

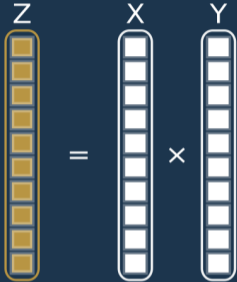
Gray Scott Reloaded 2024 : Computing on heterogeneous hardware

Pierre Aubert



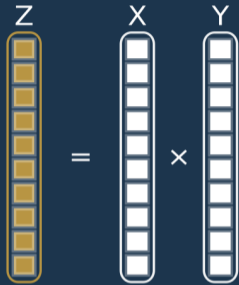
Simple Examples

Hadamard Product



Simple Examples

Hadamard Product

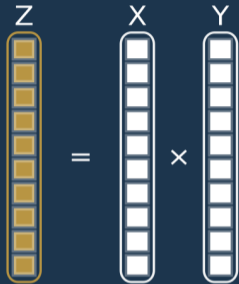


Reduction



Simple Examples

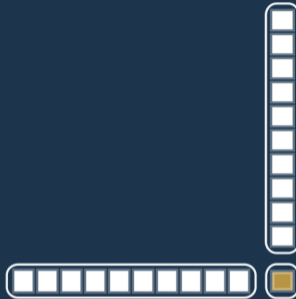
Hadamard Product



Reduction

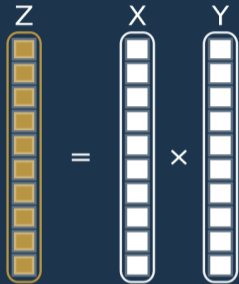


Dot Product



Simple Examples

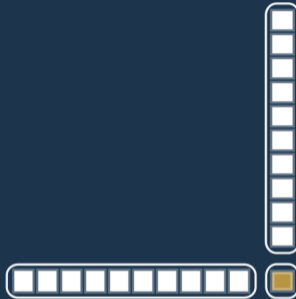
Hadamard Product



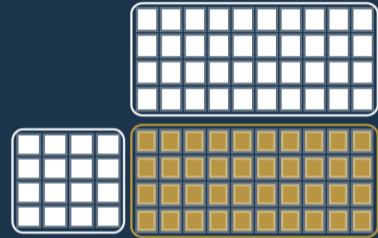
Reduction



Dot Product

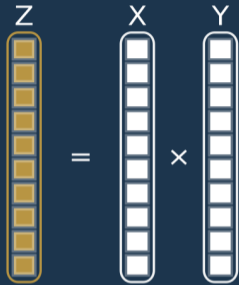


Matrix Product



Simple Examples

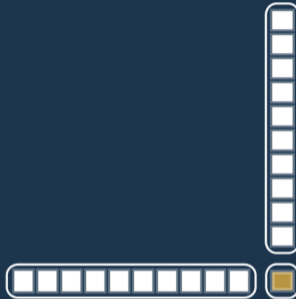
Hadamard Product



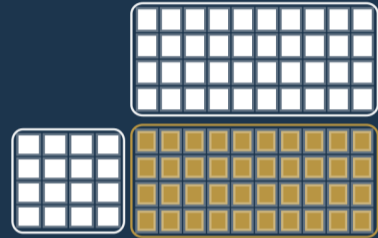
Reduction



Dot Product



Matrix Product

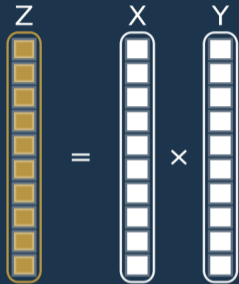


MKL



Simple Examples

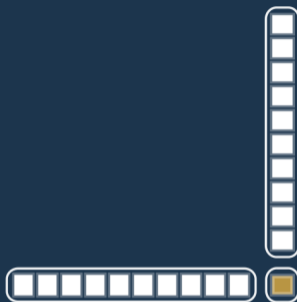
Hadamard Product



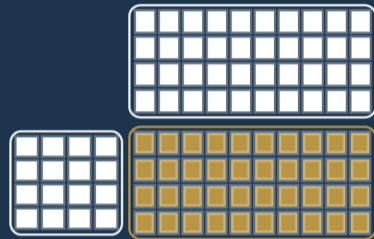
Reduction



Dot Product



Matrix Product



MKL

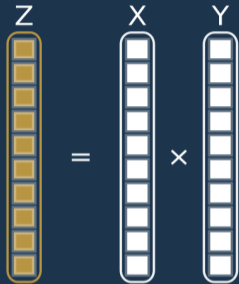


Eigen



Simple Examples

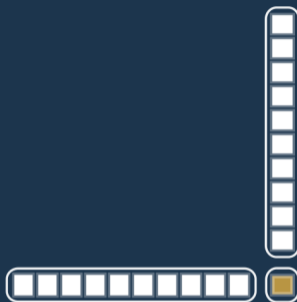
Hadamard Product



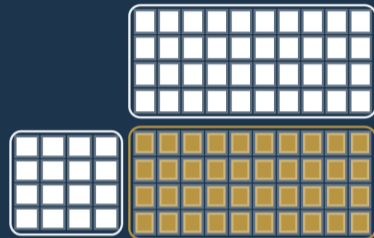
Reduction



Dot Product



Matrix Product



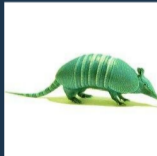
MKL



Eigen

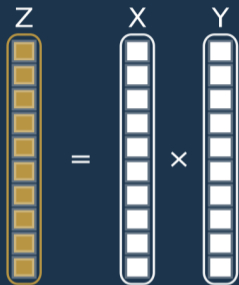


Armadillo



Simple Examples

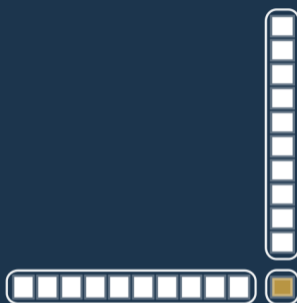
Hadamard Product



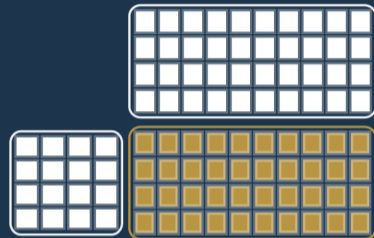
Reduction



Dot Product



Matrix Product



MKL



Eigen

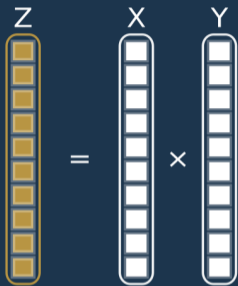


Armadillo



Simple Examples

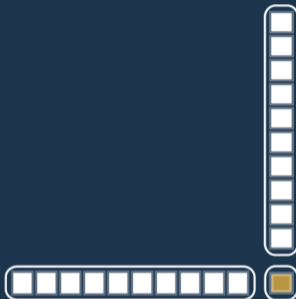
Hadamard Product



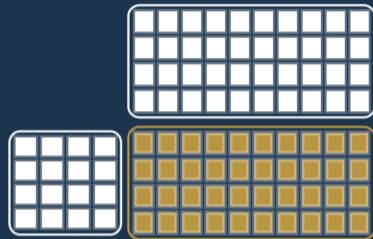
Reduction



Dot Product



Matrix Product



MKL



Eigen

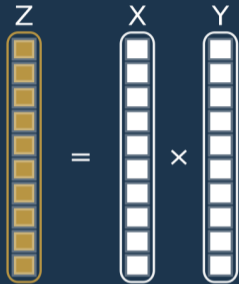


Armadillo



Simple Examples

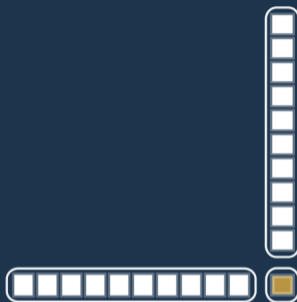
Hadamard Product



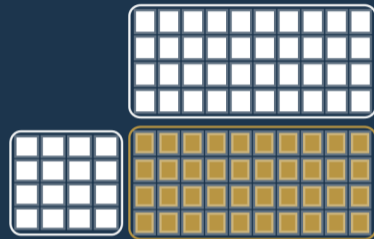
Reduction



Dot Product



Matrix Product



MKL



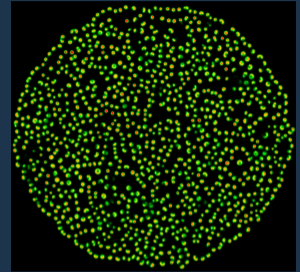
Eigen



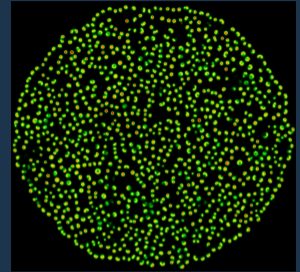
Armadillo



Gray Scott reaction (a chemistry game of life)



Gray Scott reaction (a chemistry game of life)



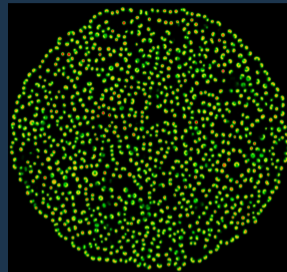
Gray Scott reaction (a chemistry game of life)



Computing :

$$\frac{\partial u}{\partial t} = r_u \nabla^2 u - uv^2 + f_r \times (1 - u)$$

$$\frac{\partial v}{\partial t} = r_v \nabla^2 v + uv^2 - (f_r + k_r) \times v$$



- ▶ u and v are concentration of product **U** and **V**
- ▶ r_u and r_v diffusion rate of **U** and **V**
- ▶ k_r (**Kill Rate**), conversion rate from **V** to **P**
- ▶ f_r (**Feed Rate**), speed of process which feed **U** and kills **V** and **P**
- ▶ $\nabla^2 u$ and $\nabla^2 v$ are différence of space concentration between current cell and its neighbours

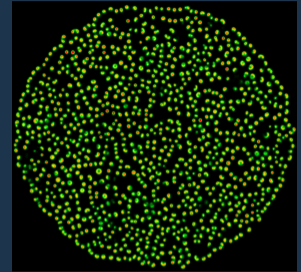
Gray Scott reaction (a chemistry game of life)



Computing :

$$\frac{\partial u}{\partial t} = r_u \nabla^2 u - uv^2 + f_r \times (1 - u)$$

$$\frac{\partial v}{\partial t} = r_v \nabla^2 v + uv^2 - (f_r + k_r) \times v$$



- ▶ u and v are concentration of product **U** and **V**
- ▶ r_u and r_v diffusion rate of **U** and **V**
- ▶ k_r (**Kill Rate**), conversion rate from **V** to **P**
- ▶ f_r (**Feed Rate**), speed of process which feed **U** and kills **V** and **P**
- ▶ $\nabla^2 u$ and $\nabla^2 v$ are différence of space concentration between current cell and its neighbours
- ▶ Easy to understand
- ▶ Not so easy for the compiler
- ▶ Possibility of high speed up

Attendees

- ~ **40** Attendees
- **21** - **56** years old
- **Engineers, PhD Students, Students, Researchers or Professors** :
 - **ONERA, Collège de France, INRIA, CEA, CNRS, CERN, GANIL,**
 - **ENS** (Lyon, Paris-Saclay),
 - **Université** (Bordeaux, Aix-Marseille, Paris-Saclay, La Rochelle, Lyon1, Savoie-Mont-blanc)

- ~ **40** Attendees
- **21 - 56** years old
- **Ingeneers, PhD Students, Students, Researchers or Professors :**
 - **ONERA, Collège de France, INRIA, CEA, CNRS, CERN, GANIL,**
 - **ENS** (Lyon, Paris-Saclay),
 - **Université** (Bordeaux, Aix-Marseille, Paris-Saclay, La Rochelle, Lyon1, Savoie-Mont-blanc)

Satisfaction Globale :

Satisfait (50.00%), Très Satisfait (50.00%)

L'école a-t-elle répondu à vos attentes ?

Totalement: (50.00%), Au delà de mes attentes: (50.00%)

Etes-vous satisfait de l'organisation générale de l'école ?

Satisfait (50.00%), Très Satisfait (50.00%)



- **Association**
- **Valorisation / Dissemination** of Knowledge :
Schools / Seminars / Interviews
- **Bridge** between **Academy** and **Industry**

France



- **Association**
- **Valorisation / Dissemination** of Knowledge :
Schools / Seminars / Interviews
- **Bridge** between **Academy** and **Industry**

EuroCC (Catalog of HPC/HTC/HPDA formations)

France



- **Association**
- **Valorisation / Dissemination** of Knowledge :
Schools / Seminars / Interviews
- **Bridge** between **Academy** and **Industry**

EuroCC (Catalog of HPC/HTC/HPDA formations)

France



- **Association**
- **Valorisation / Dissemination** of Knowledge :
Schools / Seminars / Interviews
- **Bridge** between **Academy** and **Industry**

+33 Countries



EuroHPC

EuroCC (Catalog of HPC/HTC/HPDA formations)

France



- **Association**
- **Valorisation / Dissemination** of Knowledge :
Schools / Seminars / Interviews
- **Bridge** between **Academy** and **Industry**

+33 Countries



4 Days @ LAPP

4 Days @ LAPP



4 Days @ LAPP



Fortran

4 Days @ LAPP



Fortran



4 Days @ LAPP



Fortran



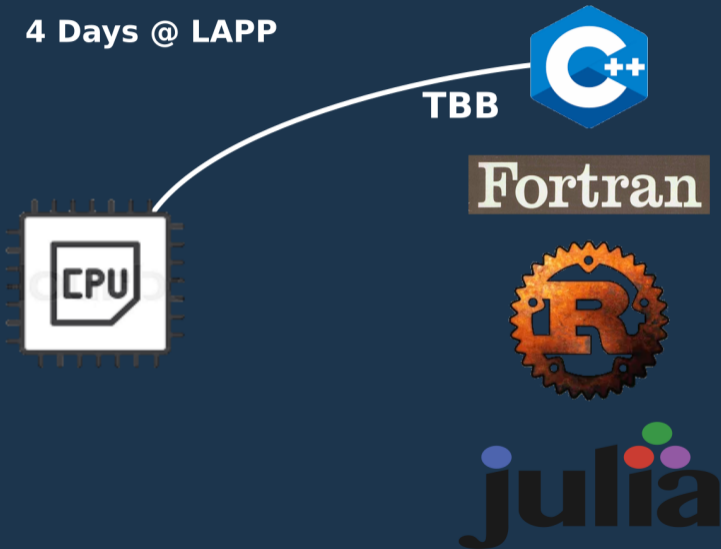
4 Days @ LAPP



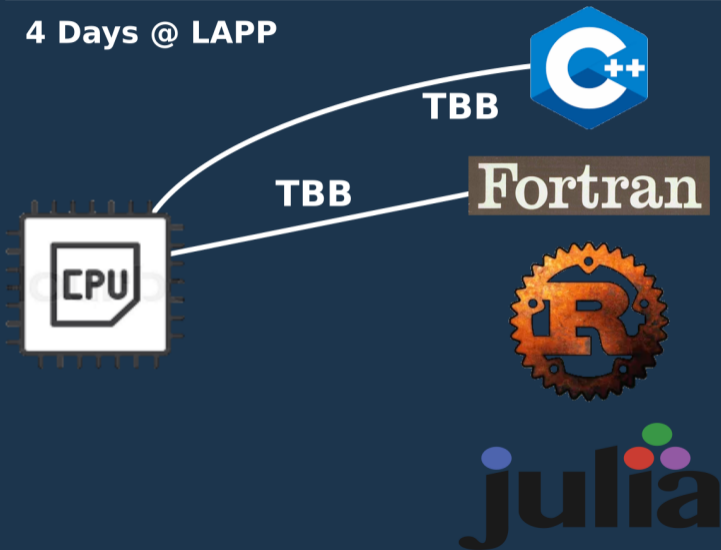
Fortran



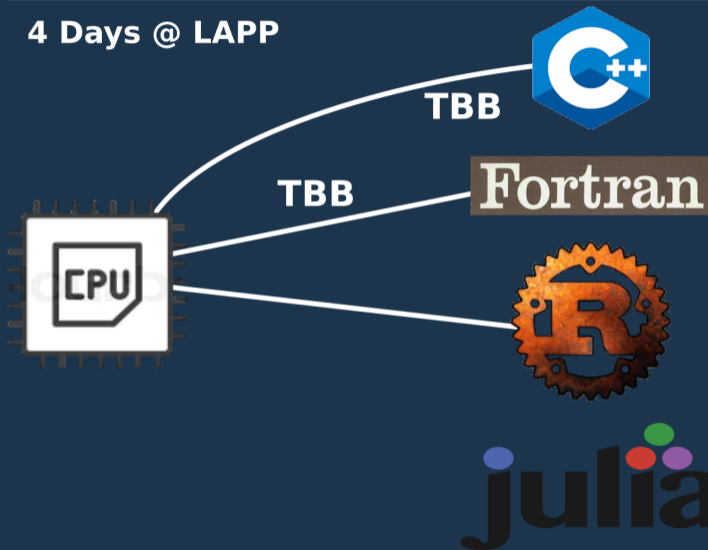
4 Days @ LAPP



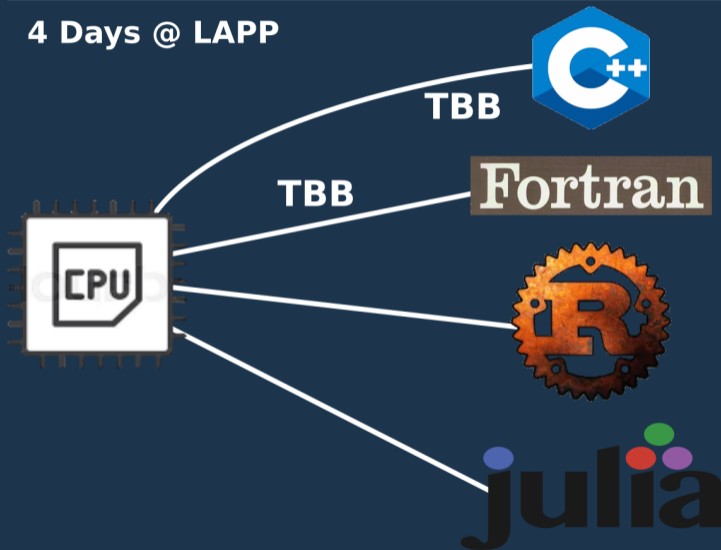
4 Days @ LAPP



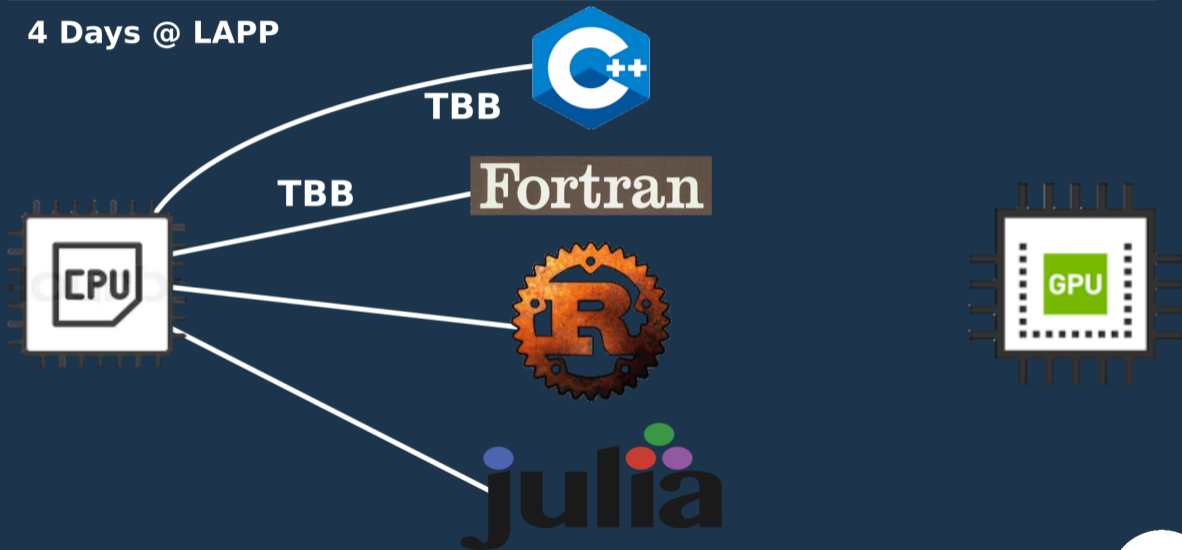
4 Days @ LAPP



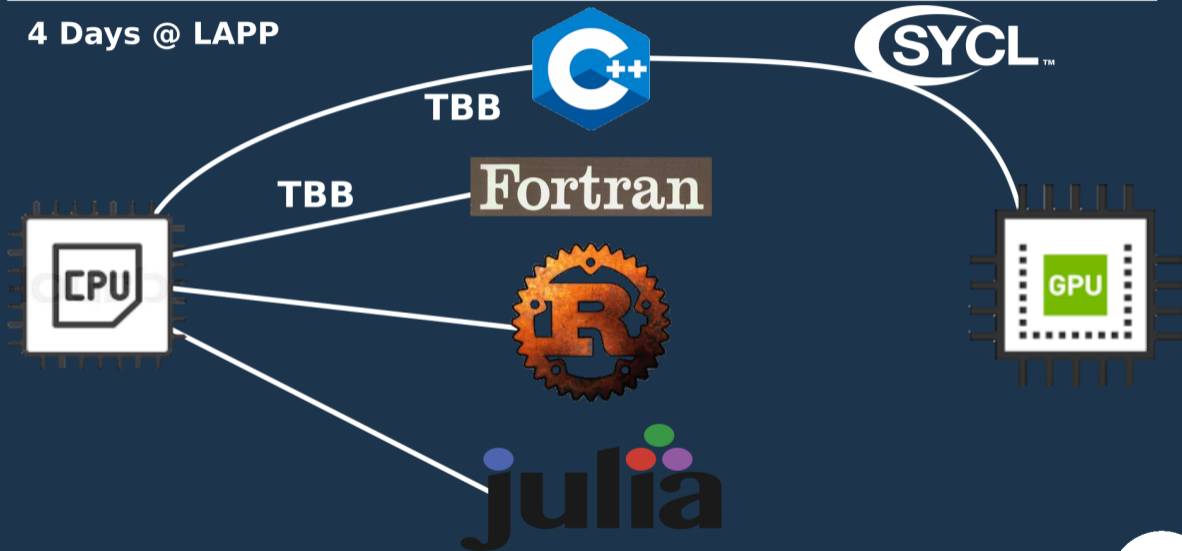
4 Days @ LAPP



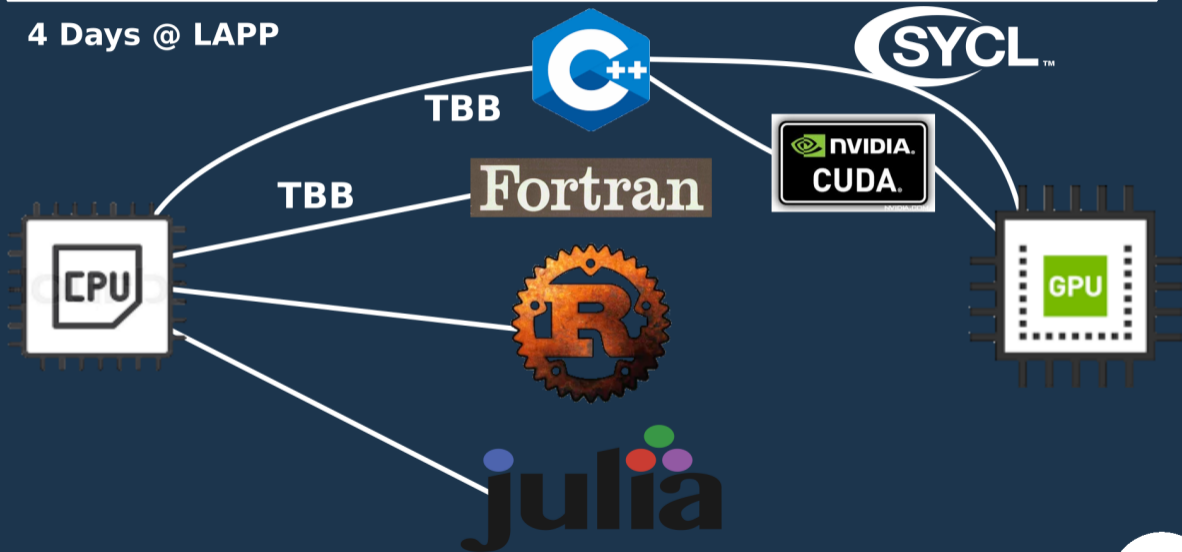
4 Days @ LAPP



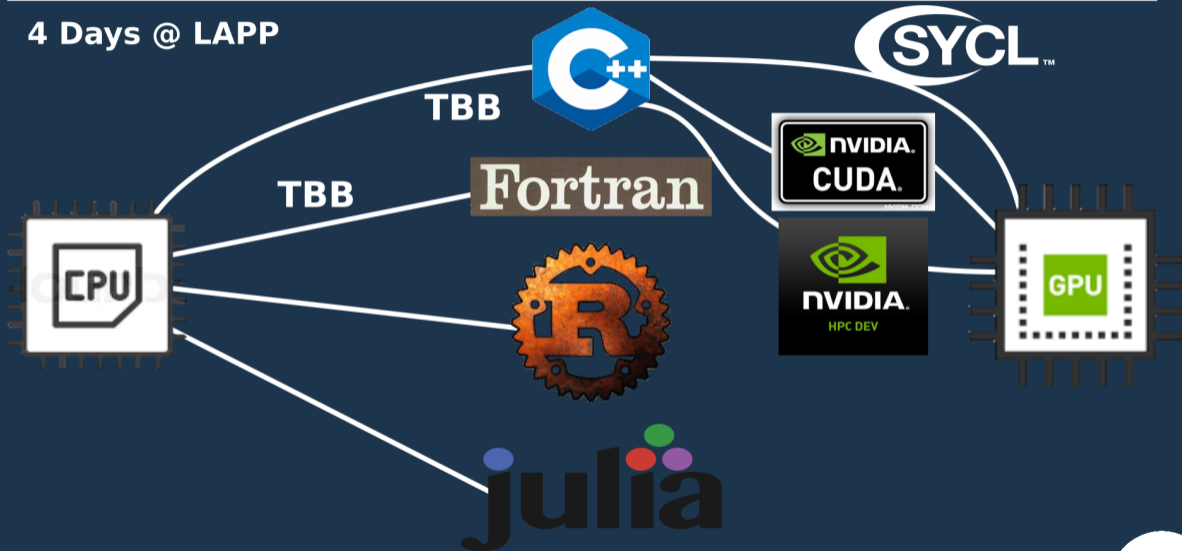
4 Days @ LAPP



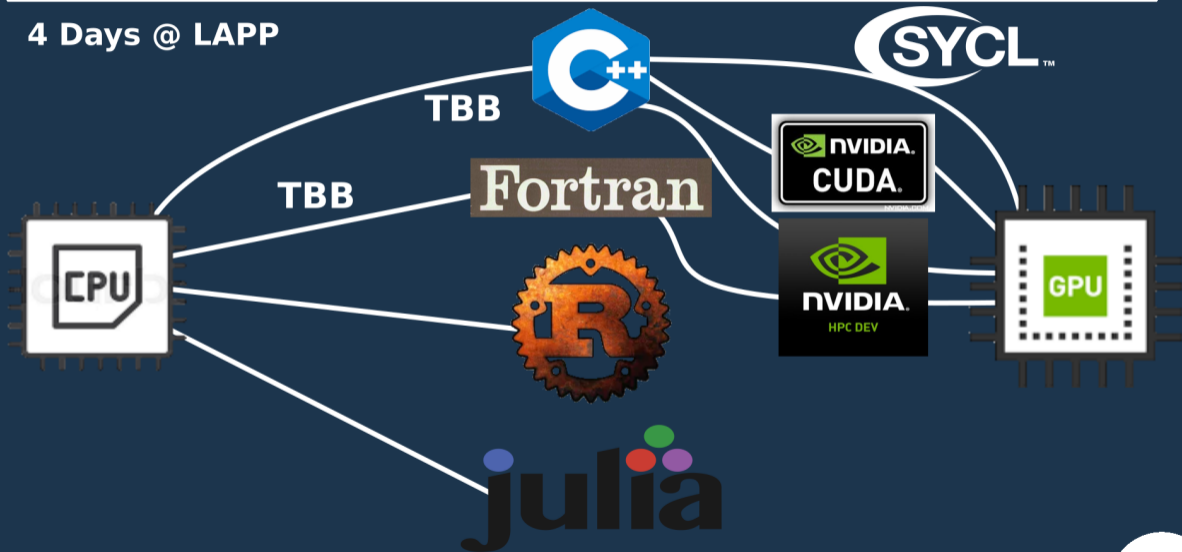
4 Days @ LAPP



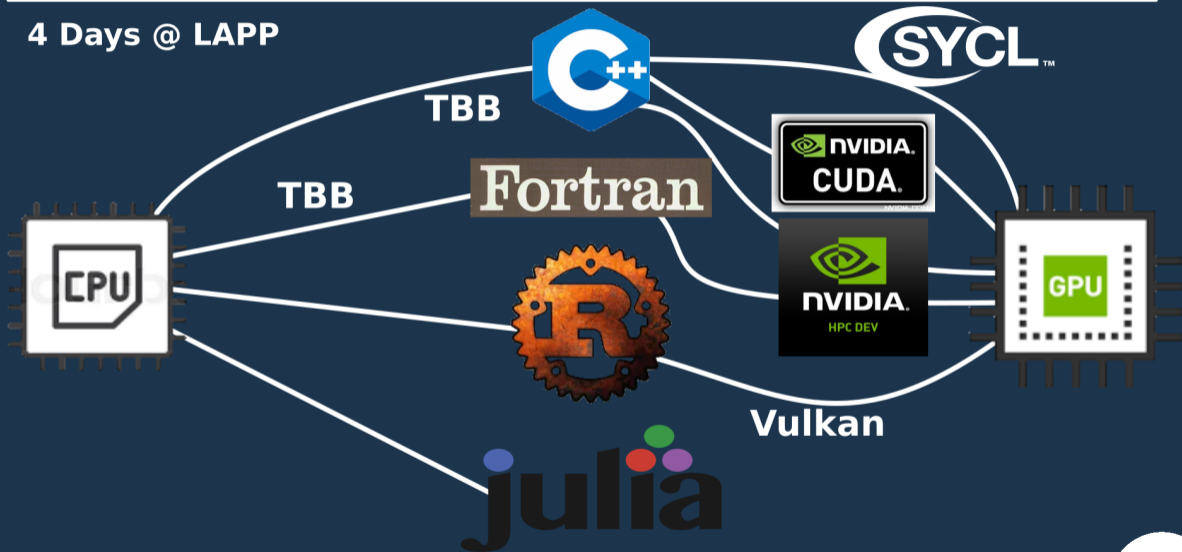
4 Days @ LAPP



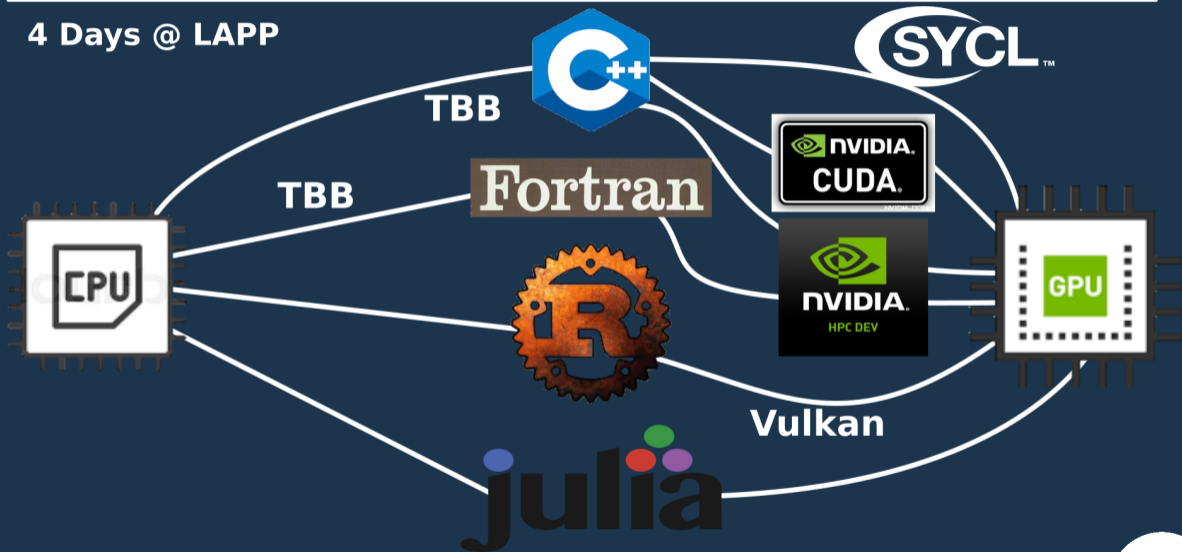
4 Days @ LAPP



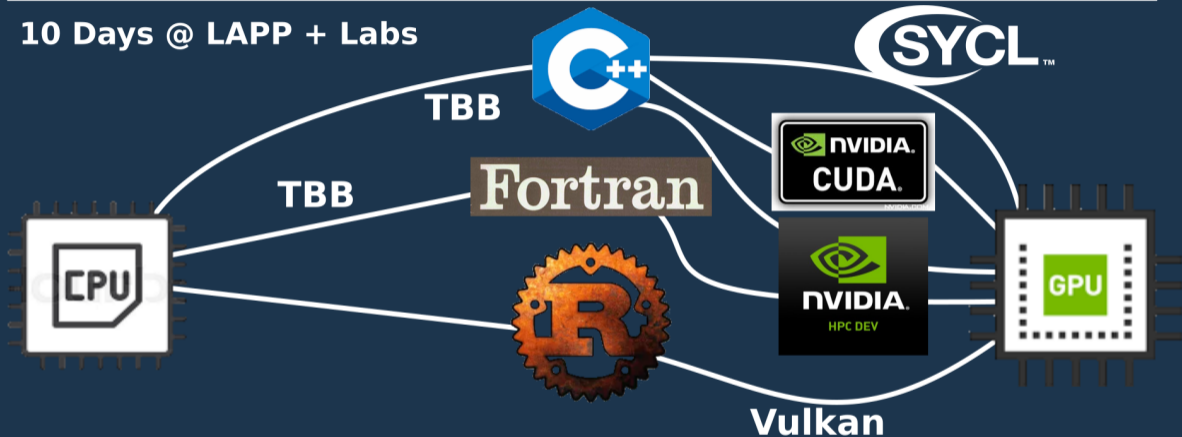
4 Days @ LAPP



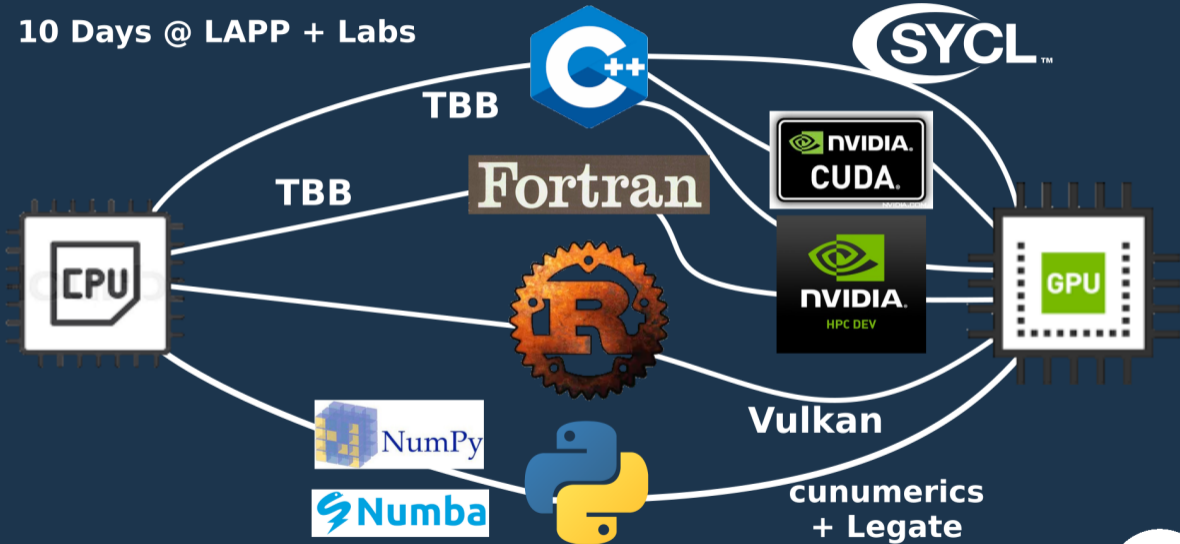
4 Days @ LAPP



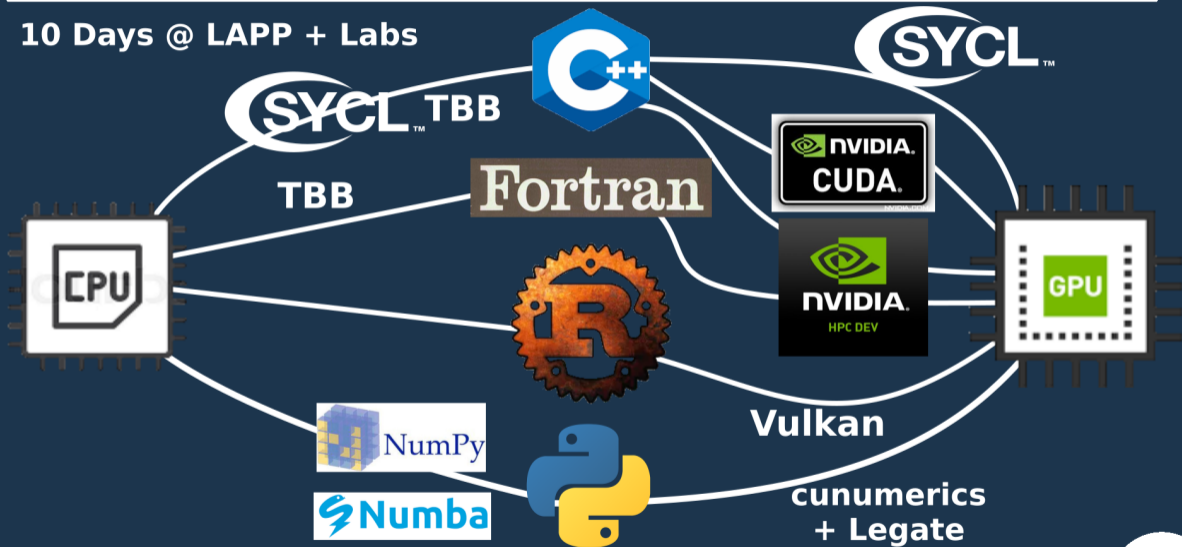
10 Days @ LAPP + Labs



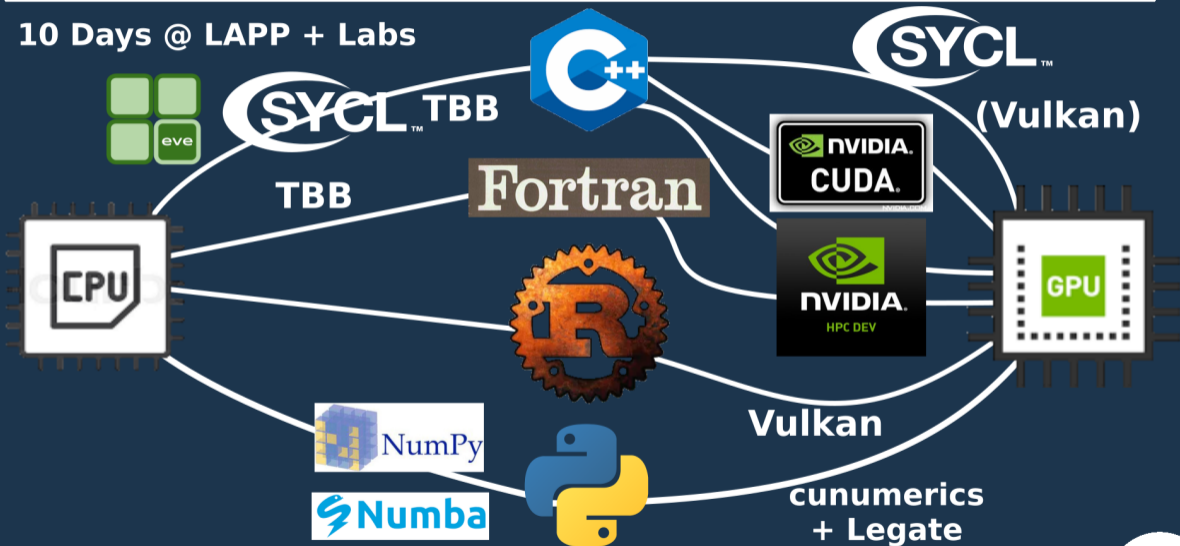
10 Days @ LAPP + Labs



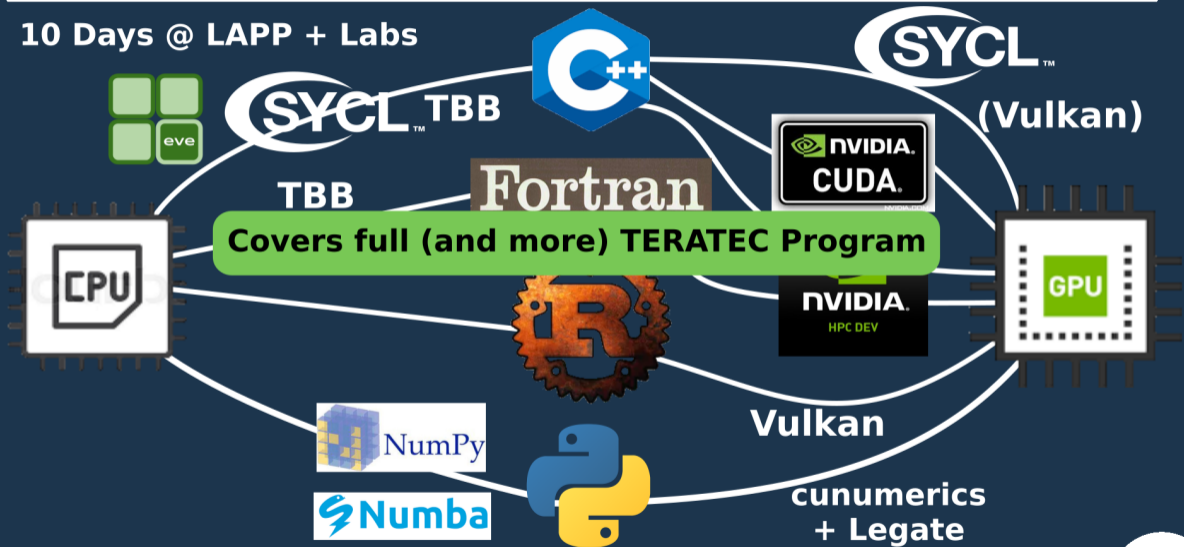
10 Days @ LAPP + Labs



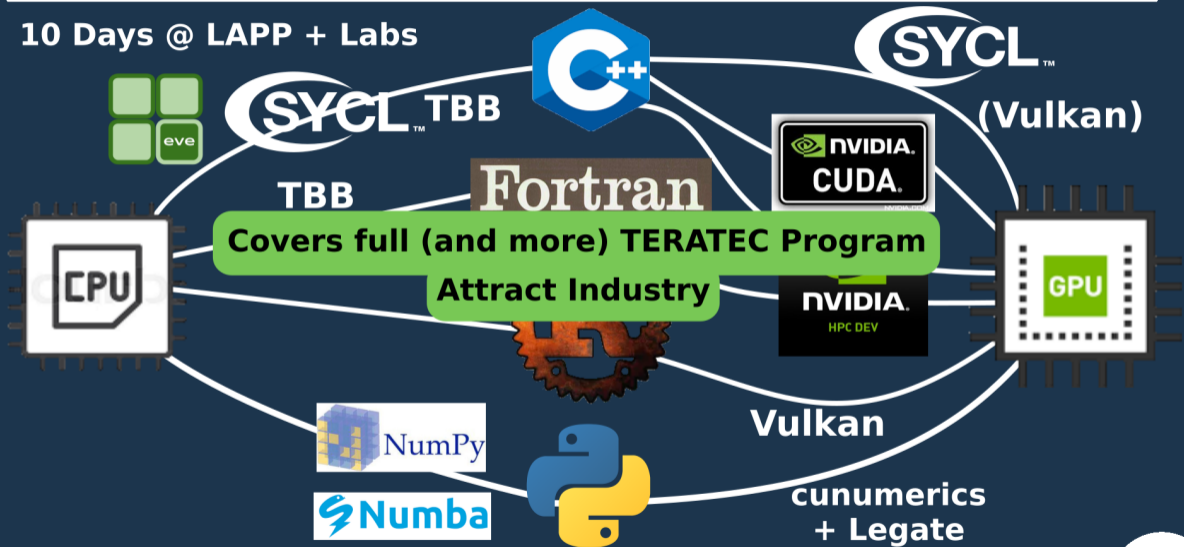
10 Days @ LAPP + Labs



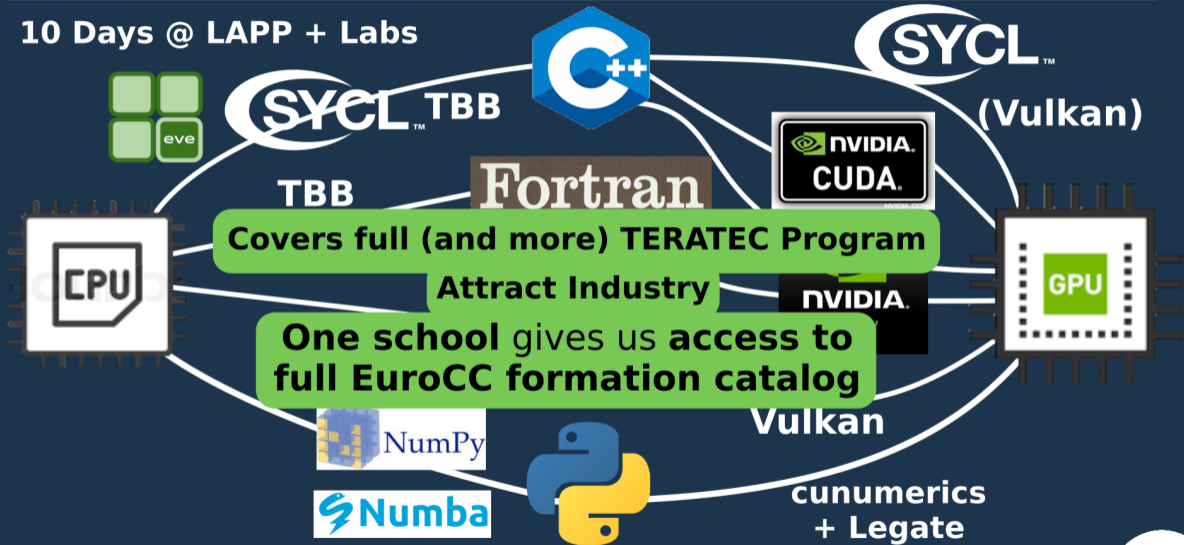
10 Days @ LAPP + Labs



10 Days @ LAPP + Labs

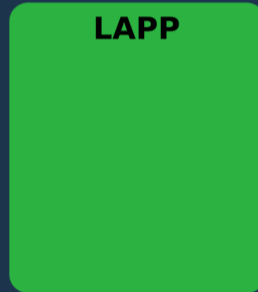


10 Days @ LAPP + Labs



Covers full (and more) TERATEC Program
Attract Industry
One school gives us access to full EuroCC formation catalog

Multi-site diffusion



Multi-site diffusion

LAPP
~ 40 people

LAPP
~ 40 people
Teachers : 6-7

LAPP

~ 40 people

Teachers : 6-7

**Webcast CC IN2P3
x4-5**

LAPP

~ 40 people

Teachers : 6-7

**Webcast CC IN2P3
x4-5**

Industry

LAPP

~ 40 people

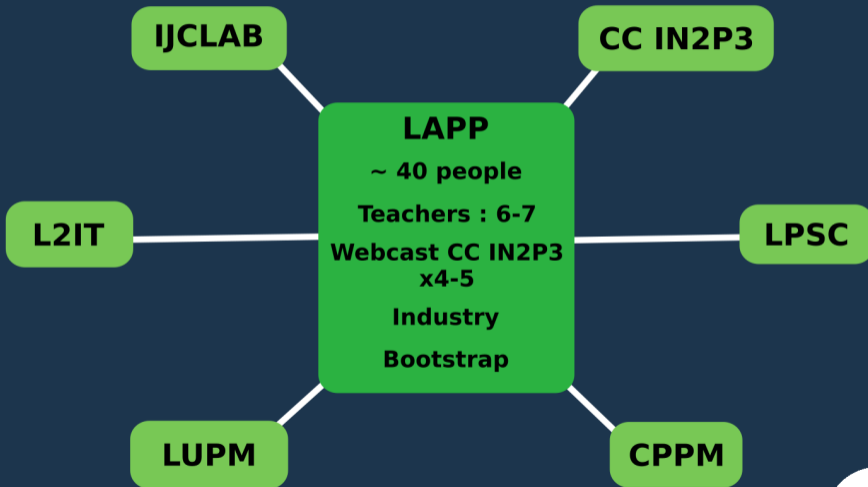
Teachers : 6-7

Webcast CC IN2P3
x4-5

Industry

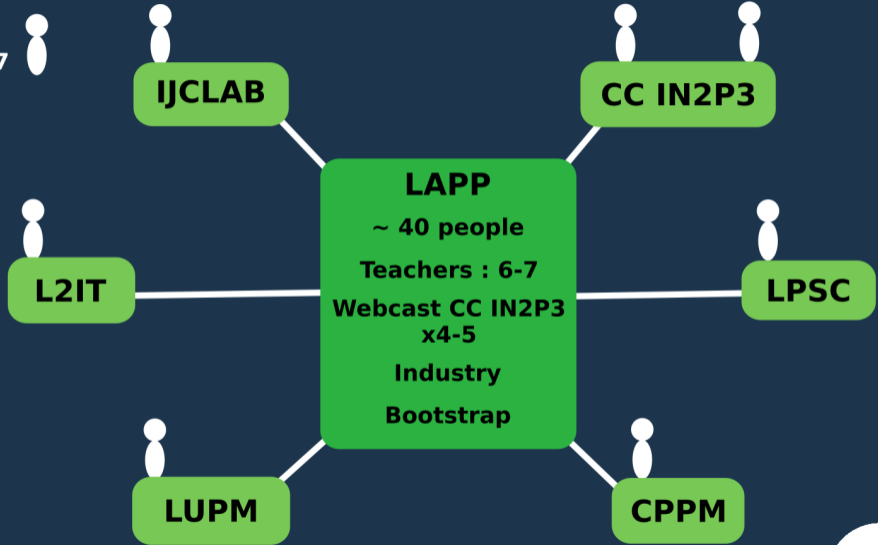
Bootstrap

Multi-site diffusion

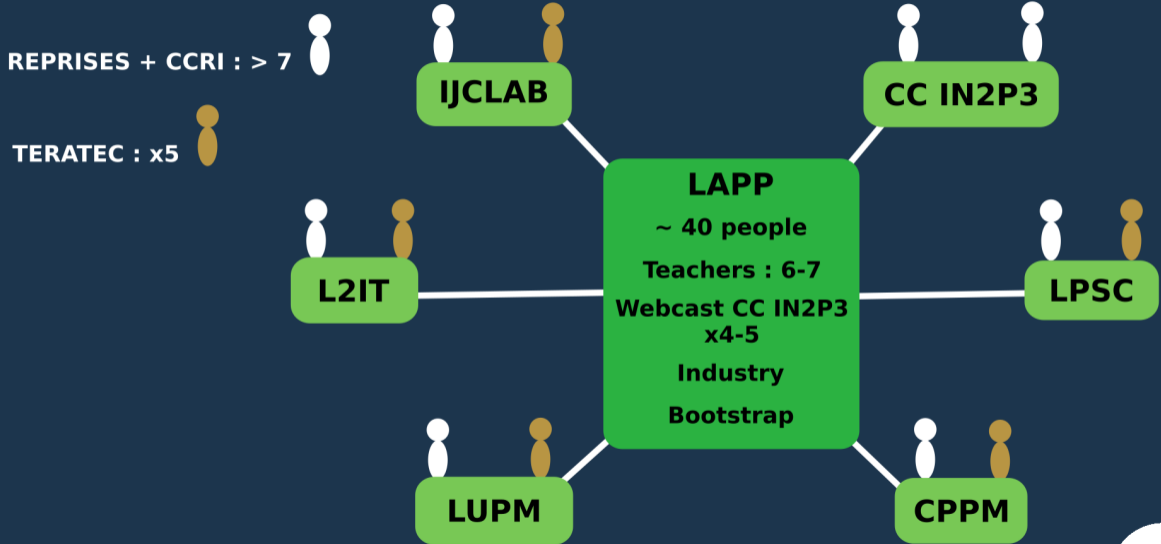


Multi-site diffusion

REPRISES + CCRI : > 7



Multi-site diffusion



- **TERATEC** partnership :
 - **Highlight** Laboratories
 - **Seminars**
 - **Conferences**
 - **Opportunities** with industrials
 - **Fête de la science**
 - **Eutopia**
 - Connection with **CCRI** :
 - **Webinars / Techninars**
 - Highlight **Journées Informatique**

- **TERATEC** partnership :
 - **Highlight** Laboratories
 - **Seminars**
 - **Conferences**
 - **Opportunities** with industrials
 - **Fête de la science**
 - **Eutopia**
 - Connection with **CCRI** :
 - **Webinars / Techninars**
 - Highlight **Journées Informatique**

If not :

- **EVERSE / OSCAR 2024 ?**
- **ANF 2025 ?**
- Other options ?