

# How

# FAIR

# is scientific data?

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# Is my data FAIR?

## Findable

- indexed and searchable

## Accessible

- retrievable by identifiers
- Standard protocols

## Interoperable

- common vocabularies

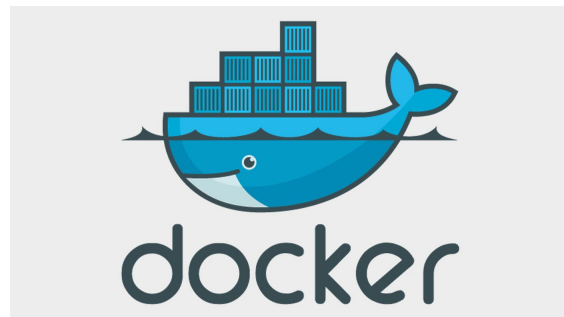
## Reusable

- clear licensing



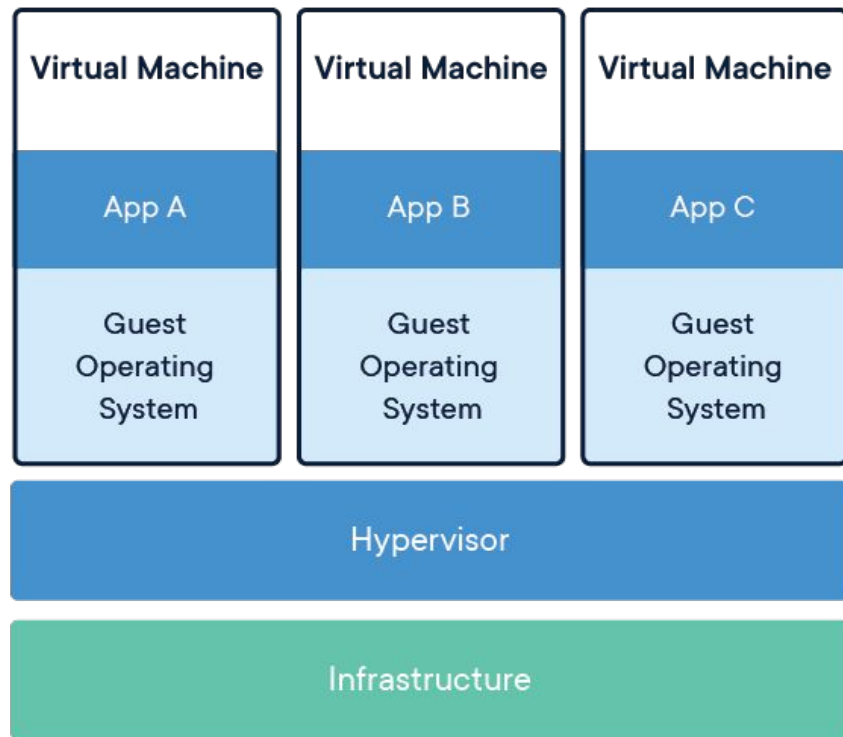
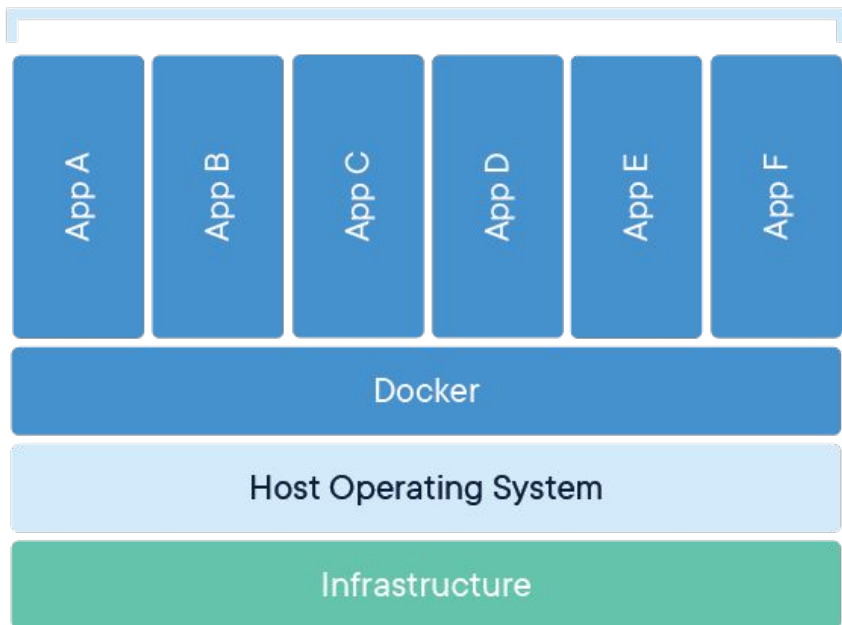
# Necessary tools

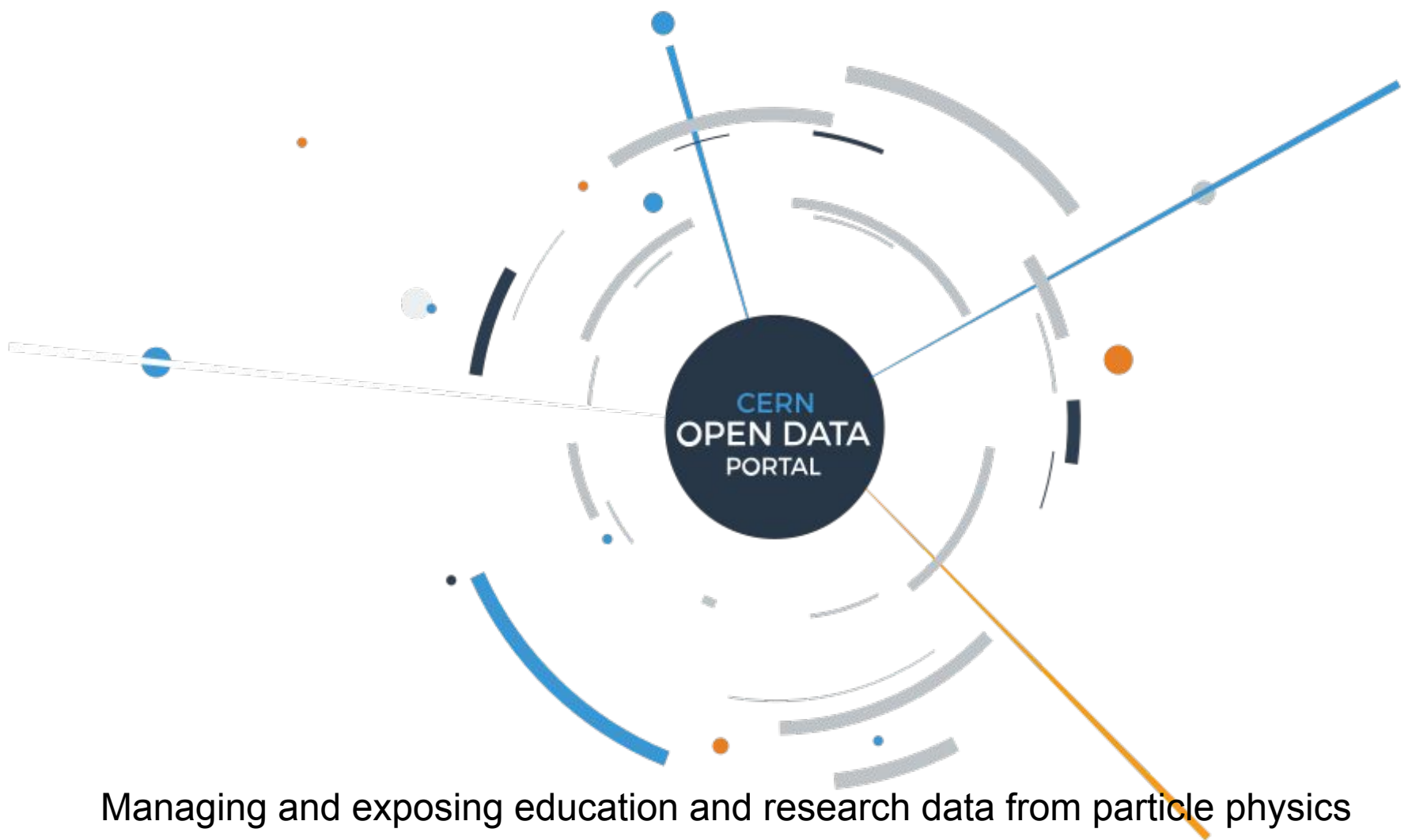
- Shell
- Git
- GitHub
- Docker
- Python



# Docker

Containerized Applications





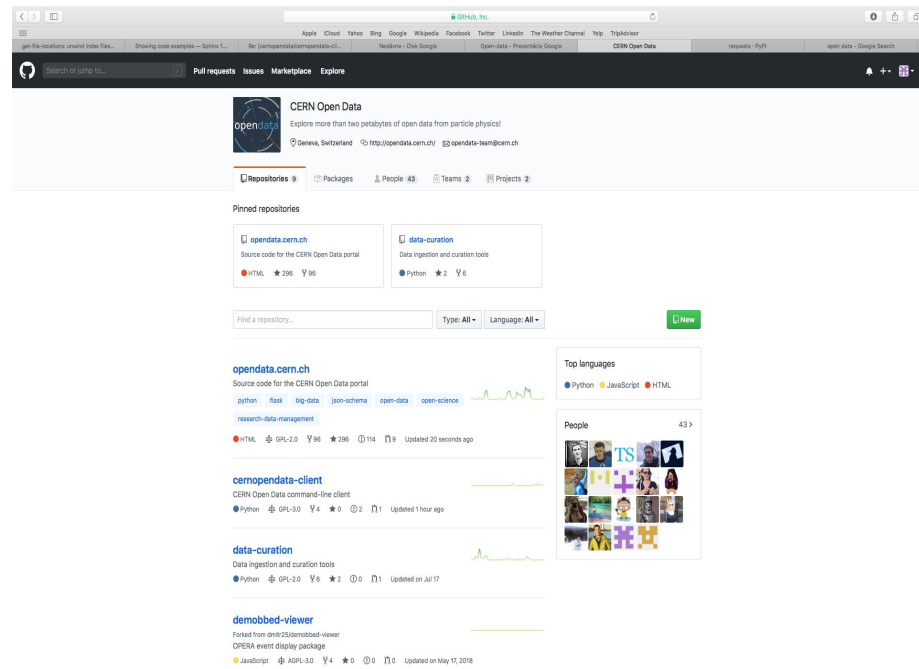
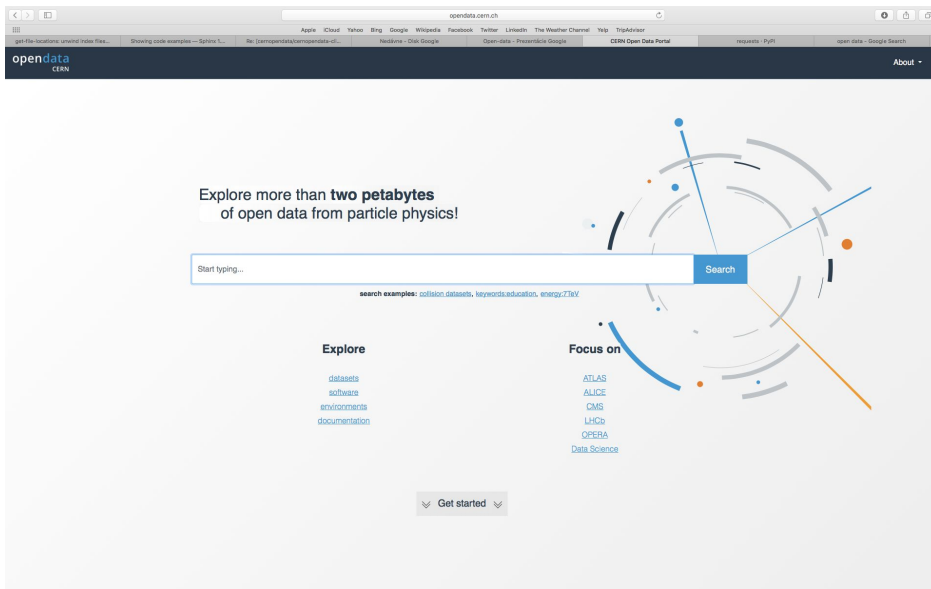
Managing and exposing education and research data from particle physics

# Why we use open data?

- Education
- Accessible information
- FAIR science



# How do open data sites look like?



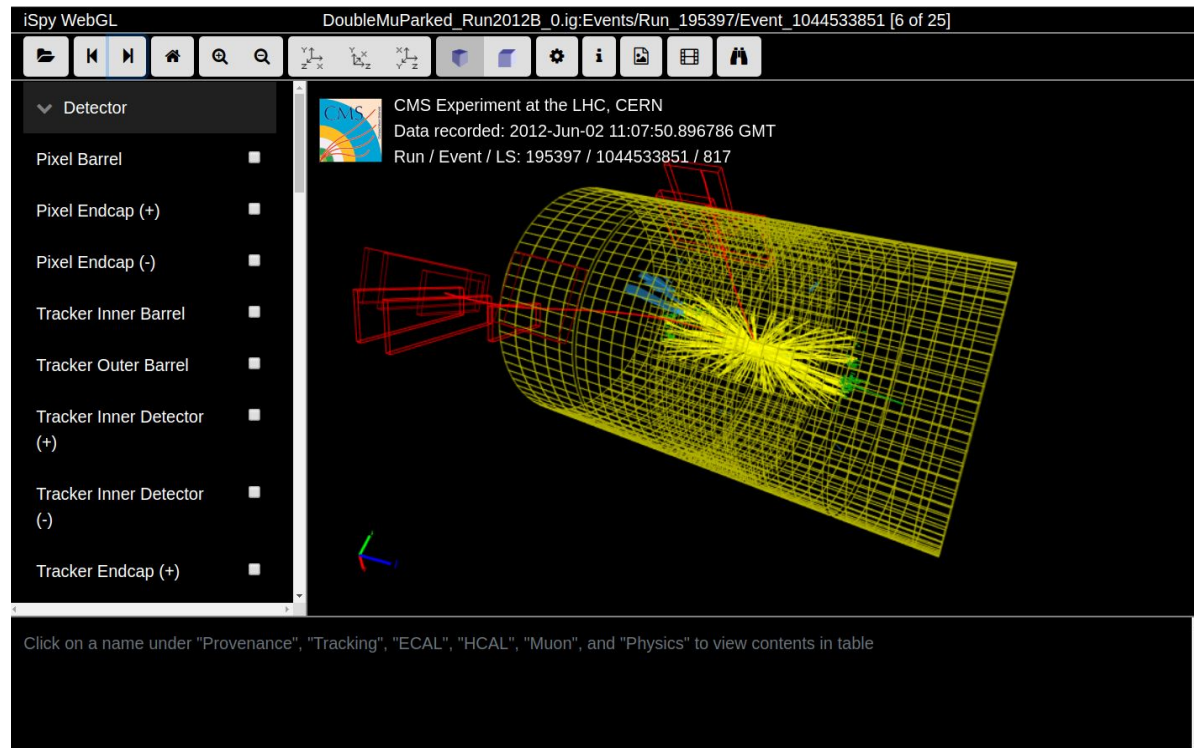
# What was our job?





# Event Display

- Interactive event simulations available in opendata



# Global tag fix and Twiki URL finder

- Bugfixing: replacement/removal of wrong tags
- New features: script searching for twiki.cern.ch urls

```
Open detect_twiki_urls.py Save
~/Desktop/opendata/opendata.cern.ch/sc

#!/usr/bin/env python

"""
Utility to find all twiki.cern.ch URLs in sources.
"""

import re
import subprocess

DEBUG = True

def main():
    """Main script doing the work."""
    found = []
    # find unique twiki.cern.ch URLs
    source = subprocess.getoutput('git grep twiki.cern.ch')
    for line in source.split('\n'):
        urls = re.findall(r'(https://twiki.cern.ch.*?)[\"\\]
    ]]', line)
        if DEBUG:
            print("*"*80)
            print("INPUT:", repr(line))
            for url in urls:
                if DEBUG:
                    print("FOUND", repr(url))
                if url not in found:
                    found.append(url)
    # print what was found
    for url in found:
        print(url)

if __name__ == '__main__':
    main()
```

Thu 17:23

CERN C Python Python subpre Moj dis Open ORCID WhatsA github

xmmit/479b2fde4b0b06e5356f94129ede520a46136a

Filip1509 / opendata.cern.ch

forked from cernopendata/opendata.cern.ch

Watch 0 Star 0 Fork 96

Code Pull requests Projects Wiki Security Insights Settings

records: system details removal from eventdisplay files

(addresses cernopendata#2790)

Signed-off-by: Filip Maxin <maxinfilip@gmail.com>

eventdisplayGTFix (#2795)

Filip1509 committed 6 hours ago 1 parent feedba3 commit 479b2fde4b0b06e5356f94129ede520a46136a

Showing 4 changed files with 0 additions and 332 deletions.

Unified Split

cernopendata/modules/fixtures/data/records/cms-eventdisplay-files-Run2011A.json

src	dst	diff
56	56	"run_period": [
57	57	"Run2011A"
58	58	],
59	59	"system_details": {
60	60	"global_tag": "FT_53_LV5_AN1:All",
61	61	"release": "CMS5W_5_3_30"
62	62	},
63	63	"title": "Event display file derived from /BTAG/Run2011A-12oct2013-v1/A00",
64	64	"type": {
65	65	"primary": "Dataset",
66	66	}
67	67	"run_period": [
68	68	"Run2011A"
69	69	],
70	70	"system_details": {
71	71	"global_tag": "FT_53_LV5_AN1:All",
72	72	"release": "CMS5W_5_3_30"
73	73	},
74	74	"title": "Event display file derived from /DoubleElectron/Run2011A-12oct2013-v1/A00",
75	75	"type": {
76	76	"primary": "Dataset",
77	77	}
78	78	"run_period": [
79	79	"Run2011A"
80	80	],
81	81	"system_details": {
82	82	"global_tag": "FT_53_LV5_AN1:All",
83	83	"release": "CMS5W_5_3_30"
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85	85	"title": "Event display file derived from /BTAG/Run2011A-12oct2013-v1/A00",
86	86	"type": {
87	87	"primary": "Dataset",
88	88	}
89	89	"run_period": [
90	90	"Run2011A"
91	91	],
92	92	"system_details": {
93	93	"global_tag": "FT_53_LV5_AN1:All",
94	94	"release": "CMS5W_5_3_30"
95	95	},
96	96	"title": "Event display file derived from /DoubleElectron/Run2011A-12oct2013-v1/A00",
97	97	"type": {
98	98	"primary": "Dataset",
99	99	}
100	100	"run_period": [
101	101	"Run2011A"
102	102	],
103	103	"system_details": {
104	104	"global_tag": "FT_53_LV5_AN1:All",
105	105	"release": "CMS5W_5_3_30"
106	106	},
107	107	"title": "Event display file derived from /BTAG/Run2011A-12oct2013-v1/A00",
108	108	"type": {
109	109	"primary": "Dataset",
110	110	}
111	111	"run_period": [
112	112	"Run2011A"
113	113	],
114	114	"system_details": {
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116	116	"release": "CMS5W_5_3_30"
117	117	},
118	118	"title": "Event display file derived from /DoubleElectron/Run2011A-12oct2013-v1/A00",
119	119	"type": {
120	120	"primary": "Dataset",
121	121	}
122	122	"run_period": [
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127	127	"release": "CMS5W_5_3_30"
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129	129	"title": "Event display file derived from /BTAG/Run2011A-12oct2013-v1/A00",
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160	160	"release": "CMS5W_5_3_30"
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171	171	"release": "CMS5W_5_3_30"
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178	178	"Run2011A"
179	179	],
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182	182	"release": "CMS5W_5_3_30"
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188	188	"run_period": [
189	189	"Run2011A"
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191	191	"system_details": {
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193	193	"release": "CMS5W_5_3_30"
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200	200	"Run2011A"
201	201	],
202	202	"system_details": {
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204	204	"release": "CMS5W_5_3_30"
205	205	},
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212	212	],
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233	233	"Run2011A"
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267	267	],
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272	272	"title": "Event display file derived from /DoubleElectron/Run2011A-12oct2013-v1/A00",
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277	277	"Run2011A"
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279	279	"system_details": {
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359	359	},
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369	369	"release": "CMS5W_5_3_30"
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413	413	"release": "CMS5W_5_3_30"
414	414	},

# Jupyter notebooks and invariant mass

- Dynamic environment to run and understand code in scientific context

## 3) Plotting the histogram

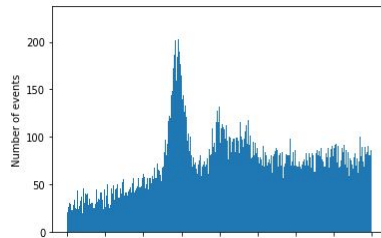
Now we can create and plot the histogram of the values of the invariant masses that we got. The histogram shows that in how many events the invariant mass of the muon pair has been in the certain value range. Note that we will use total 500 bins in the histogram, so you won't spot the separate bins because there are so many of them.

```
In [3]: # Plot the histogram with the function hist() of the matplotlib.pyplot module:
# (http://matplotlib.org/api/pyplot_api.html?highlight=matplotlib.pyplot.hist#matplotlib.pyplot.hist).
# 'Bins' determines the number of the bins used.
plt.hist(invariant_mass, bins=500)

# Name the axes and give the title.
plt.xlabel('Invariant mass [GeV]')
plt.ylabel('Number of events')
plt.title('The histogram of the invariant masses of two muons \n') # \n creates a new line for making the title look better

# Show the plot.
plt.show()
```

The histogram of the invariant masses of two muons



# Opendata-client

- Used in shell
- What can we use it for?
  - cernopendata-client → get-file-locations (list of files belonging to a dataset)  
→ get-record (records content by its recid, doi or title..)
- Were there any issues?



```
((base) rokas-macbook:cernopendata-client anovorol$ git branch
  11-git-fix
  11-gt-fix
  9-unwind-index-files
  docs-authors
* master
((base) rokas-macbook:cernopendata-client anovorol$ git checkout 9-unwind-index-files
Switched to branch '9-unwind-index-files'
((base) rokas-macbook:cernopendata-client anovorol$ git status
On branch 9-unwind-index-files
Untracked files:
  (use "git add <file>..." to include in what will be committed)

        .DS_Store

nothing added to commit but untracked files present (use "git add" to track)
((base) rokas-macbook:cernopendata-client anovorol$ cernopendata-client --help
Usage: cernopendata-client [OPTIONS] COMMAND [ARGS]...

Options:
  --help  Show this message and exit.

Commands:
  get-file-locations  Get a list of files belonging to a dataset.
  get-record          Get records content by its recid, doi or title...
((base) rokas-macbook:cernopendata-client anovorol$ cernopendata-client get-file-locations --helpo
Usage: cernopendata-client get-file-locations [OPTIONS]
Try "cernopendata-client get-file-locations --help" for help.

Error: no such option: --helpo
((base) rokas-macbook:cernopendata-client anovorol$ cernopendata-client get-file-locations --help
Usage: cernopendata-client get-file-locations [OPTIONS]

  Get a list of files belonging to a dataset.

Options:
  --recid INTEGER      Record ID
  --doi TEXT           Digital Object Identifier.
  --title TEXT         Record title
  --protocol [root|http] Protocol to be used in links.
  --expand / --no-expand Expand file indexes? [default=yes]
  --help              Show this message and exit.
((base) rokas-macbook:cernopendata-client anovorol$ cernopendata-client get-file-locations --recid 1 --no-expand
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0000_file_index.json
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0000_file_index.txt
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0001_file_index.json
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0001_file_index.txt
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0002_file_index.json
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0002_file_index.txt
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0003_file_index.json
root://eospublic.cern.ch/eos/opendata/cms/Run2010B/BTau/AOD/Apr21ReReco-v1/file-indexes/CMS_Run2010B_BTau_AOD_Apr21ReReco-v1_0003_file_index.txt
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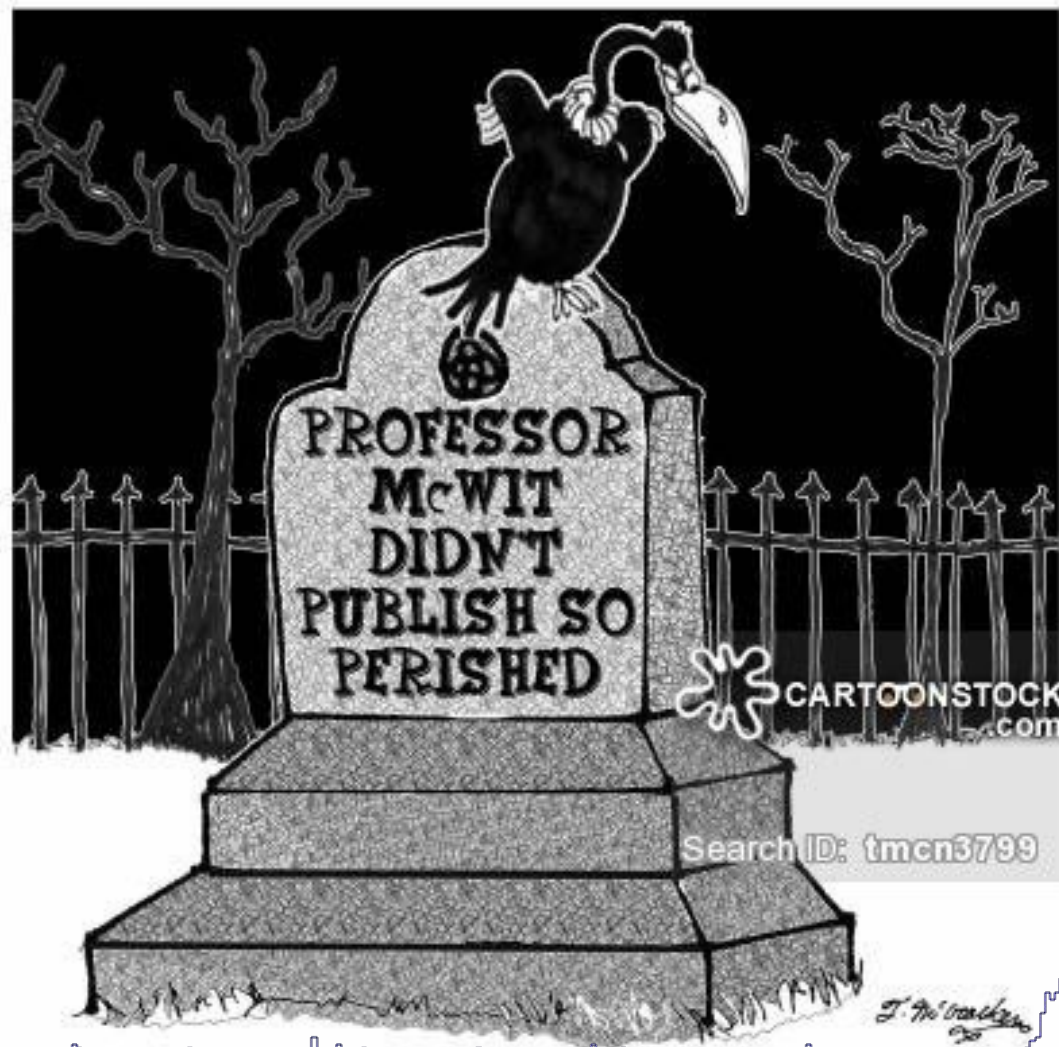


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# reana

REusable ANALyses

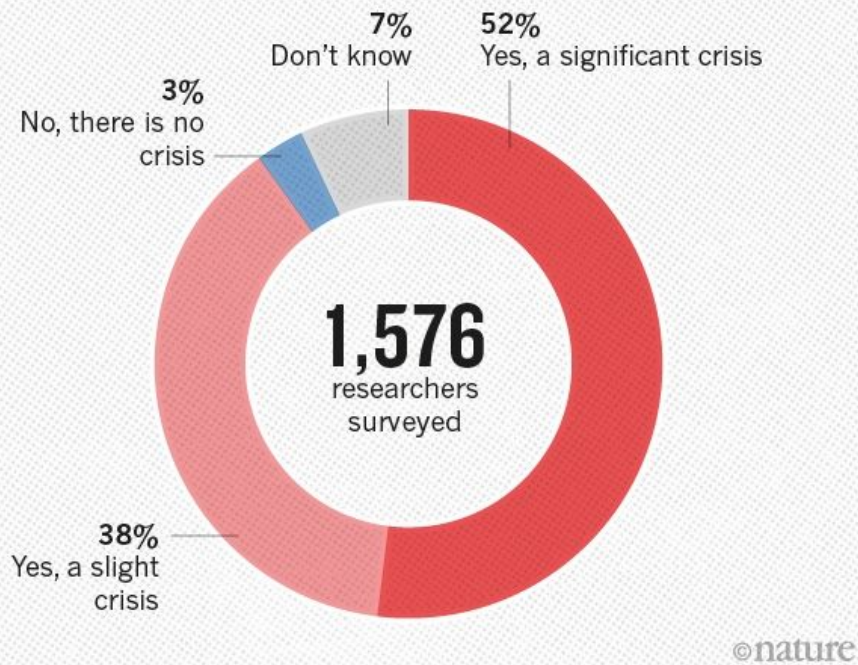




Search ID: tmcn3799

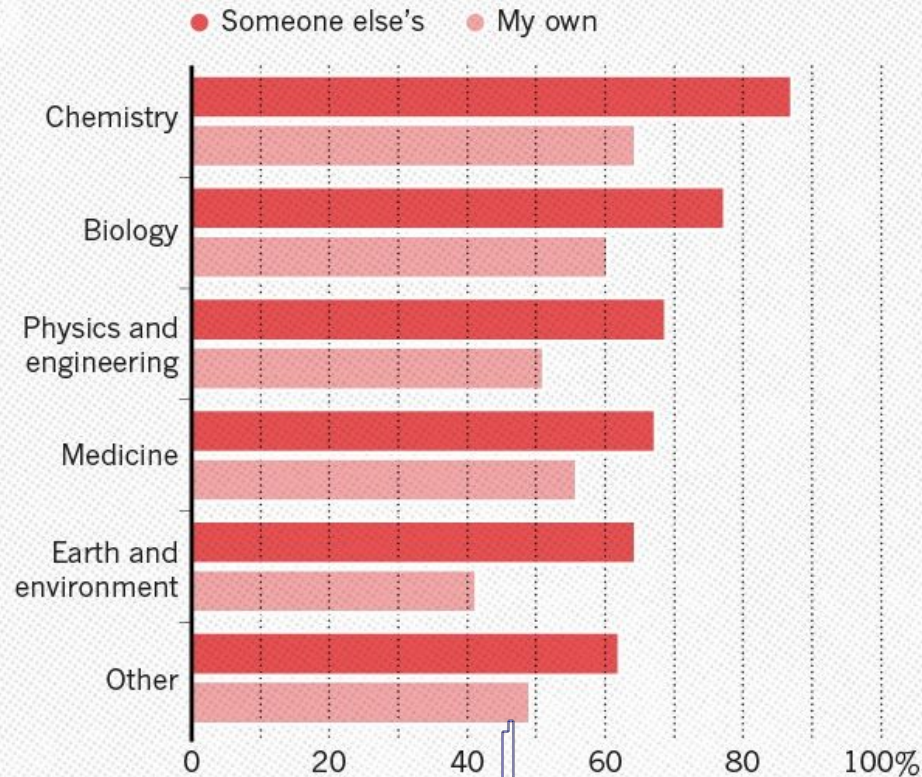


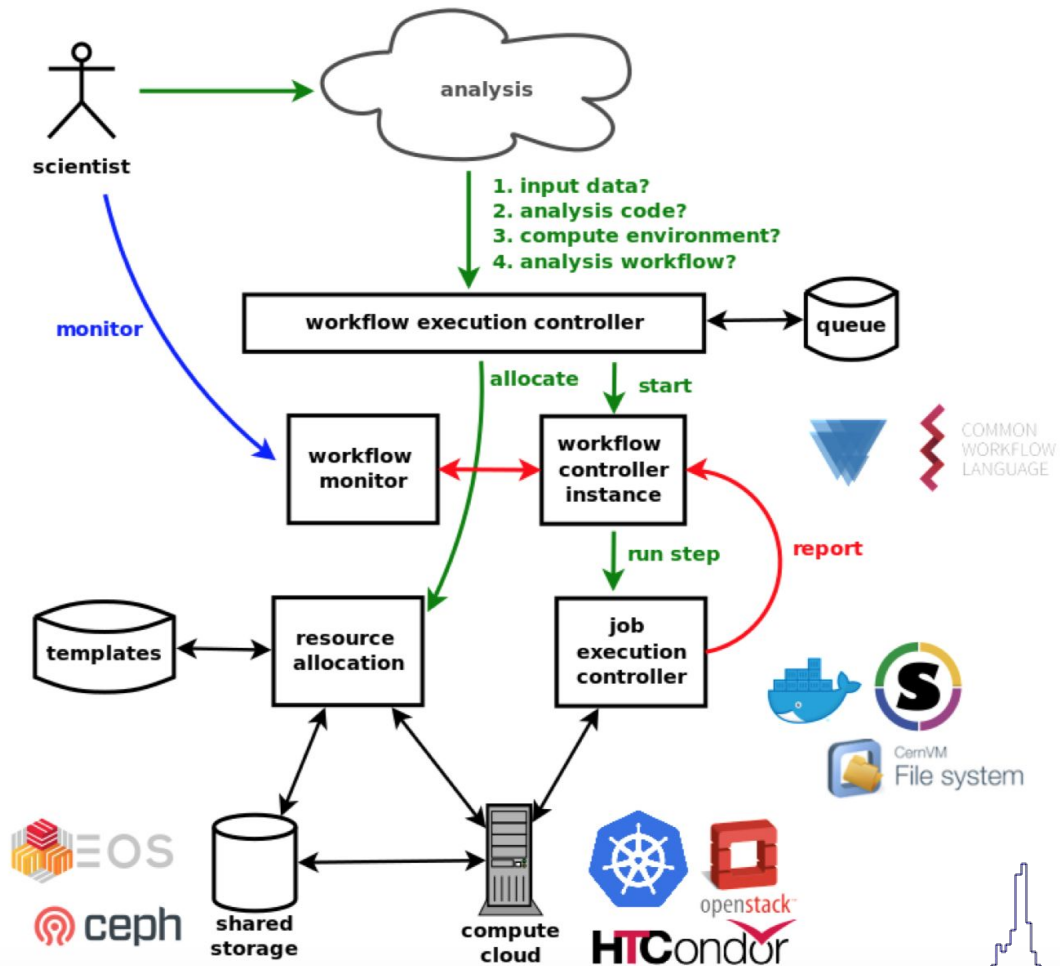
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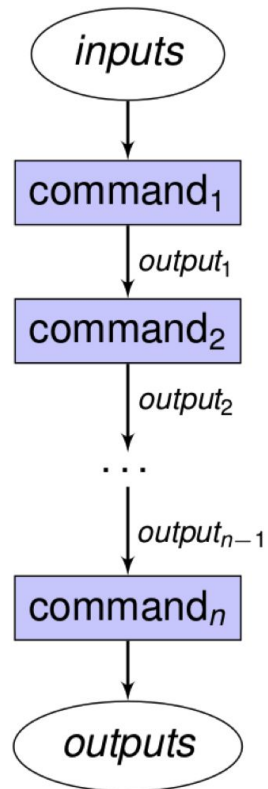


## HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?

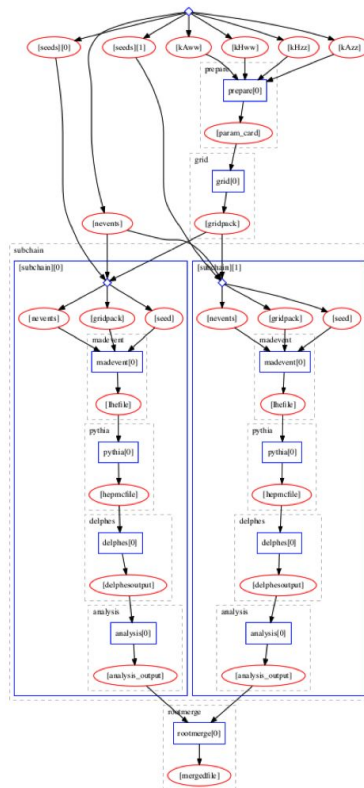
Most scientists have experienced failure to reproduce results.



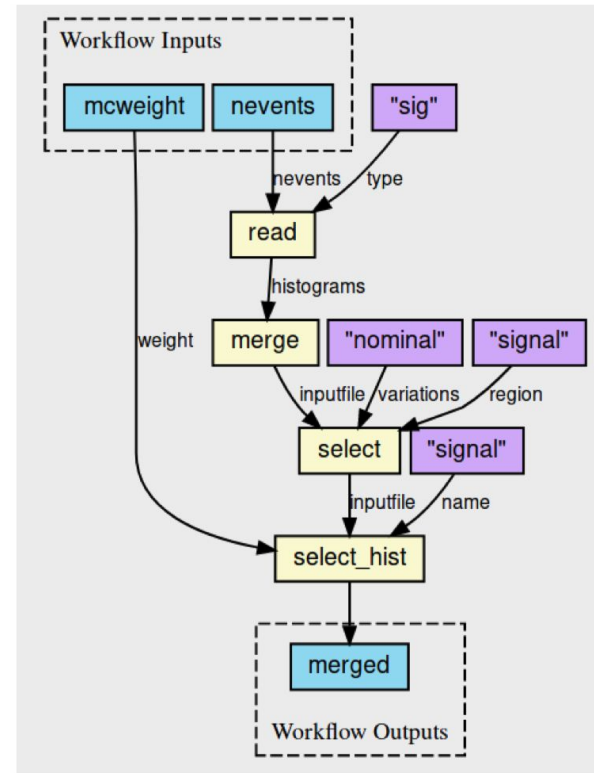




Serial



Yadage




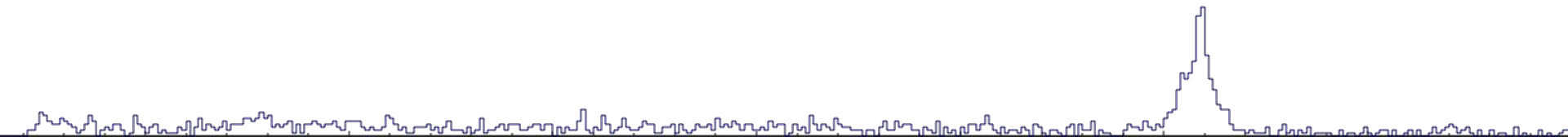
CWL

# Our contribution - REANA example

1. Take data from



2. Use **existing code** to produce dimuon spectrum.
3. Containerize the code using **docker** 
4. Produce a REANA example on GitHub.



# Invariant mass

$$X \equiv \begin{pmatrix} ct \\ x \\ y \\ z \end{pmatrix}, \quad X' = \Lambda X, \quad ds^2 \equiv dX \cdot dX = c^2(t)^2 - dx^2 - dy^2 - dz^2 \text{ is invariant}$$

$$ds = cd\tau, \quad d\tau = \frac{ds}{c} \text{ is invariant}$$

$$U \equiv \frac{dX}{d\tau} = \frac{dt}{d\tau} \begin{pmatrix} c \\ \mathbf{u} \end{pmatrix} = \gamma \begin{pmatrix} c \\ \mathbf{u} \end{pmatrix}, \quad U \cdot U = c^2$$

$$P \equiv mU = \begin{pmatrix} m\gamma c \\ m\gamma \mathbf{u} \end{pmatrix} = \begin{pmatrix} E/c \\ \mathbf{p} \end{pmatrix}, \quad P \cdot P = m^2 c^2 = (E/c)^2 - \mathbf{p}^2$$





# Final result

reanahub / reana-demo-cms-dimuon-mass-spectrum

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Code Issues 0 Pull requests 0 Projects 0 Wiki Security Insights

REANA example - CMS dimuon mass spectrum

6 commits 1 branch 0 releases 3 contributors MIT

Branch: master New pull request Create new file Upload files Find File Clone or download

ronalddobos and tiborsimko docs: README.rst	Latest commit a974447 23 hours ago
datasets	initial import 2 days ago
docs	docs: README.rst 9 minutes ago
python	initial import 2 days ago
src	code: changes in graph axis descriptions 3 hours ago
.gitignore	docs: README.rst 9 minutes ago
BuildFile.xml	initial import 2 days ago
LICENSE	Initial commit 2 days ago
README.rst	docs: README.rst 9 minutes ago
demoanalyzer_cfg.py	initial import 2 days ago
reana.yaml	reana: initial configuration 2 hours ago
run.sh	workflow: standalone run.sh script to run analysis in docker 22 hours ago

README.rst

## REANA example - CMS dimuon mass spectrum

We start by creating a [reana.yaml](#) file describing the above analysis structure with its inputs, code, runtime environment, computational workflow steps and expected outputs:

We can now install the REANA command-line client, run the analysis and download the resulting ROOT file containing plots:

```
$ # create new virtual environment
$ virtualenv ~/.virtualenvs/myreana
$ source ~/.virtualenvs/myreana/bin/activate
$ # install REANA client
$ pip install reana-client
$ # connect to some REANA cloud instance
$ export REANA_SERVER_URL=https://reana.cern.ch/
$ export REANA_ACCESS_TOKEN=XXXXXXX
$ # create new workflow
$ reana-client create -n my-analysis
$ export REANA_WORKON=my-analysis
$ # upload input code and data to the workspace
$ reana-client upload
$ # start computational workflow
$ reana-client start
$ # ... should be finished in about 1 minute
$ reana-client status
$ # download output root file with generated plots
$ reana-client download
```

Please see the [REANA-Client](#) documentation for more detailed explanation of typical `reana-client` usage scenarios.

## Contributors

The list of contributors in alphabetical order:

- Radovan Lascsak
- Ronald Dobos
- Tibor Sinko

# Thank you for your attention



Yes I know what REANA means

R - *I*

E - *have*

A - *no*

N - *idea*

A - *send help*

Yes I'm HAPPY



H  
A  
P  
P  
Y

**Sad**

2happy4meirl