Elastic Analysis Facility (EAF)

Maria P. Acosta EAF (an SCD project) - ACORN

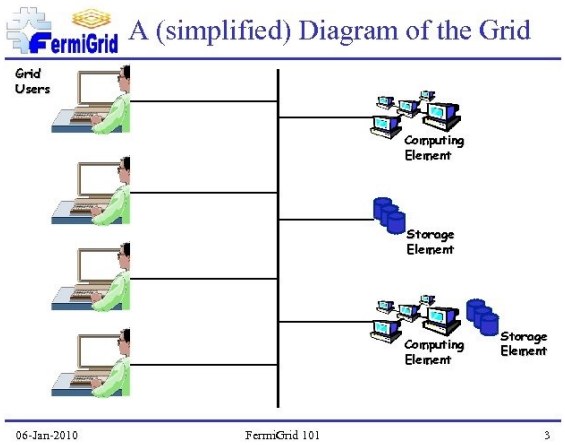
FIFE meeting

July 7th 2022

Analysis Facilities for the Future

A working version of an AF definition from the March HSF AF Forum kick-off meeting:

"The infrastructure and services that provide integrated data, software and computational resources to execute one or more elements of an analysis workflow. These resources are shared among members of a virtual organization and supported by that organization."



Some examples:

- LPC CAF
- Experiment VM nodes
- Custom submit points for Condor jobs (i.e DES)
- Local bash/sh, IDEs, Jupyter Notebooks

Fermilab's AF -- Fundamental principles:

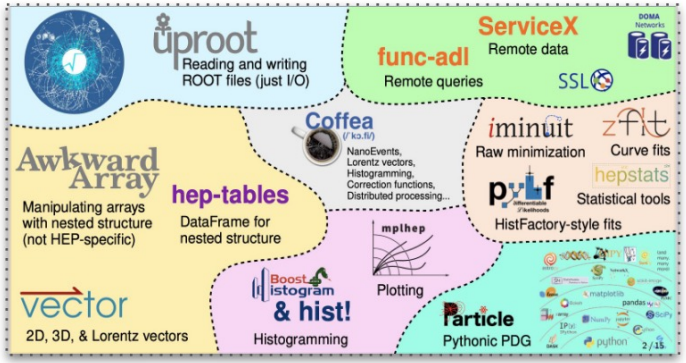
A JupyterHub-based web facility for scientific analysis for Fermilab experiments and scientists

- Create a user-oriented analysis facility based on our own experience supporting scientists on traditional technologies.
- Explore, deploy and collaborate on industry-level tools and strategies for optimizing data analysis.
- Facilitate the use and access of a pool of large, specialized hardware for all Fermilab users in and Elastic way.
- Foster collaboration with experiments and science groups in order to better understand current and future analysis needs.
- Provide effective, requirement-oriented computing solutions.

Secure	Integrated & functional	Multi-VO	DevOps (operational sustainability)	Active collaboration

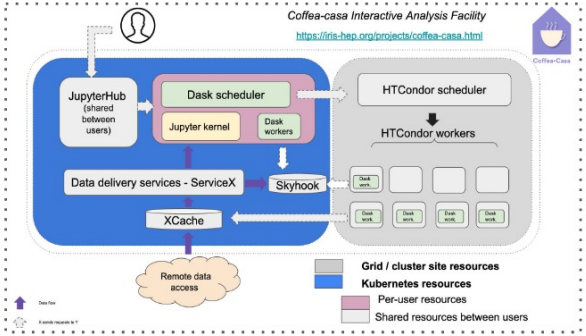
The ultimate goal:

Analysis Tools

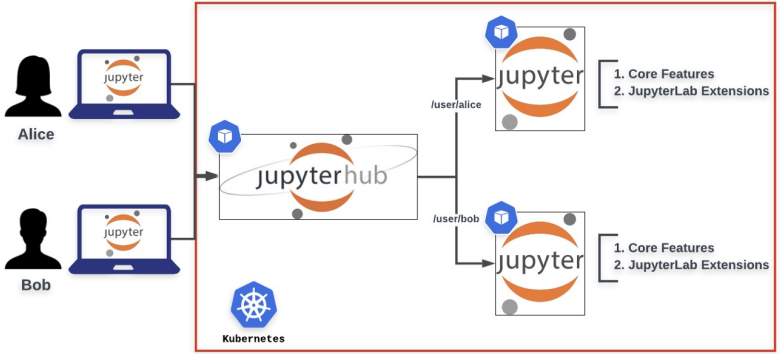


Analysis Facilities

(coffea-casa AF or any other facility matching tech.requirements)



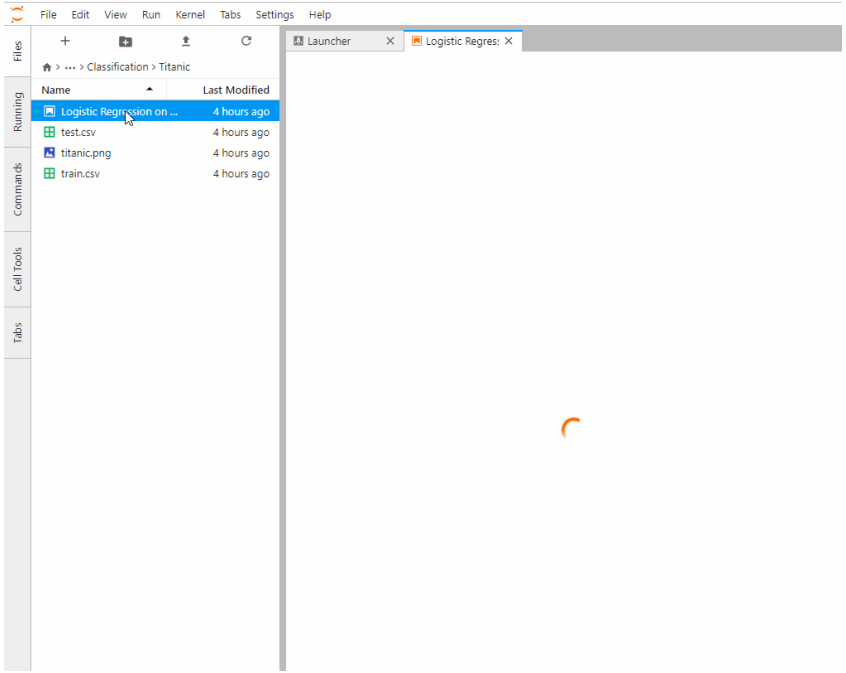
A JupyterHub-based deployment

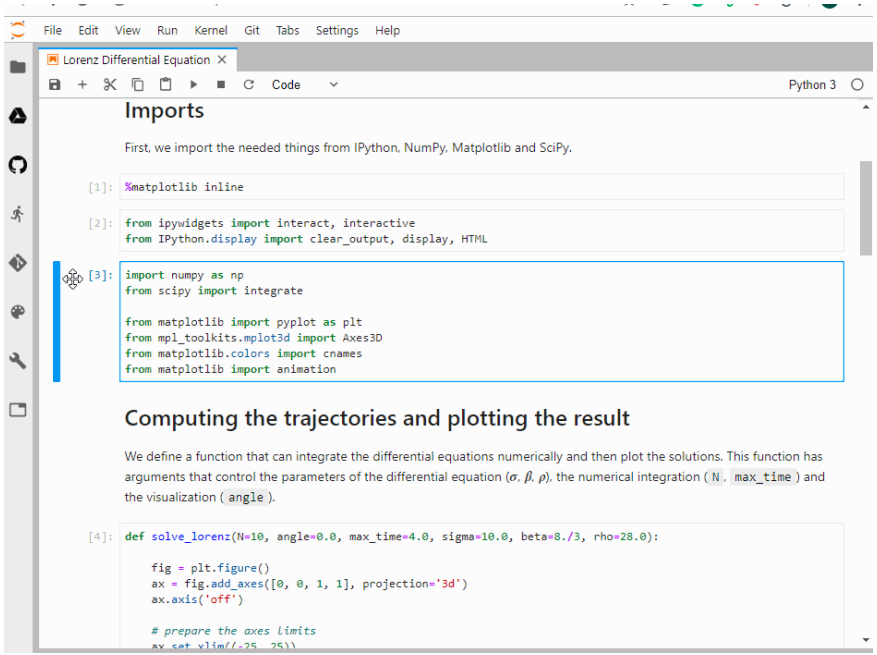


- Originally standalone Jupyter Notebooks.
- Evolved to a self-hosted, multi-user platform for hosting multiple notebooks, kernels and highly customizable environments.
- Can be deployed in multiple platforms including Cloud, on prem and Kubernetes.

✓ Implements authentication, login pages and token-based roles
✓ Tracks activity and does effective resource management
✓ Proxying is done behind the scenes

A JupyterHub-based deployment





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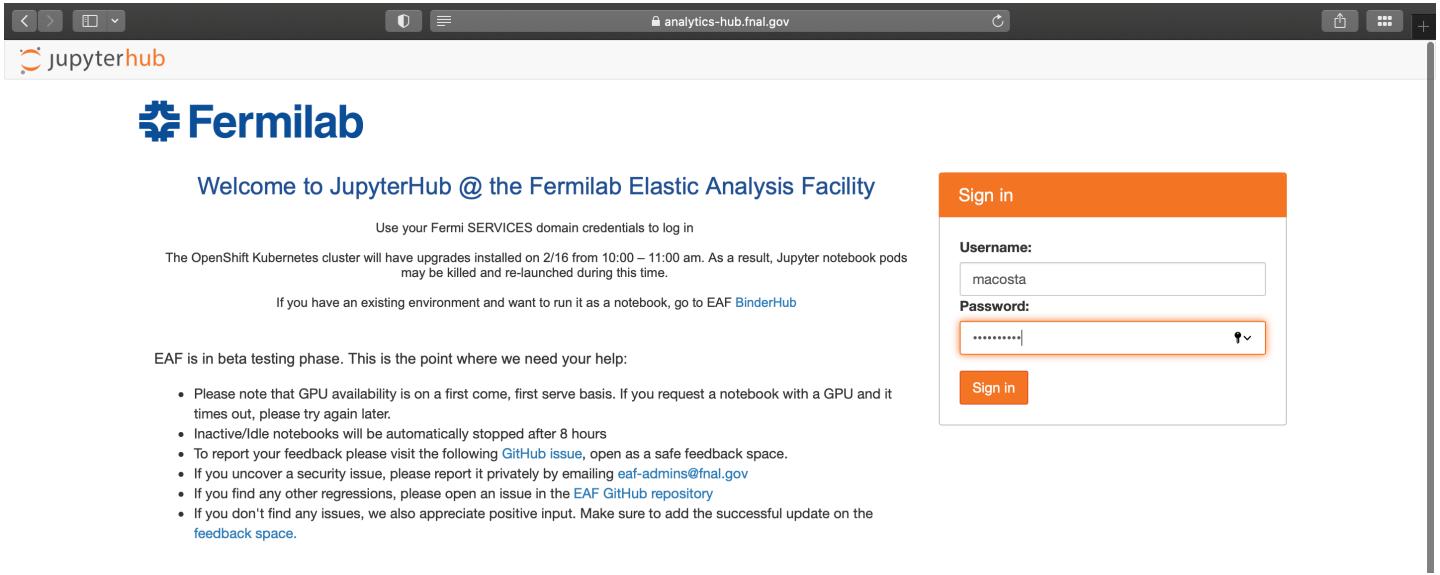
A JupyterHub-based deployment - Login and Auth



- Accessible from the Lab network or via VPN
- Login with SERVICES account
- UID/GID will be propagated to the notebook in order to preserve permissions

A JupyterHub-based deployment - Current Catalog

jupyterhub Home Token Help/FAQ Admin Services macosta Logout

Server Options

LBNF/DUNE/ProtoDUNE
- SL7 Interactive General Purpose Notebook
- GPU SL7 Interactive (NVIDIA Tesla T4)
- GPU SL7 Interactive (NVIDIA Tesla K40m)

FIFE/Neutrinos
- SL7 Interactive General Purpose Notebook
- GPU SL7 Interactive (NVIDIA Tesla K40m)
- GPU SL7 Interactive (NVIDIA Tesla T4)

Fermi generic SL7/CC8
- Basic SL7 Interactive
- Basic CC8 Interactive

ACORN
- ACORN CPU Only SL7 Interactive
- ACORN GPU SL7 Interactive (NVIDIA Tesla T4)
- L-CAPE CPU Only SL7 Interactive
- L-CAPE GPU SL7 Interactive (NVIDIA Tesla K40)
- L-CAPE GPU SL7 Interactive (NVIDIA Tesla T4)
- READS CPU Only SL7 Interactive
- READS GPU SL7 Interactive (NVIDIA Tesla K40)
- READS GPU SL7 Interactive (NVIDIA Tesla T4)

Cosmic Frontier
- SL7 Interactive General Purpose Notebook
- GPU SL7 Interactive (NVIDIA Tesla K40m)
- GPU SL7 Interactive (NVIDIA Tesla T4)

CMSLPC
- SL7 Interactive
- COFFEA-DASK SL7 Interactive
- GPU SL7 Interactive (NVIDIA Tesla K40m)
- GPU SL7 Interactive (NVIDIA Tesla T4)
- GPUaaS - Boosted Decision Trees SL7 Interactive (NVIDIA Tesla T4)

Start

A JupyterHub-based deployment - Named servers

analytics-hub.fnal.gov

jupyterhub Home Token Help/FAQ Admin Services macosta Logout

Stop My Server | My Server

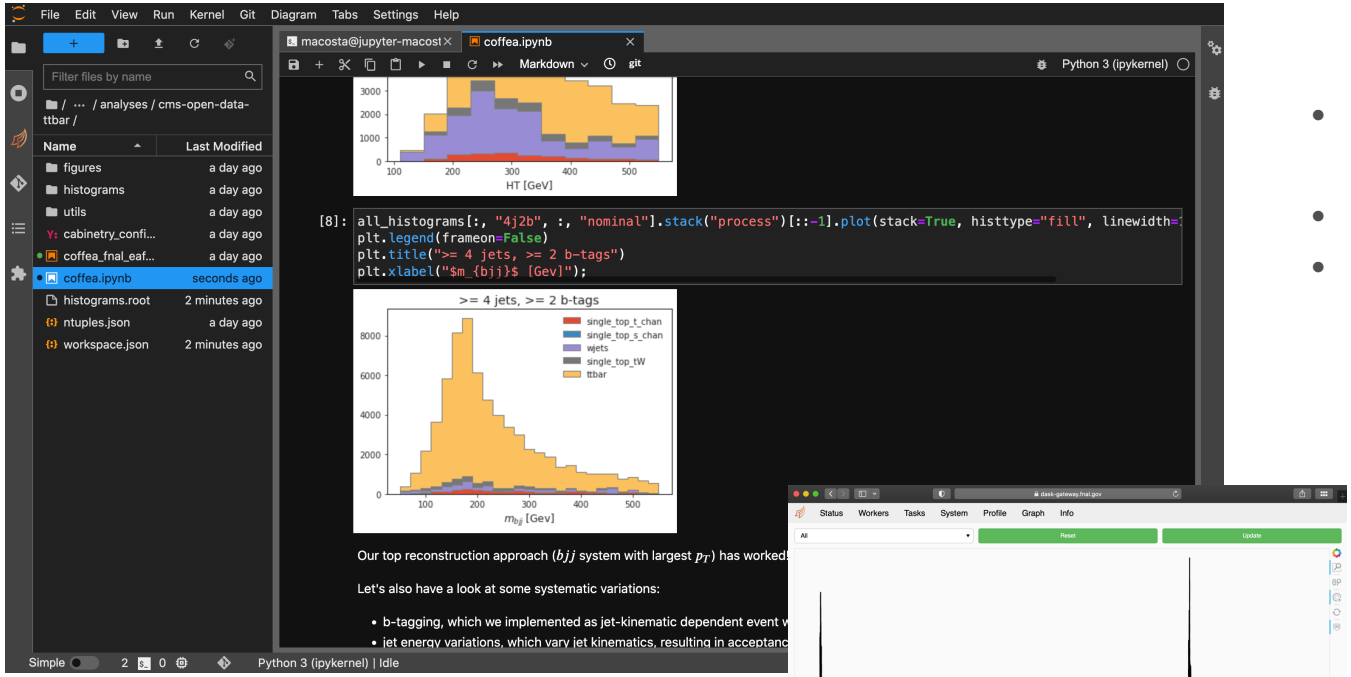
Named Servers

In addition to your default server, you may have additional 5 server(s) with names. This allows you to have more than one server running at the same time.

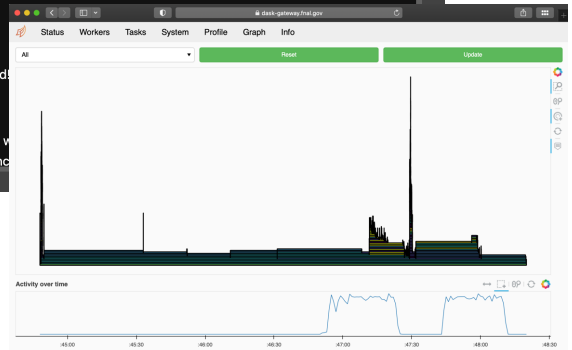
Server name	URL	Last activity	Actions
Name your server Add New Server			
ad		21 days ago	start delete
dask	/user/macosta/dask	a day ago	stop
dune		a month ago	start delete
fife		3 months ago	start delete
lpc		5 days ago	start delete

- Up to five, independent, isolated environments with shared persistent storage
- Activity monitoring and Application Token page
- CVMFS mounts, home areas and other specialized software will be included in the notebook

A JupyterHub-based deployment (on Beta) https://analytics-hub.fnal.gov



CMSLPC notebook running AGC COFFEA analysis



- 43 Beta users (thank you!)
- 22 Notebook flavors
- 1.2 Tb Ceph persistent storage allocated (of 45TB)

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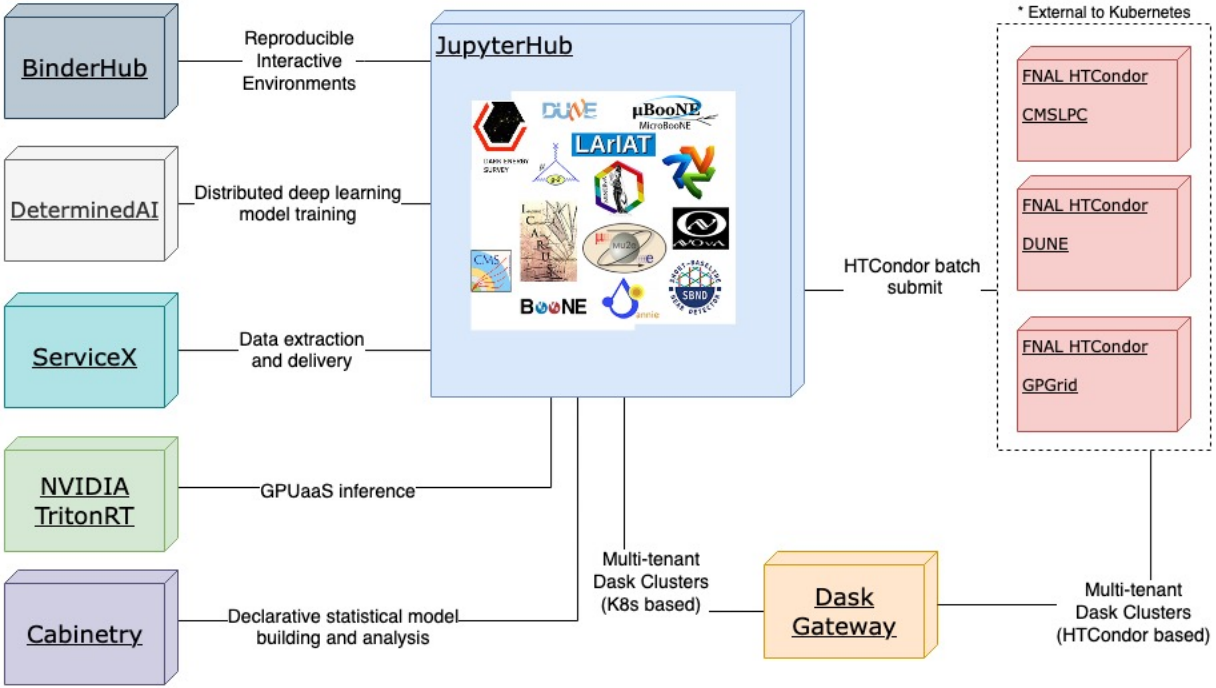
Current applications Ecosystem



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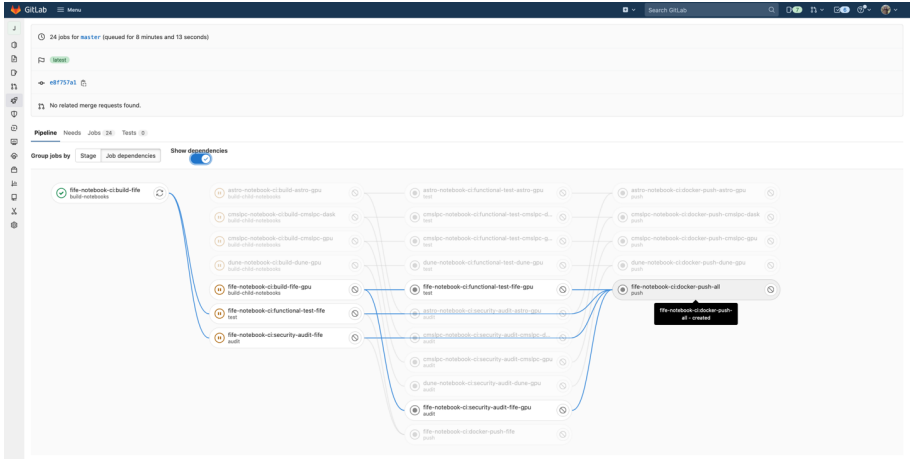
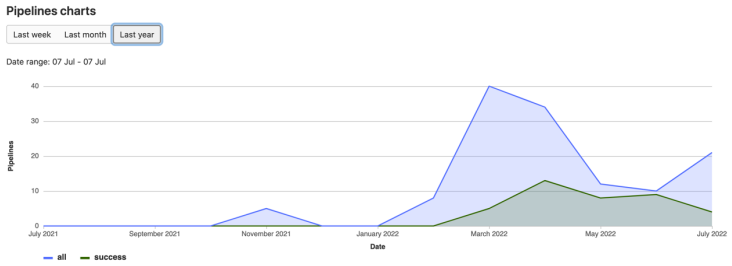
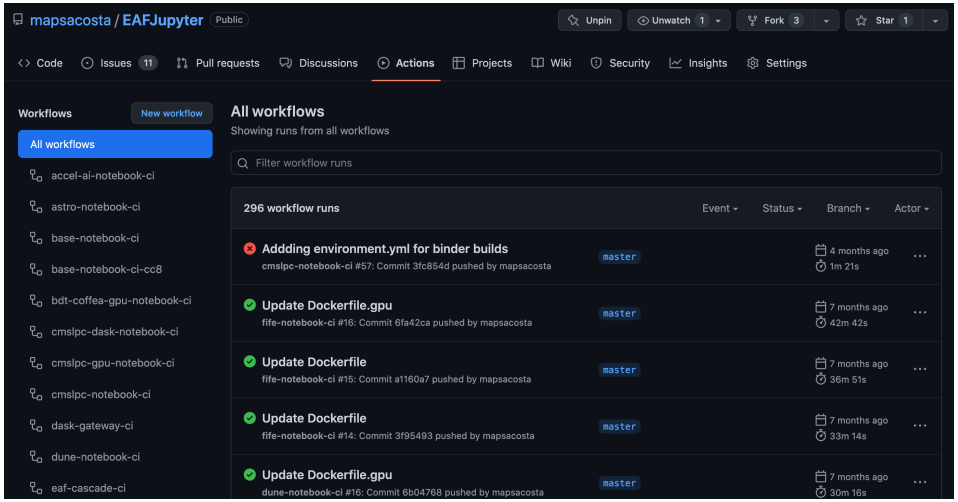
Operational Sustainability - GitLab analytics for CI/CD



A partial pipeline with dependencies



GitHub workflows for automated builds



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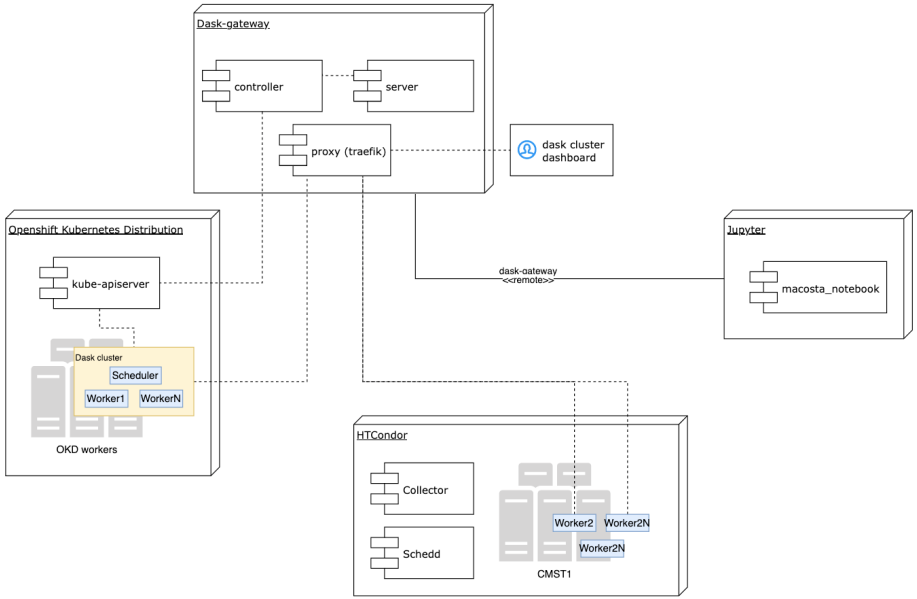
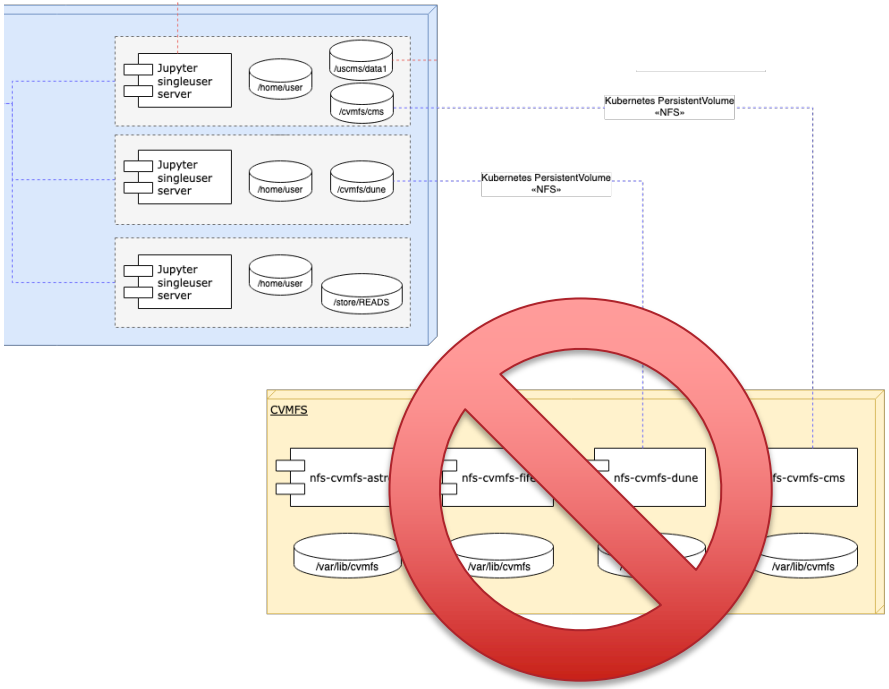
New functionality - Hybrid Dask Clusters



- lpcdaskgateway is a client extension for Dask Gateway which enables CMS users to dynamically obtain Dask compute resources from the LPC pool in the form of containerized dask worker jobs and from Kubernetes if they need/prefer.
- Latest version is installed by default and deployed to the COFFEA-DASK notebook on EAF.
- We are working on contributing multiple patches upstream as a result of this R&D work

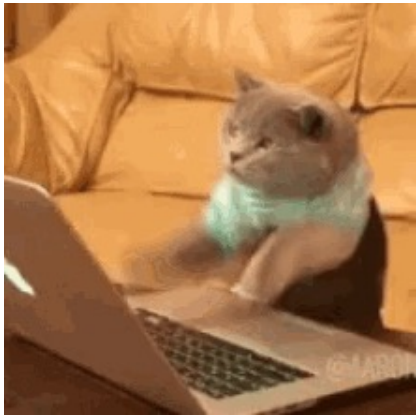
New functionality - cvmfsexec



- Removes the need to provide CVMFS via NFS mounts as it is known to be a problematic setup.
- We implemented some fault tolerance and pod lifecycle management to prototype servers with little improvement.
- Cvmfesexec - Developed by Dave Dykstra, allows mounting CVMFS repositories as an unprivileged user.
- First Kubernetes prototype implementation is live on EAF with local caches (per-user)

We need experiments input

- Have a project that could benefit from JupyterHub?
- Is there a computing need or requirement that fits the AF model?



Contact us!

- Email me (macosta@fnal.gov) and Burt Holzman (burt@fnal.gov) with your thoughts!
- Visit the NEW Documentation site: https://eafjupyter.readthedocs.io
- If you uncover a security issue, please report it privately by emailing eaf-admins@fnal.gov.
- If you find any other regressions, please open an issue in the EAF GitHub repository.
- If you don't find any issues, we also appreciate positive input. Make sure to add the successful update on the feedback space.

Closing thoughts

- Enabling data analysis tools and platforms and optimizing current CMS Software stack in preparation for HL-LHC is a huge motivator, but not the only one.
- DUNE, mu2e, cosmic frontier and other areas of the lab will benefit from a flexible, web-based terminal with Python engines, centralized authentication and authorization, shared home mounts and persistent storage.
- Opportunities for innovation and broader collaboration with industry and inter-division groups.
- Computing needs to understand needs of science to properly support it, this is a joint effort, and everyone is a part of it.
- Jobsub lite and FedID projects are becoming increasingly important for EAF, collaboration and communication is essential.

Thanks ☺ Questions?

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@macosta on Slack

Backup – detailed component diagram