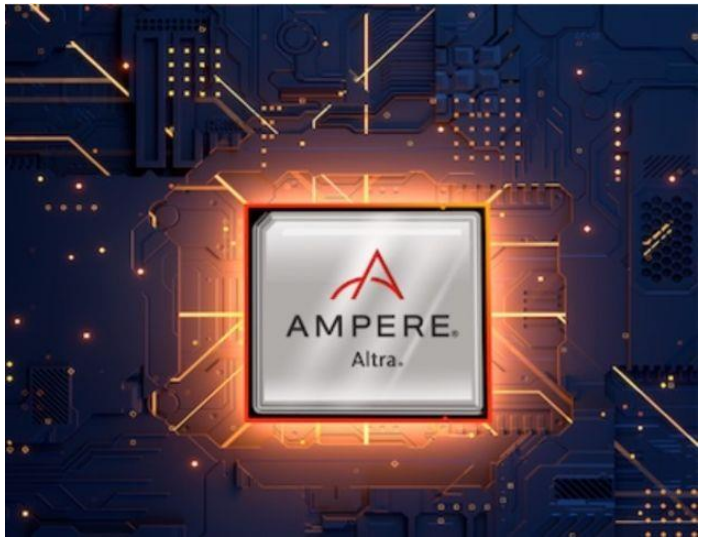
Compute Science Group

- Technology scooting
  - From CPU to FPGA.
- Code optimization
- Compute node architecture, Co-design

Stencil Order	Extent	Memory Accesses/Elem.	Flops/Elem.
2	3×3×3	8	8
4	5×5×5	14	15
6	7×7×7	20	22
8	9×9×9	26	29
10	11×11×11	32	36
12	13×13×13	38	43



(a) 2nd order stencil (b) 4th order stencil



Genesis

Motivation

Offering

Get hybrid READY

Be hybrid SMARTLY

with