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Highlights from Track 5: Software Development

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ORIGINS Excellence Cluster

Bundesministerium
für Bildung
und Forschung

Track 5: Software Development

“Software frameworks; software management, continuous integration; software building; testing and quality assurance; software distribution; programming techniques and tools; coding for heterogeneous architectures; integration of ML and other toolkits.”

- 42 oral contributions from 39 speakers (and lots of contributors)
- 13 posters in rows 14-16

We would like to thank all the contribution for the interesting and well prepared talks

(as well as the lively discussion)

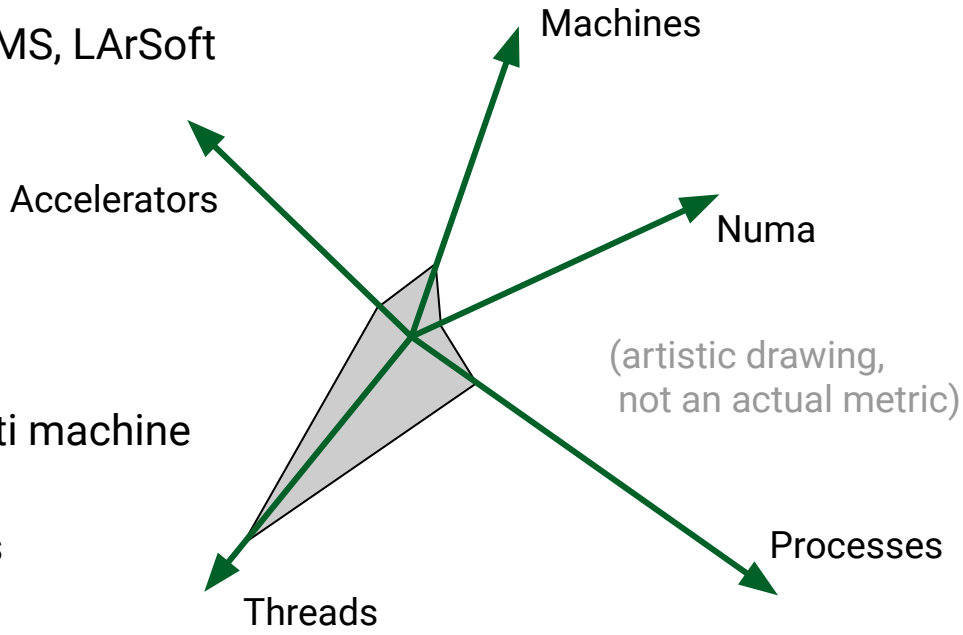
Following is are some **very** selected and biased highlights from this session.

Performance

Large effort to utilize all dimensions of performance

- multithreaded frameworks established
- thread performance by e.g. ATLAS, ILC, CMS, LArSoft
- GPU effort by e.g. LHCb, CMS, ATLAS

⇒ Shift to optimize in multiple dimensions



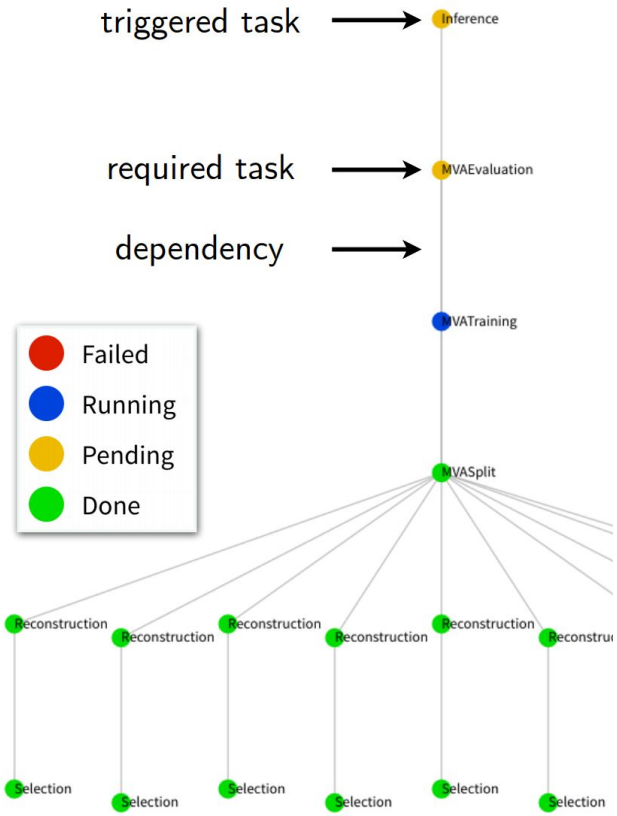
Two complementary approaches

- monolithic framework augmented by multi machine workflow management (e.g. Raythena)
- loosely coupled microservice frameworks (e.g. ALFA, CLARA)

Workflow management

Evolution in workflow management automation

- shift to more and advanced automated workflow decisions
- from early in the process (e.g. LHCb trigger configuration)
- up to analysis level (e.g. law)
- including the big frameworks (e.g. ATLAS, CMS, ALFA, CLARA, …)



Package Managers

"How to provide all the software we depend on?"

All our experiments depend on a large set of software dependencies

- support different versions
- reproducible builds
- install anywhere
- setup for use

➔ Effort under HSF Umbrella to evaluate solutions (one of the first HSF Working groups)

➔ Discussions and joint meetings between experiments

HEP Software Foundation

Spack Package Manager

Picking up momentum in HEP

- used by FCC, Key4HEP, SupeNEMO
- FAIR moving to spack
- CMS has proof of concept
- ATLAS considering but things still to be understood
- LHCb and Belle II willing to follow

spack.io

SpackDev: Multi-Package Development with Spack

“Coordinated build & test for integration, or initialize an environment for rapid build & test cycles of a particular package.”

- extension to Spack to help with development of interdependent packages

Packaging: Other Options and Use Cases

Spack is not the only possible solution

- Gentoo Prefix and many more

Conda and Conda Forge

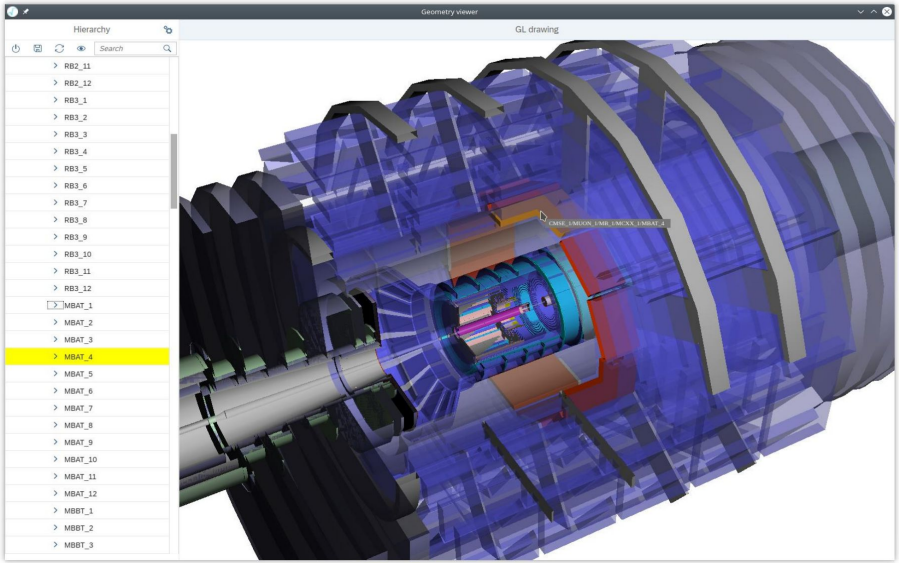
"Reliably install ROOT in under 5 minutes on any machine"

Chris Burr

- user centric software management
- increasing ease of use of many of our software packages

```
conda install python=3.8 root uproot boost-histogram
```

High Level Libraries (and more)



ROOT moving to Web technologies for Visualization

- reduce dependency on system libraries
- experimental but feedback welcome!

Boost Histogram

Standalone, high-performance, header-only histogramming library added to boost

- good python bindings

```
histogram(regular(20, -3, 3, options=underflow | overflow))
                  +-------------------------------------------------------+
[-inf,    -3) 9   |                                                       |
[  -3, -2.7) 19   |=                                                      |
[-2.7, -2.4) 36   |==                                                     |
[-2.4, -2.1) 110  |=====                                                  |
[-2.1, -1.8) 191  |=========                                              |
[-1.8, -1.5) 275  |=============                                          |
[-1.5, -1.2) 518  |========================                               |
[-1.2, -0.9) 644  |==============================                         |
[-0.9, -0.6) 914  |==========================================             |
[-0.6, -0.3) 1107 |=================================================      |
[-0.3,    0) 1183 |=======================================================|
[   0,  0.3) 1185 |=======================================================|
[ 0.3,  0.6) 1120 |=================================================      |
[ 0.6,  0.9) 874  |========================================               |
[ 0.9,  1.2) 663  |==============================                         |
[ 1.2,  1.5) 491  |======================                                 |
[ 1.5,  1.8) 322  |===============                                        |
```

Thank you for all the informative presentations and discussions