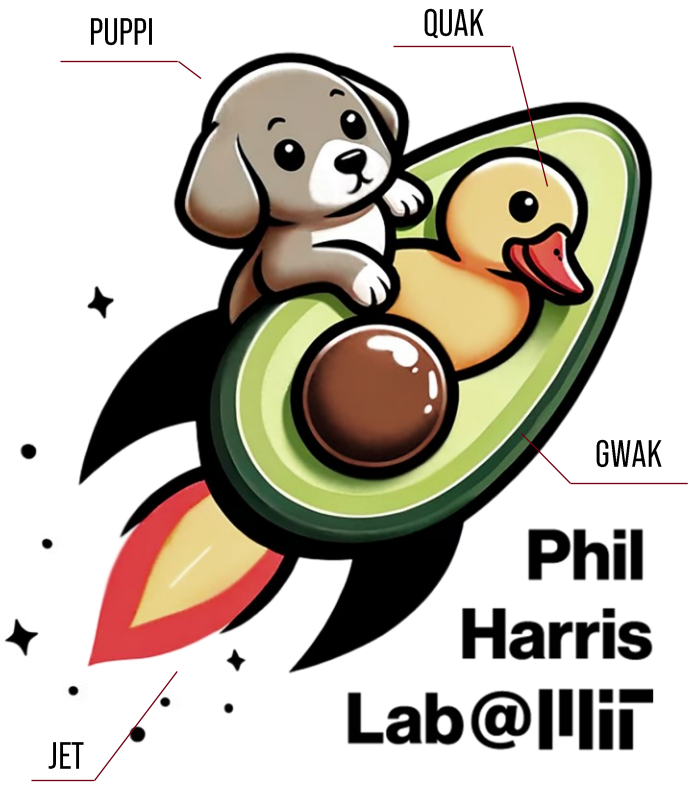
Massachusetts Institute of Technology

Data Visualization in HEP

... or histogramming and more histogramming



Andrzej Novak

06/20/2024

USCMS/IRIS-HEP Analysis Software Training (Princeton)

About & Outline

About Me

- Postdoc at MIT
  - Previously at RWTH Aachen
- CMS Common Analysis Tools
  - DPROC (Data Processing Tools) L3
  - Part of initiative for standard CMS color scheme
- **mplhep**
  - author and maintainer

Outline

- Links and Resources
- CMS Colors and Figure Guidelines

Live Jupyter tutorial

- Quick matplotlib, mplhep, hist demo
- Histogramming in practice
- Bonus: extended examples

Links and Resources

- CMS CAT Documentation (Work in Progress but already helpful)
  - https://cms-analysis.docs.cern.ch/
- CMS-Talk Cat
  - https://cms-talk.web.cern.ch/c/physics/cat/274
- `hist` documentation
  - https://hist.readthedocs.io/en/latest/
- `hist` documentation part 2! – UHI (universal histogramming interface)
  - https://uhi.readthedocs.io/en/latest/
- `mplhep` documentation
  - https://mplhep.readthedocs.io/en/latest/
- `matplotlib` documentation
  - https://matplotlib.org/

- Stack Overflow!

CMS Official Plotting Guidelines

- CAT documentation to replace old TWikis [FigGuidelines]
  - https://cms-analysis.docs.cern.ch/guidelines/plotting/general/
  - Now featuring demo snippets for both Python and ROOT
- Updated font recommendation
  - Fonts: Helvetica (ROOT), Tex Gyre Heros (python) - open Helvetica clone
- **Plots in both python and ROOT should look the same!**
  - And should look the same regardless of OS used to produce them
  - PyROOT package available on github.com and PyPI as “cmsstyle”

In-frame

Python ROOT

```
hep.cms.label("Preliminary", loc=2, ax=ax)
```

Out-of-frame

Python ROOT

```
hep.cms.label("Preliminary", loc=0, ax=ax)
```

In-frame

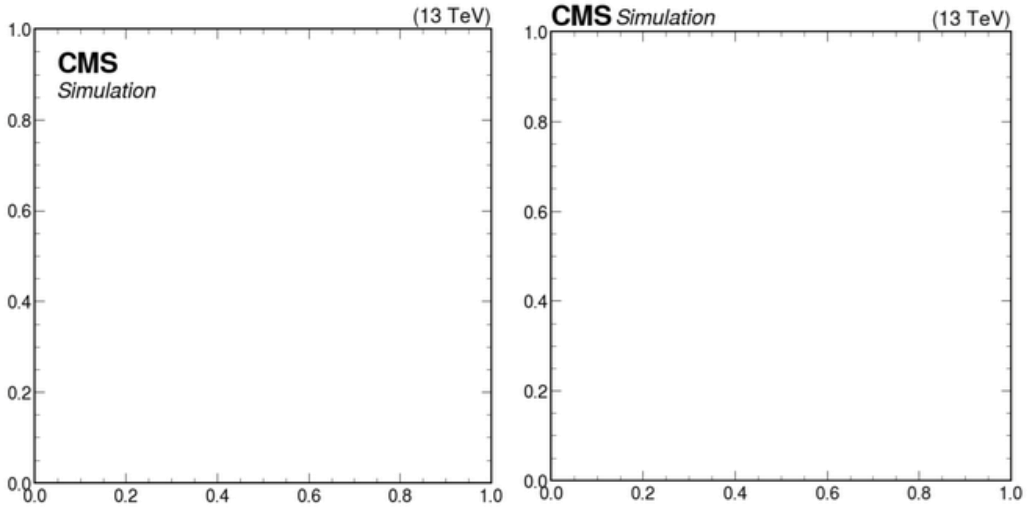
Python ROOT

```
CMS.SetExtraText("Simulation Preliminary")
CMS.SetLumi("")
canv = CMS.cmsCanvas('', 0, 1, 0, 1, '', '', square = CMS.kSquare, extraSpace=0.01
```

Out-of-frame

Python ROOT

```
CMS.SetExtraText("Simulation Preliminary")
CMS.SetLumi("")
canv = CMS.cmsCanvas('', 0, 1, 0, 1, '', '', square = CMS.kSquare, extraSpace=0.01
```



CMS Accessible Color Scheme

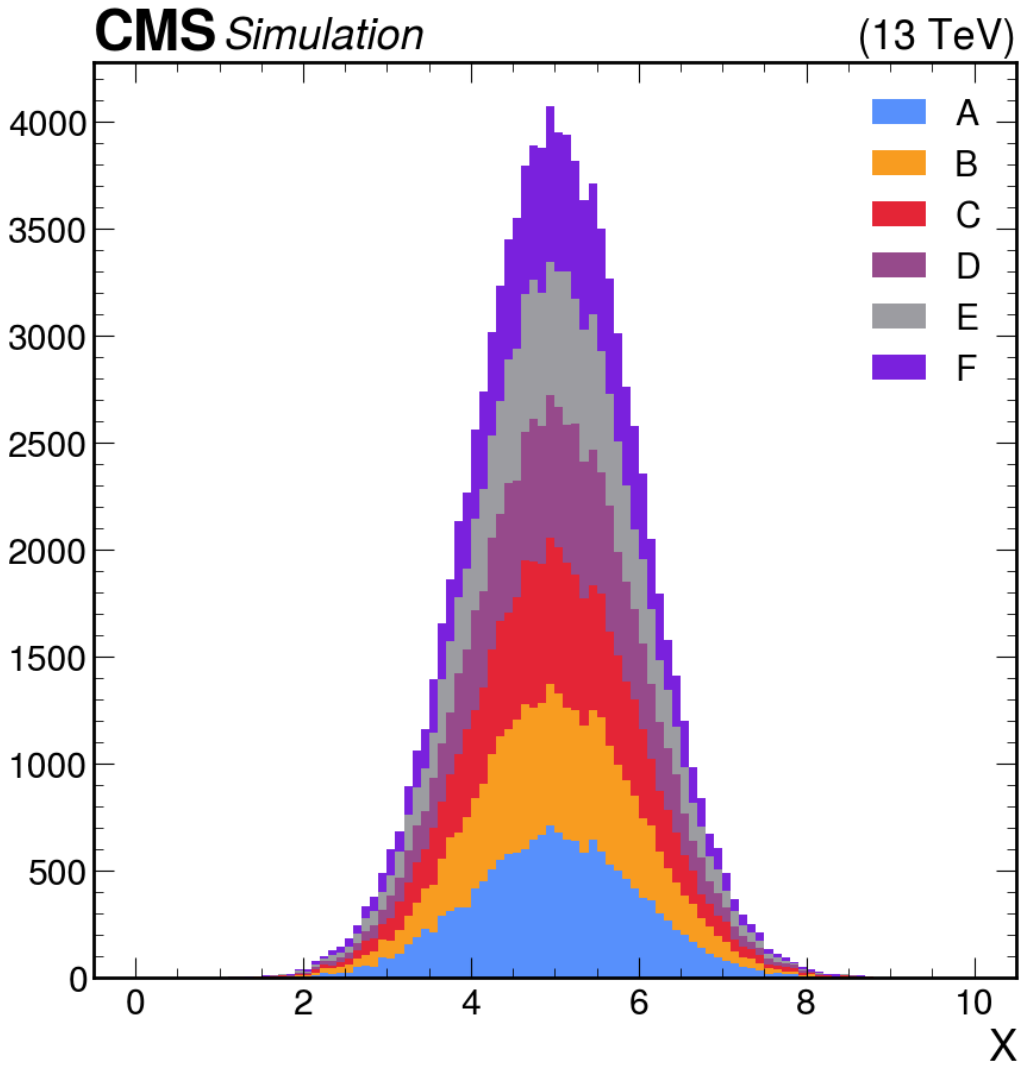
- Unify plot look for better CMS branding
- Choose color schemes for **colorblind accessibility**
  - Joint effort of **CMS Diversity Office**, PC, PubComm & CAT
  - Evaluated according to arxiv:2107.02270
  - Result of a CMS-wide vote
- Sequential color-schemes already well established
  - Default to “viridis”

```
sns.color_palette("rocket", as_cmap=True)
```

```
sns.color_palette("magma", as_cmap=True)
```

```
sns.color_palette("mako", as_cmap=True)
```

```
sns.color_palette("viridis", as_cmap=True)
```



Live Demo