Hyper*Spy*

Francisco de la Peña

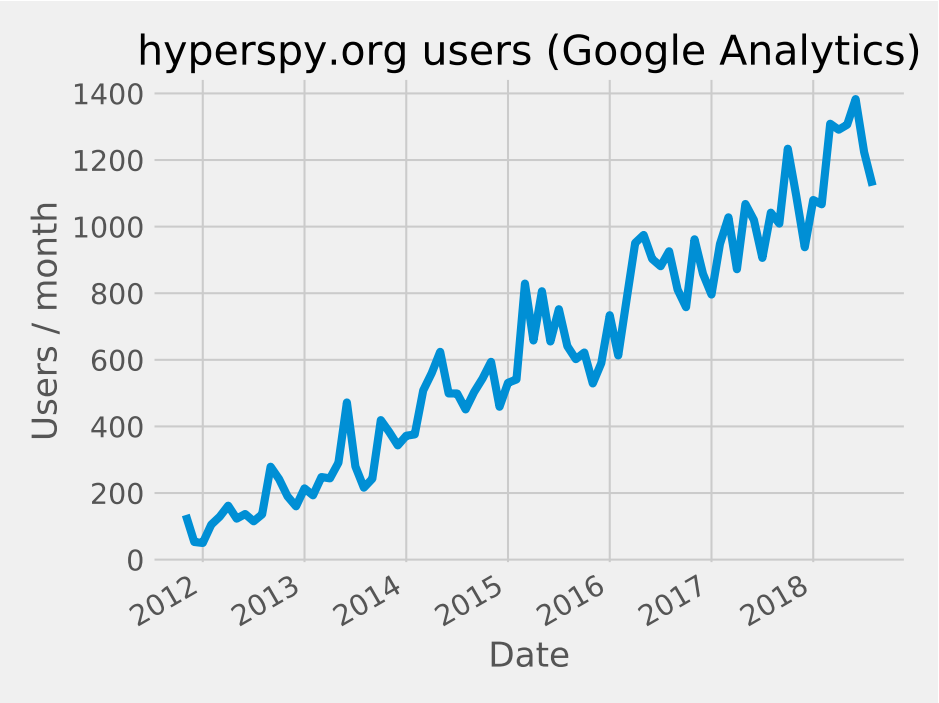
Diamond Light Source
2nd of March 2020

Outline

1. HyperSpy Today
2. How did we get here?

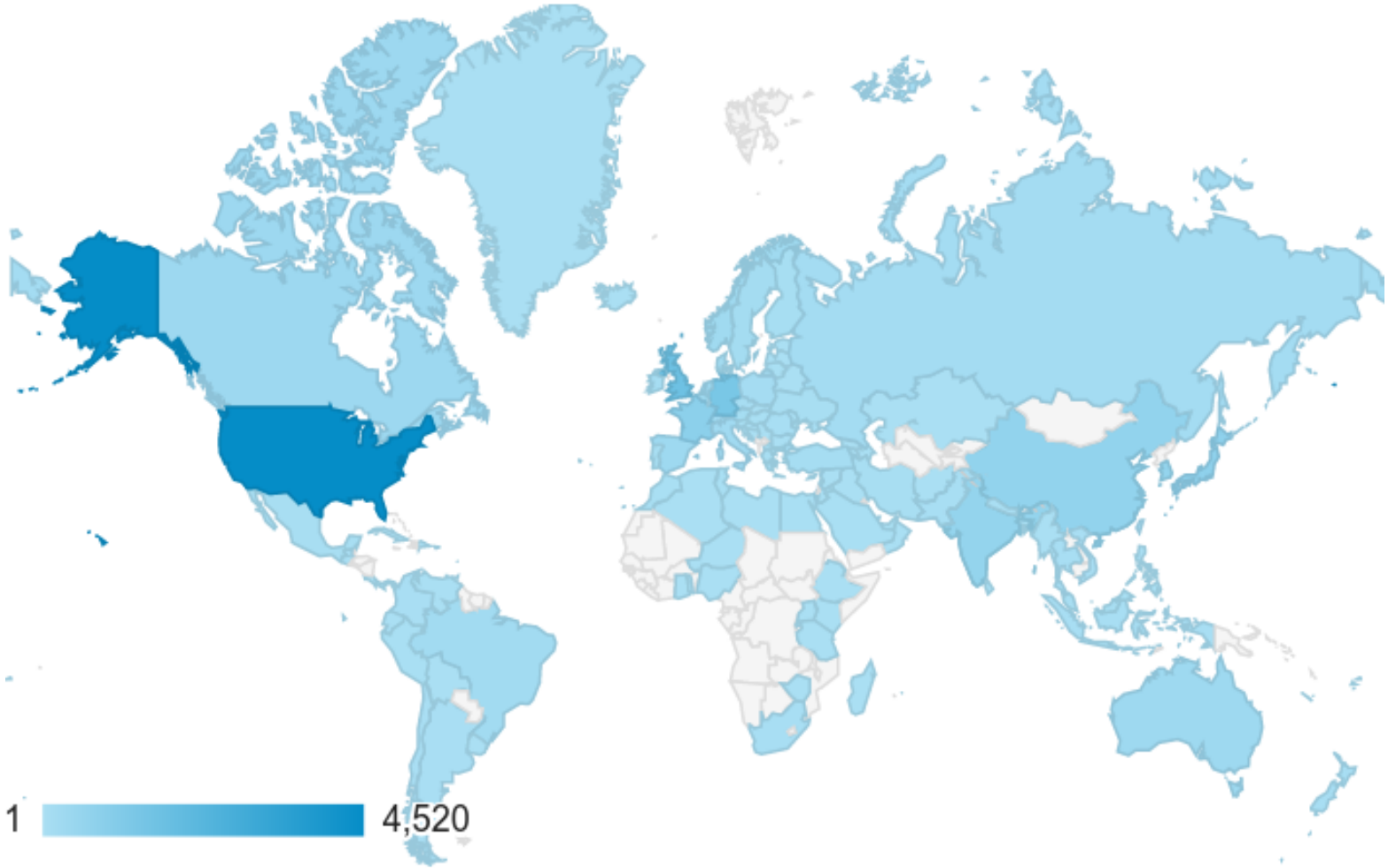
HyperSpy today–some stats

- $> 3000\,\mathrm{downloads/month}$
- $> 100k$ lines of code
- > 4000 citations
- 40 contributors
- Used by more than 40 packages in GitHub



HyperSpy users by country

hyperspy.org users from January-September 2018



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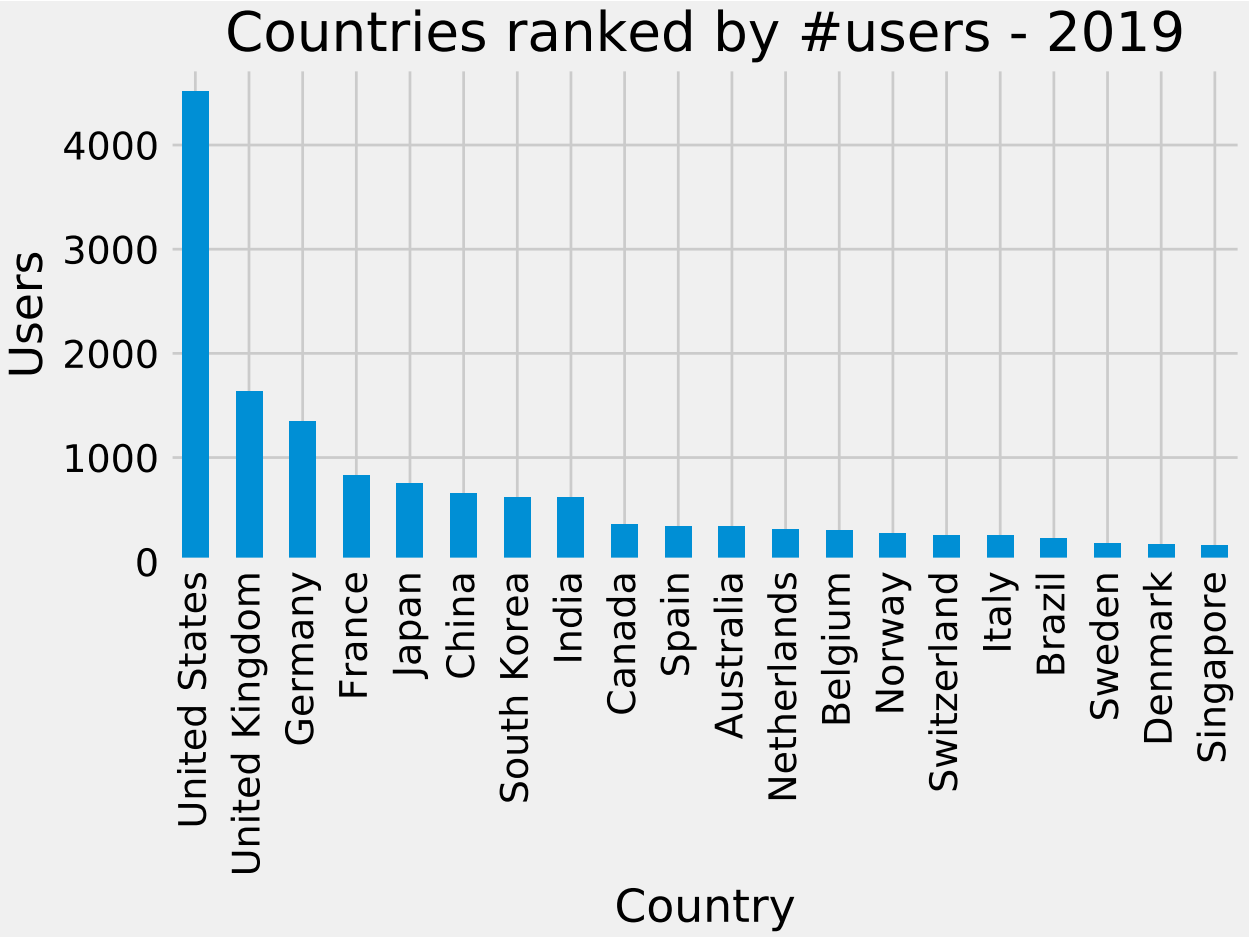

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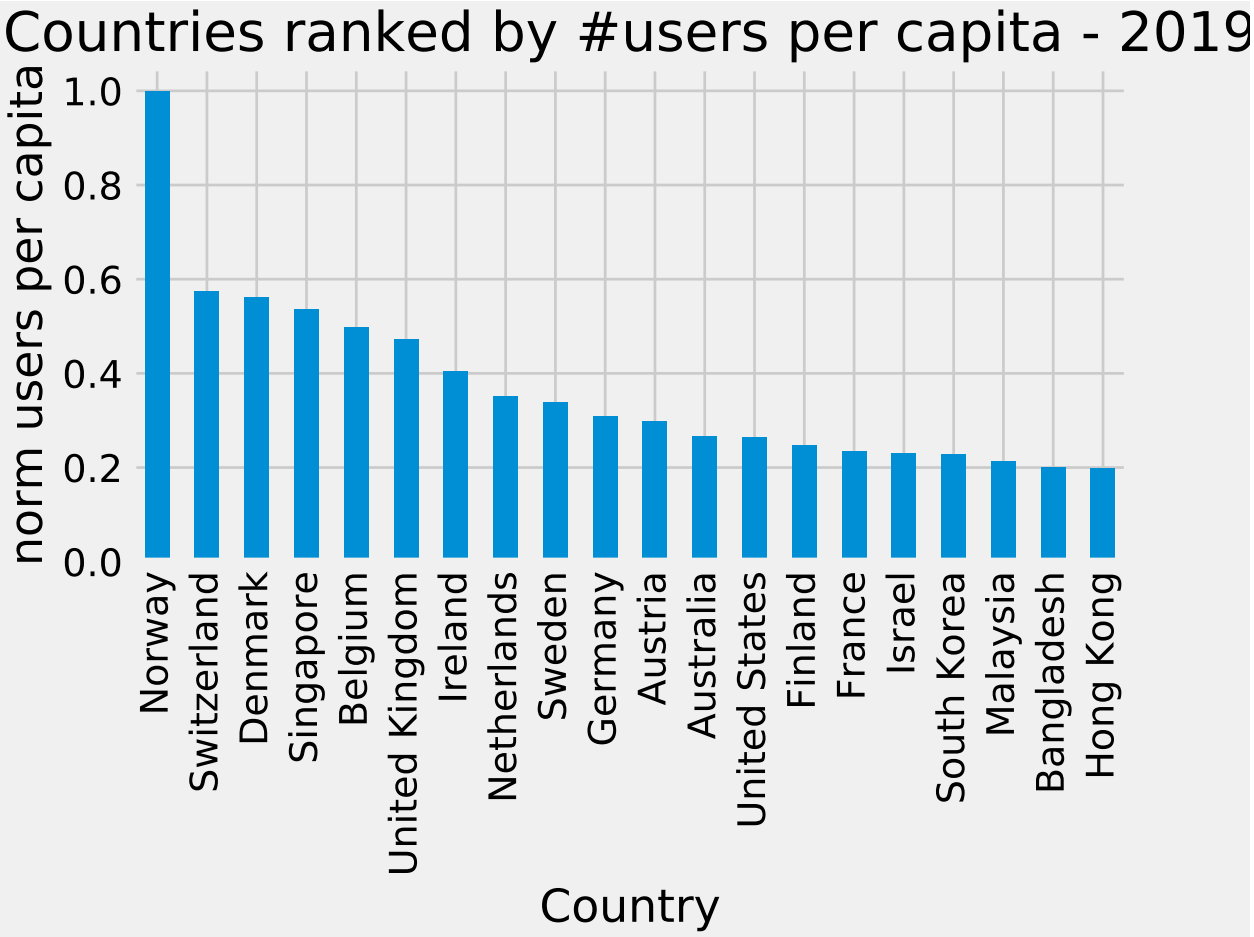

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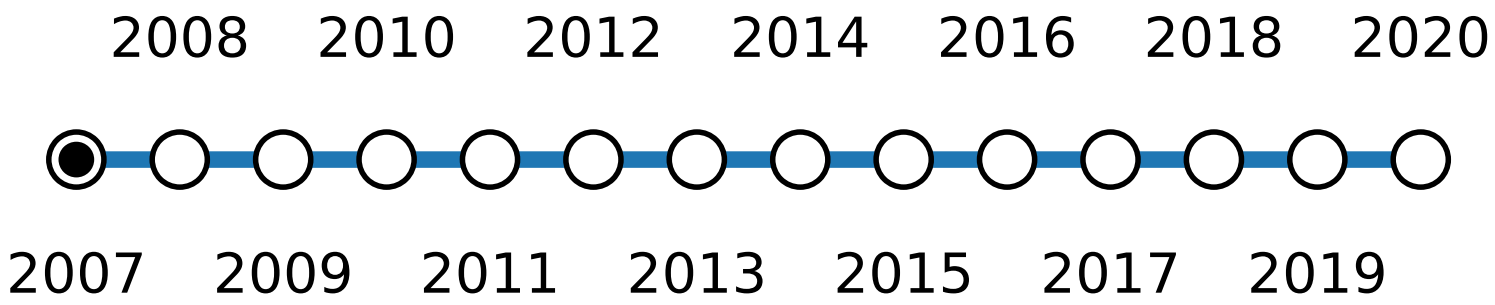
2 How did we get here?

What is HyperSpy? Take 1.

HyperSpy is a computer program for electron microscopy data analysis.

What is HyperSpy? (2007)



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- By placing the functions in classes a structure started to emerge.

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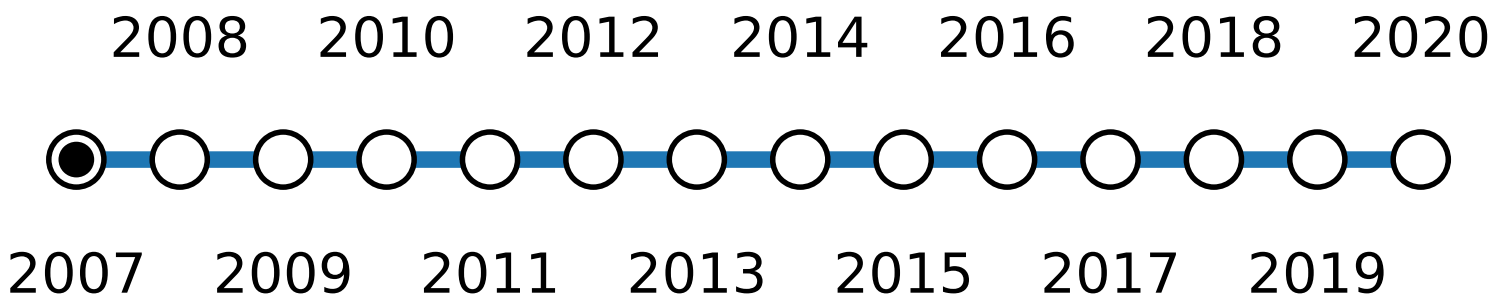

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My personal set of Python routines for EELS data analysis of spectrum images.

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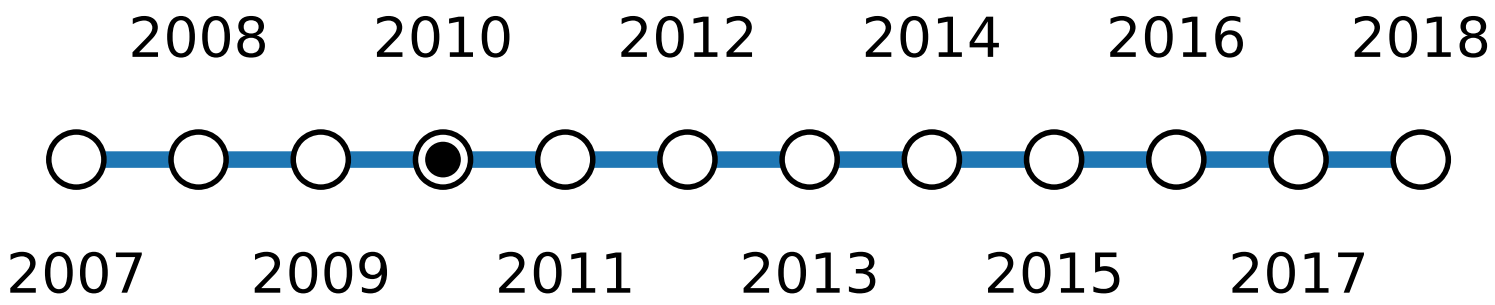

- Multivariate analysis routines implemented.
- EELSLab released under GPLv2 license.
- First users. First trainings in Paris and Oxford.

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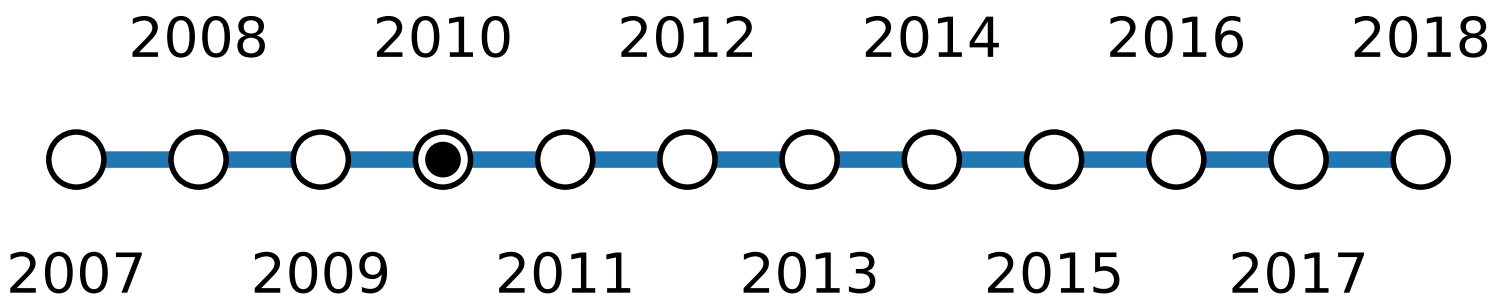

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HyperSpy is . . .

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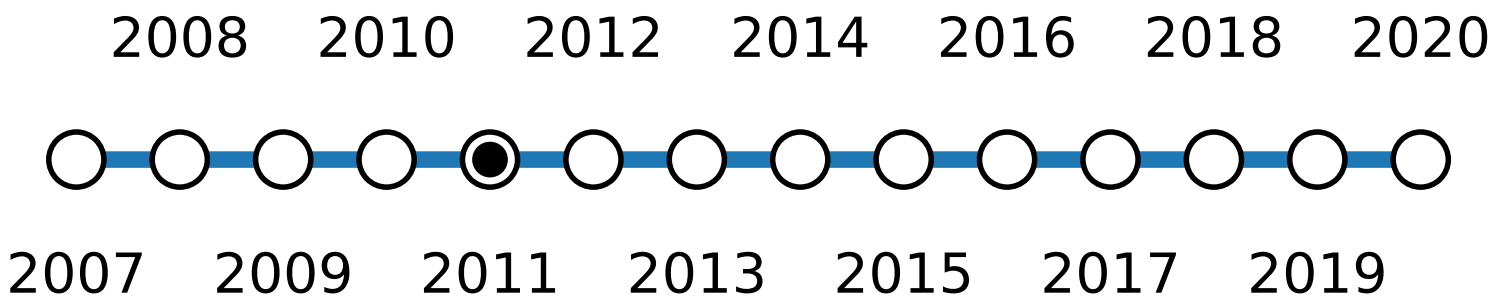

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- We refactor the code to make it multi-dimensional.
- We rename it to “HyperSpy”.

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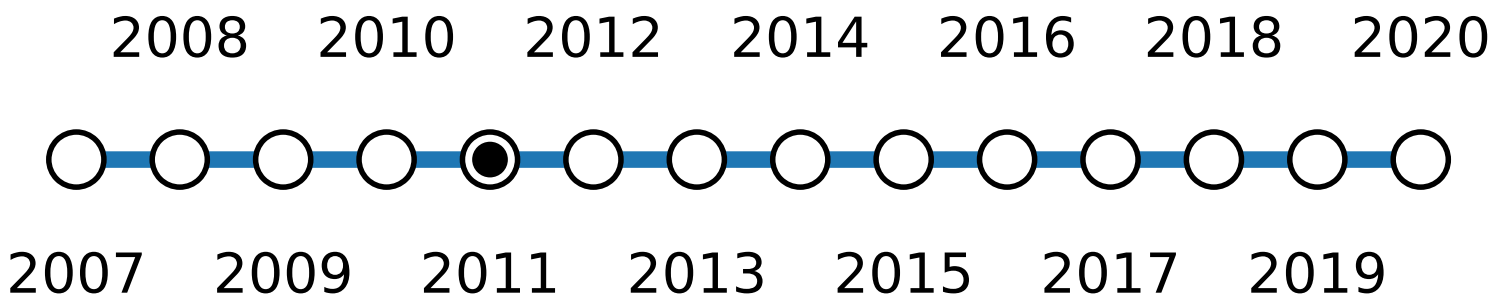

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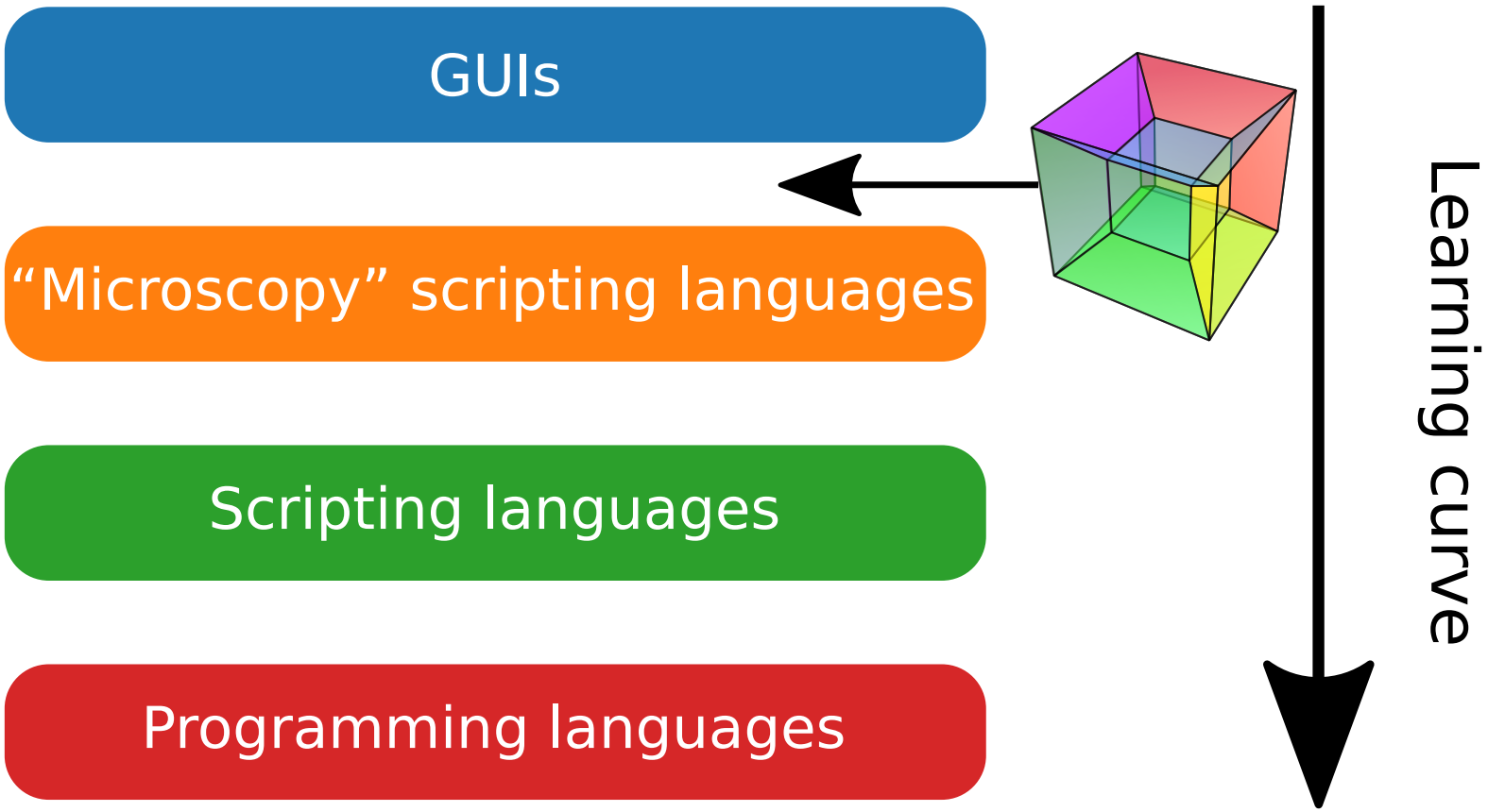
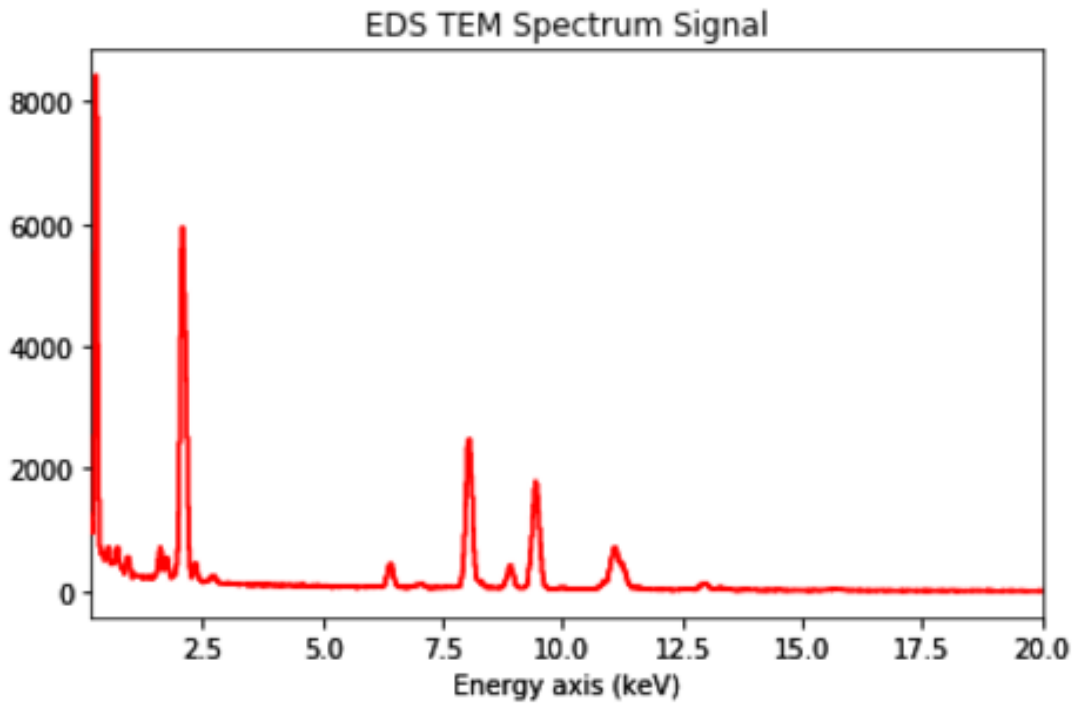


Example of HyperSpy vs Digital Micrograph syntax

```
In [4]: s.plot()
```



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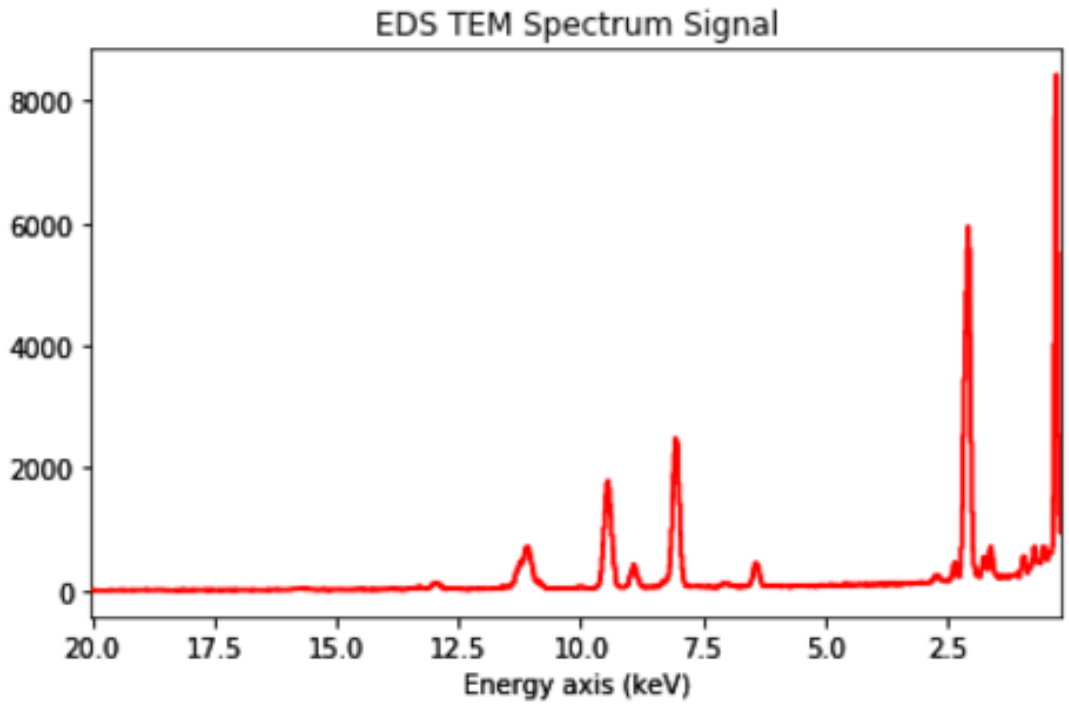
```
In [5]: s.isig[::-1].plot()
```

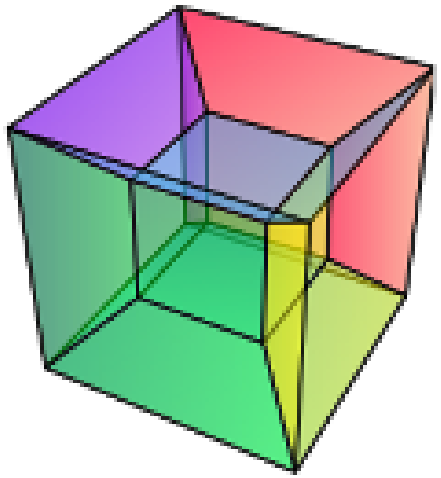


Example of HyperSpy vs Digital Micrograph syntax

```
image img := GetFrontImage()
if (img.ImageGetNumDimensions() == 3)
{
        number sx = img.ImageGetDimensionSize(0)
        number sy = img.ImageGetDimensionSize(1)
        number sz = img.ImageGetDimensionSize(2)
        image res = Slice3(img, 0, 0, sz - 1, 0, sx, 1, 1, sy, 1, 2, sz, -1)
        res.ImageCopyCalibrationFrom(img)
        TagGroupCopyTagsFrom(ImageGetTagGroup(res),ImageGetTagGroup(img))
        res.ImageSetName(img.ImageGetName() + "_reversed")
        ShowImage(res)
}
```

HyperSpy design goals in 2011

- Cutting-edge features.
- Truly multi-dimensional.
- Scalable
  - Powerful, yet
    - easy to use.
    - easy to learn.
    - Easy to extend and contribute to.
    - Code fully available.



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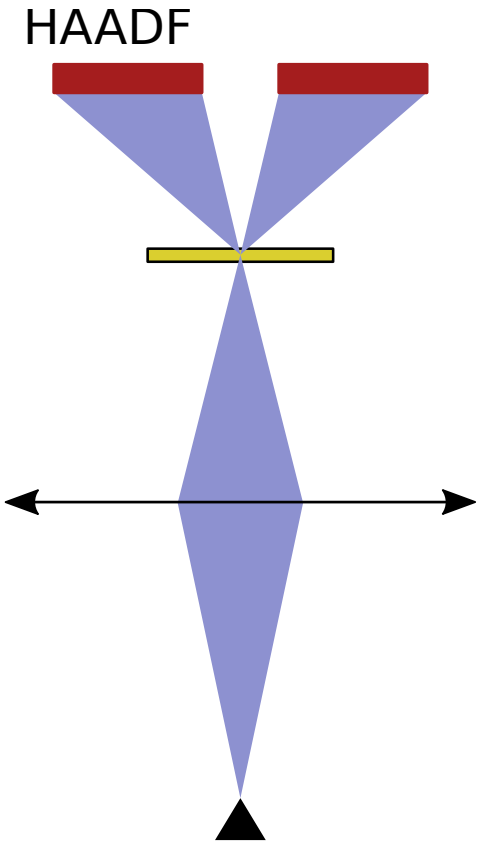

Detectors	Dimensions
HAADF	(x, y|)

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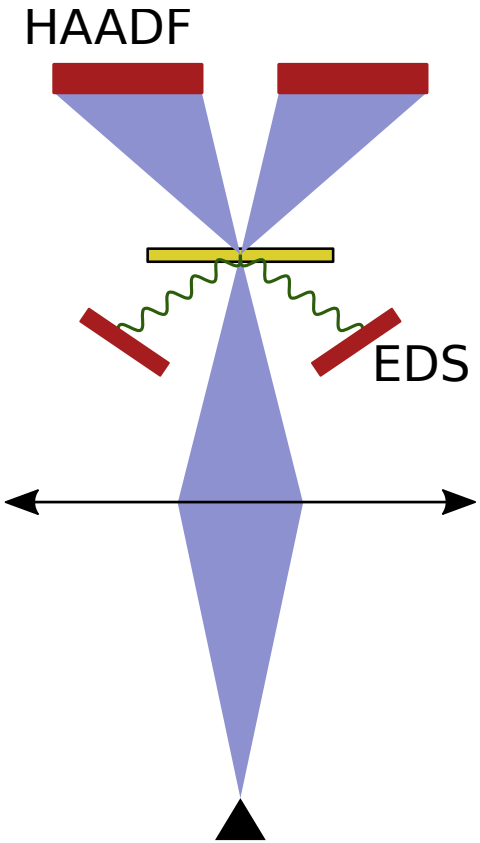

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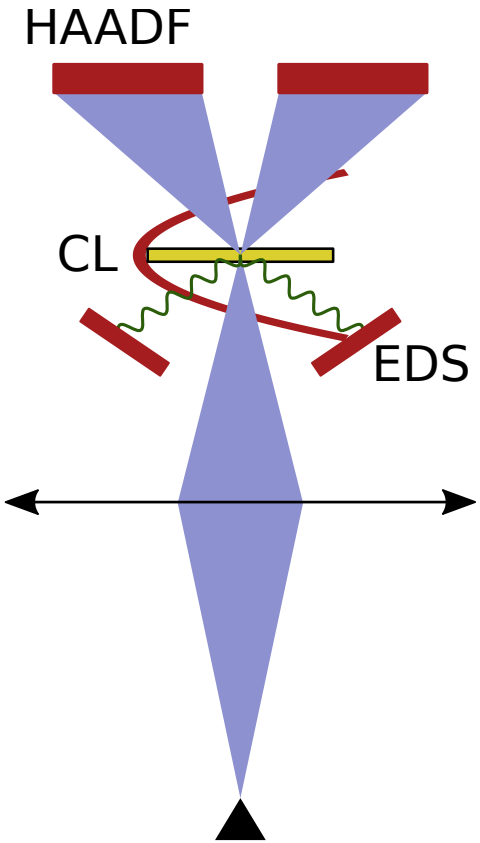

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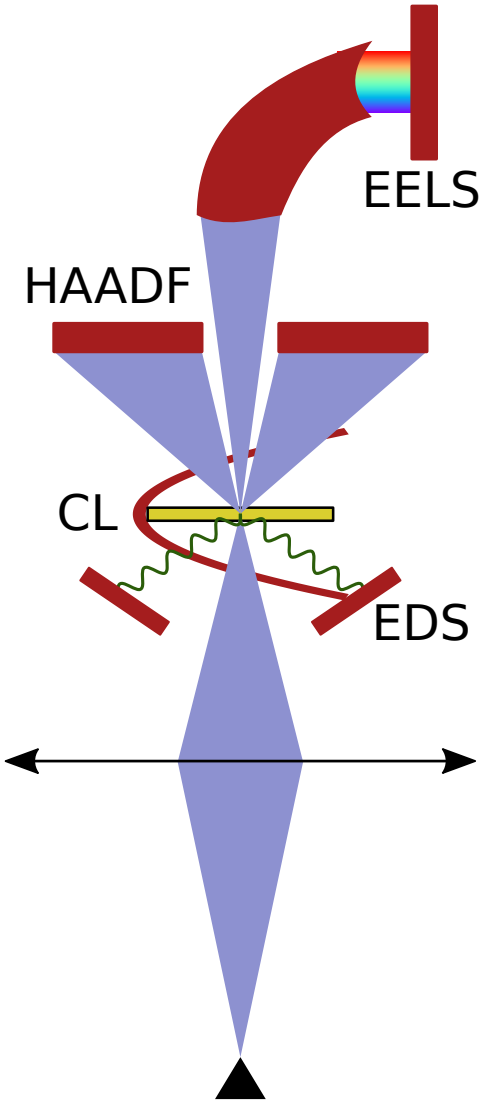

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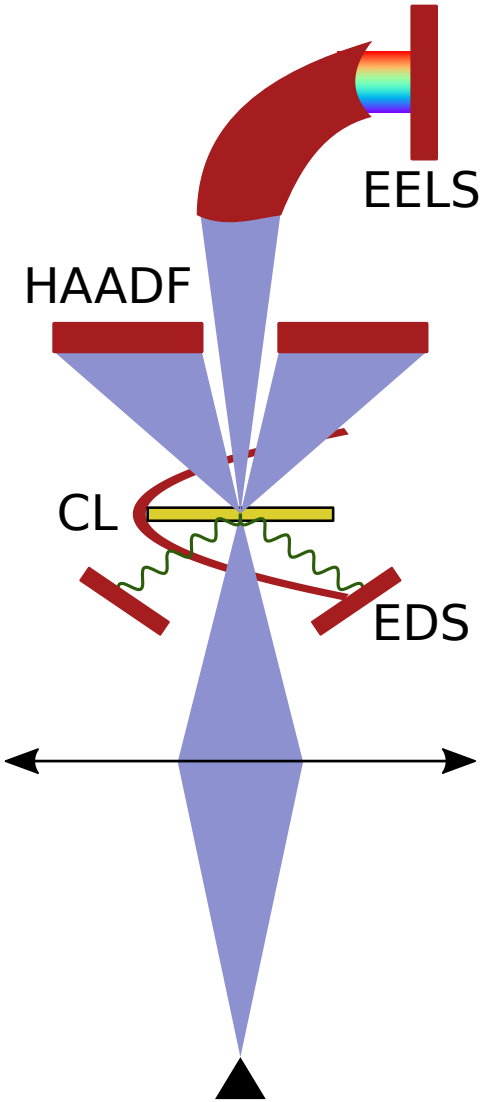

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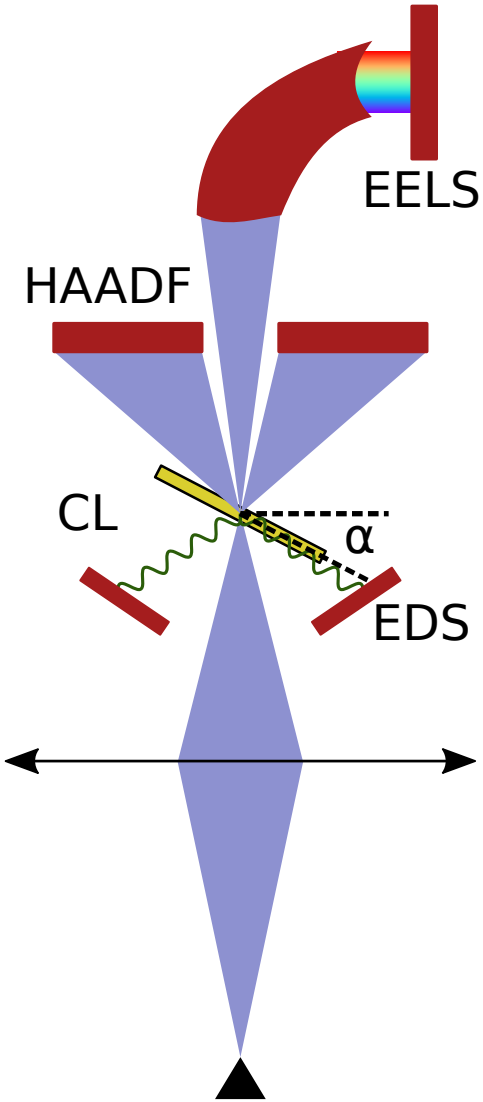

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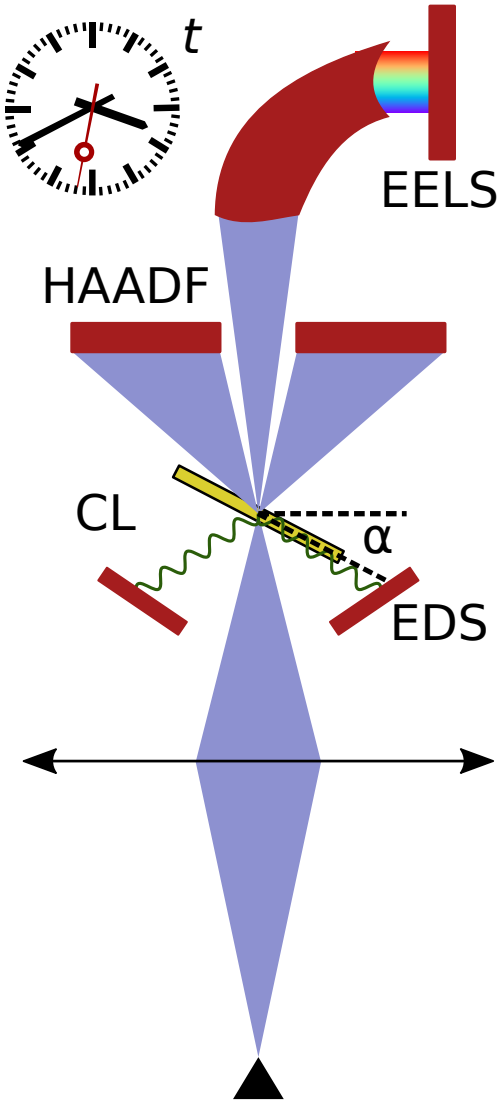

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Why Python?

- Scripting language i.e. no need to compile ⇒fast development.
- Genuine programming language.
- Readability: no need to know Python to understand what the code does ⇒Low entry barrier.
- Runs natively on Windows, Mac OS, Linux.
- Open-source: not a black box and is free.

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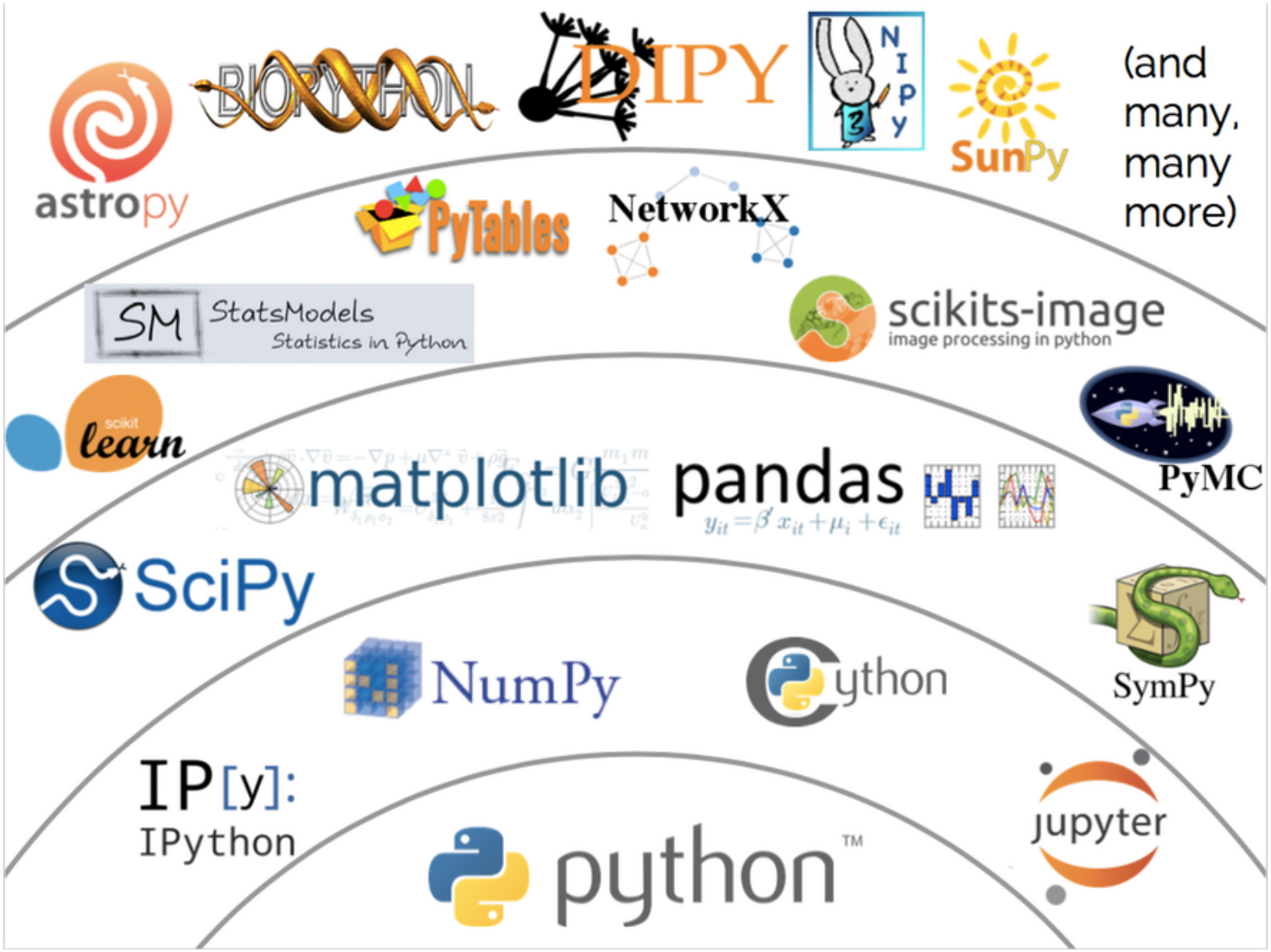
- Open-source: not a black box and is free.
- Lingua franca for scientific computing.
- Unmatched environment for scientific computing:
  - Numpy+Scipy+matplotlib ⩾(Matlab + Toolkits replacement)
  - Jupyter
  - sklearn, skimage...

The Scientific Python Stack



State of the "Scientific Python Stack" circa 2015, Jake VanderPlas

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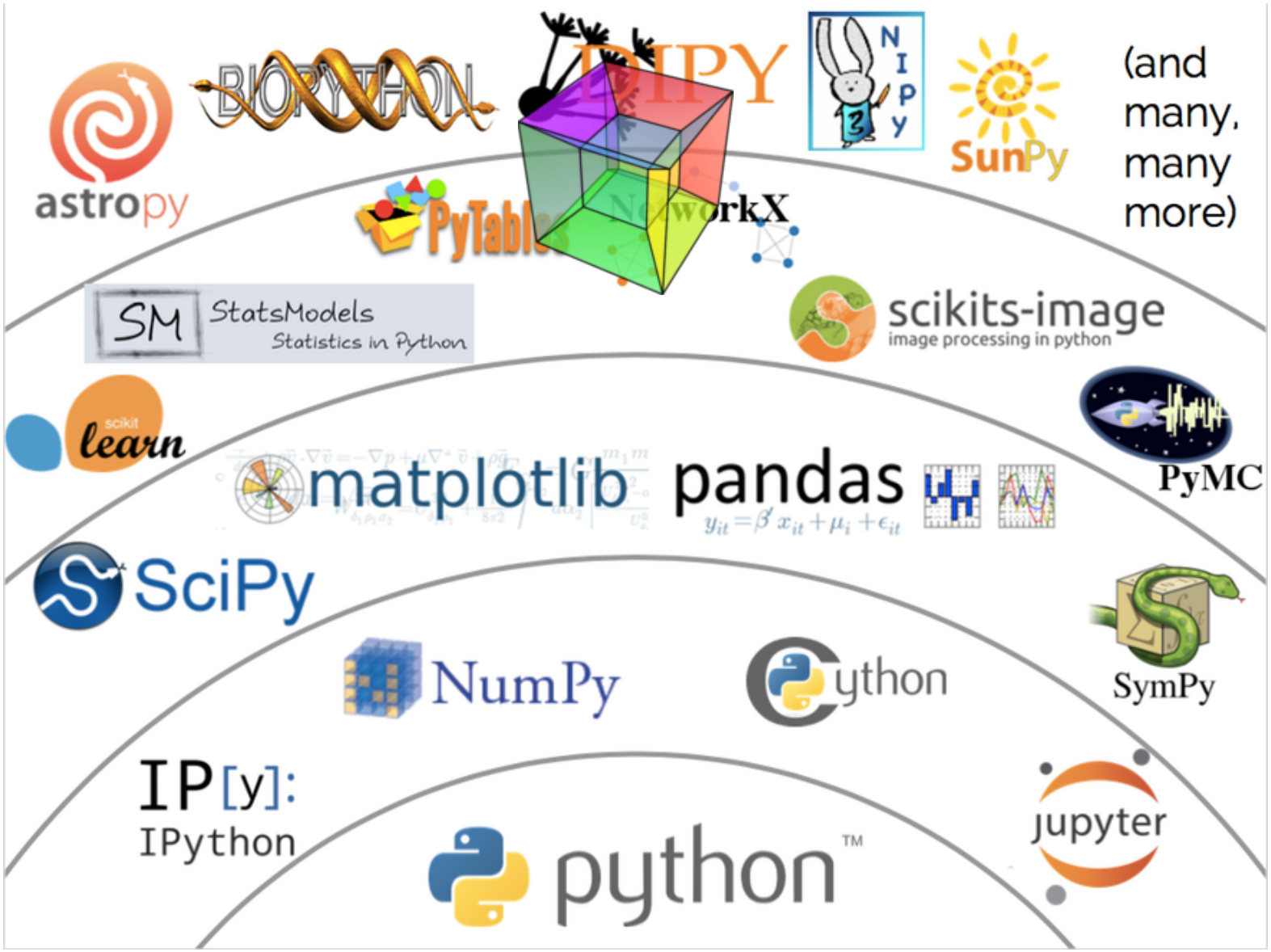

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Why Python?

I came to Python lured by the language, but I stayed because of its [scientific] community.

Fernando Pérez (UC Berkeley, creator of IPython)

Achieving sustainability: recycling

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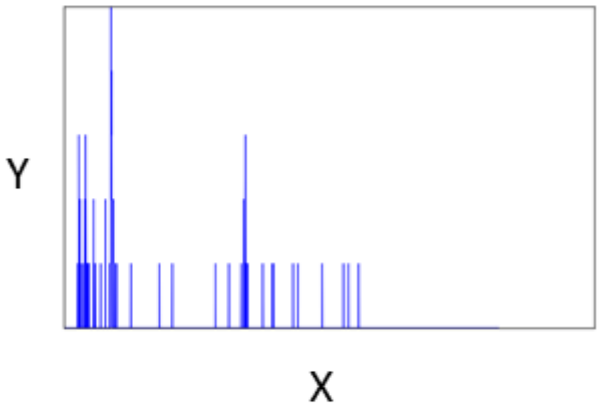

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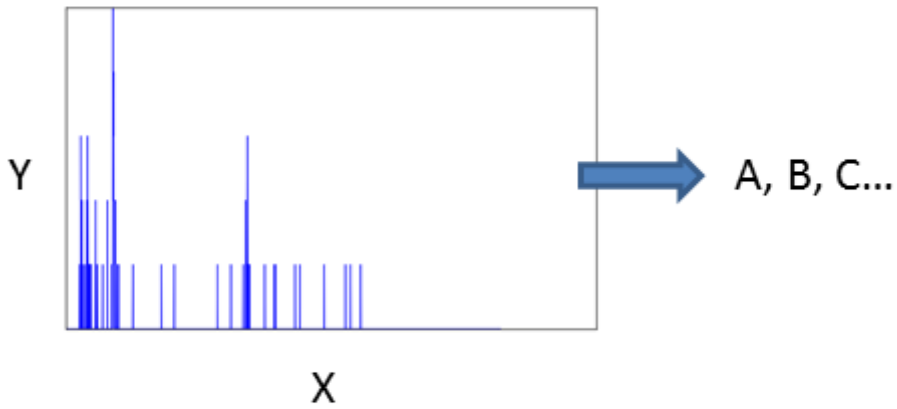

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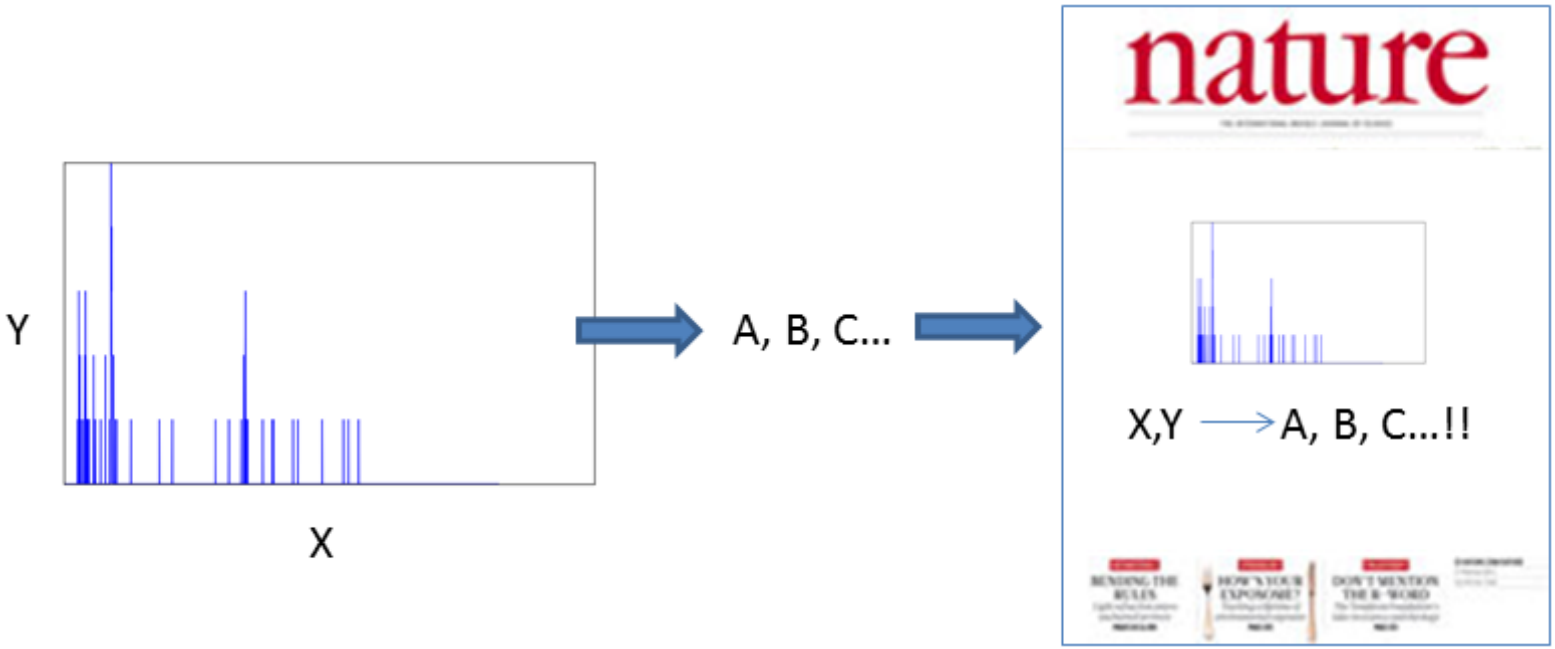

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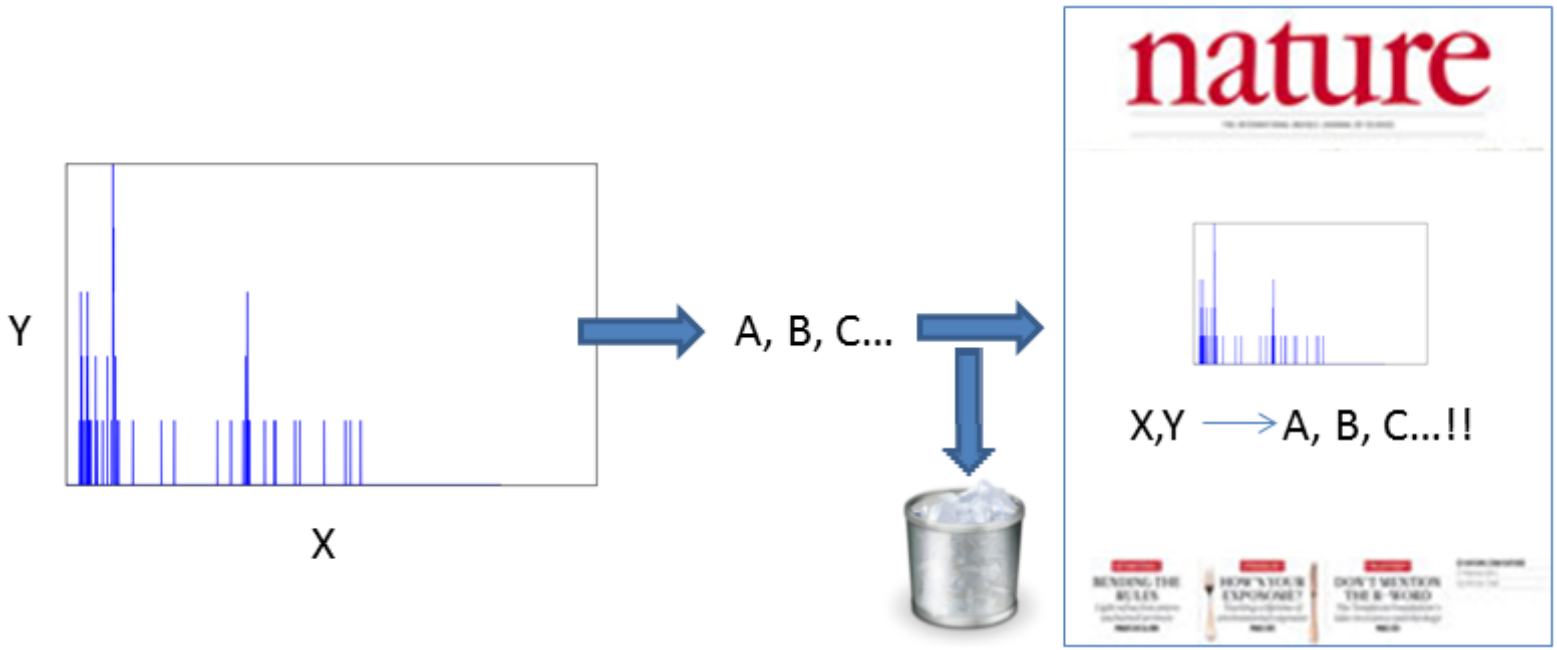

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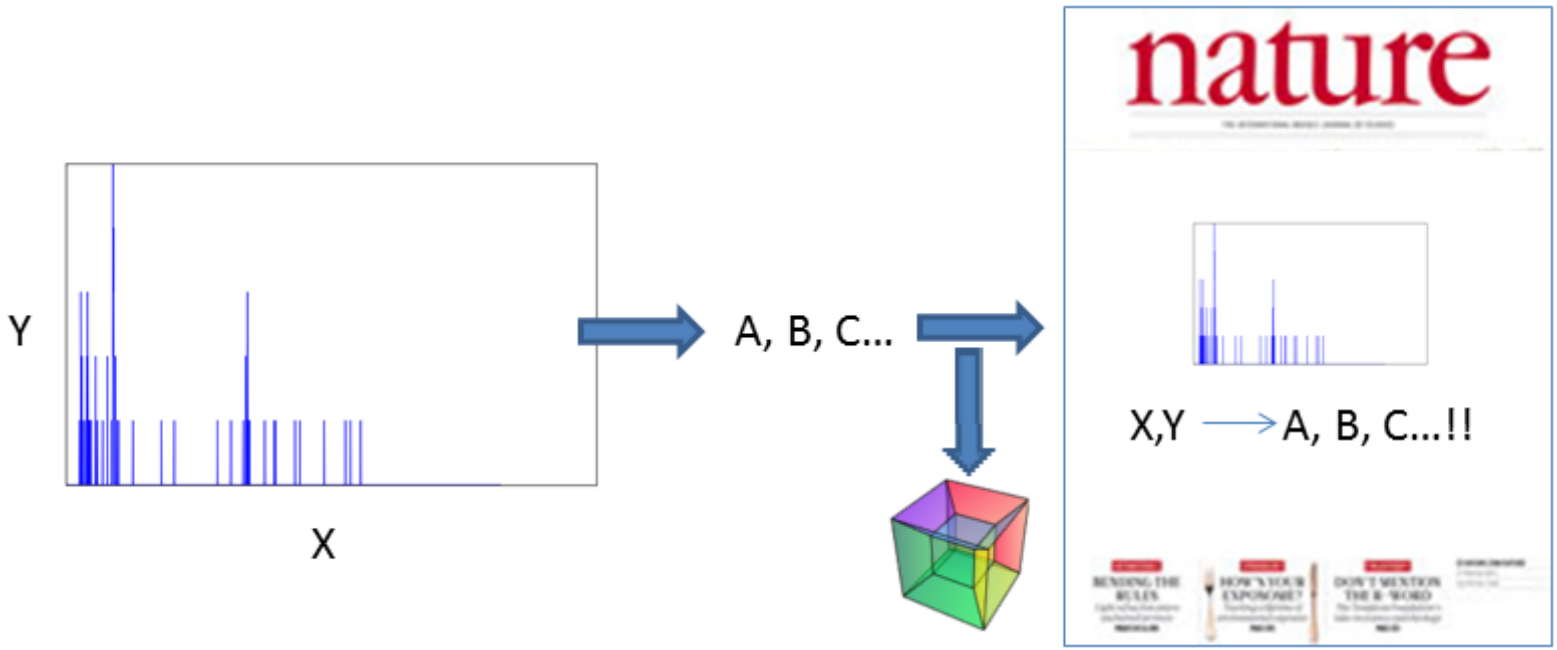

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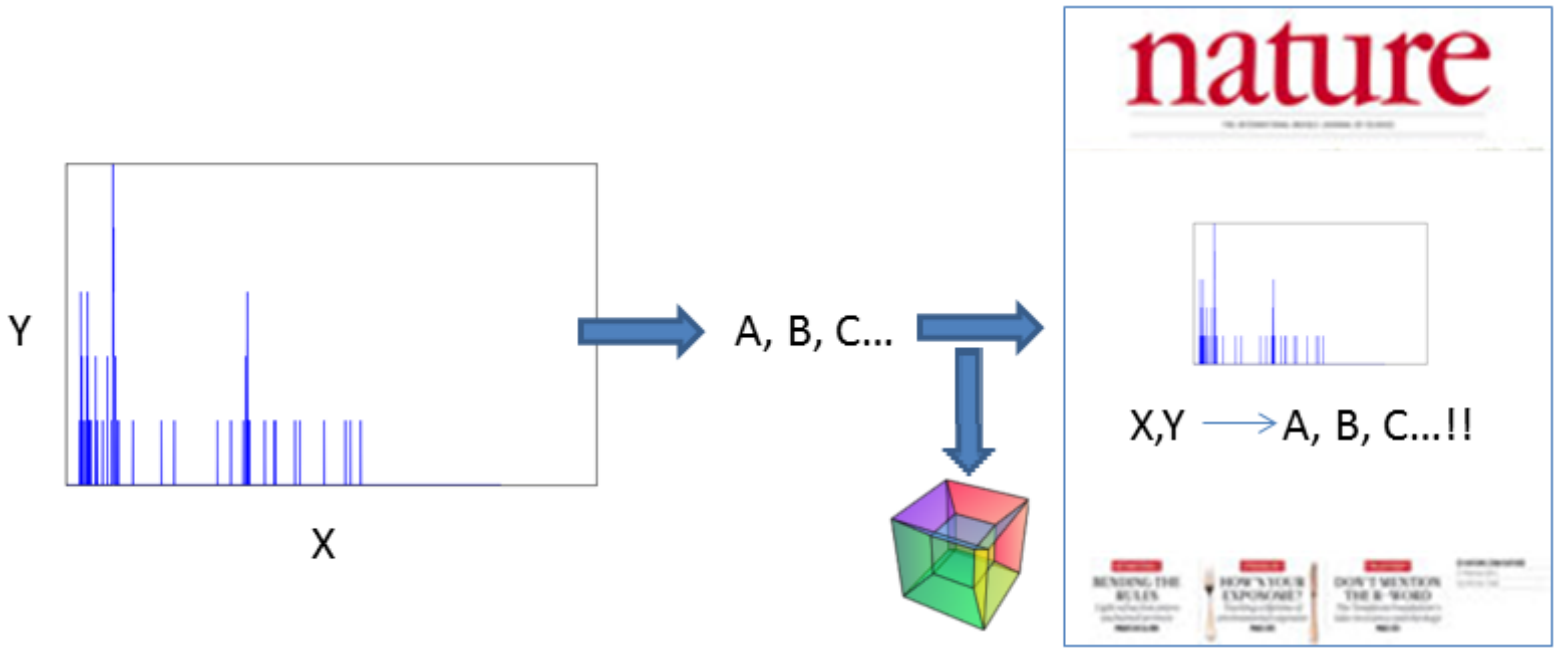
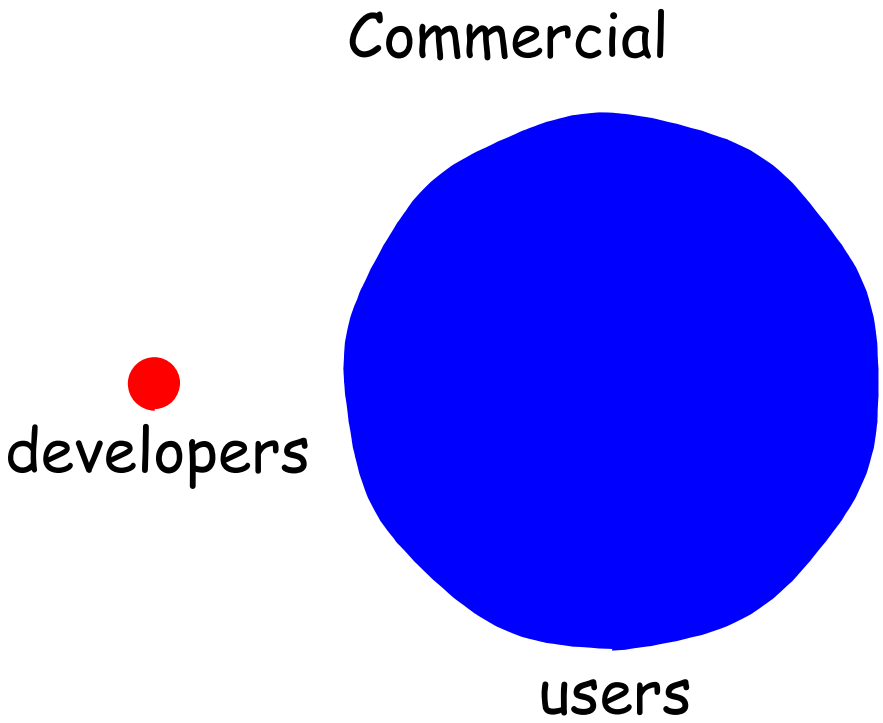


HyperSpy is . . .

a *peer-reviewed open-access journal* specialized in code for EM multi-dimensional data analysis.

Sustainable opensource development



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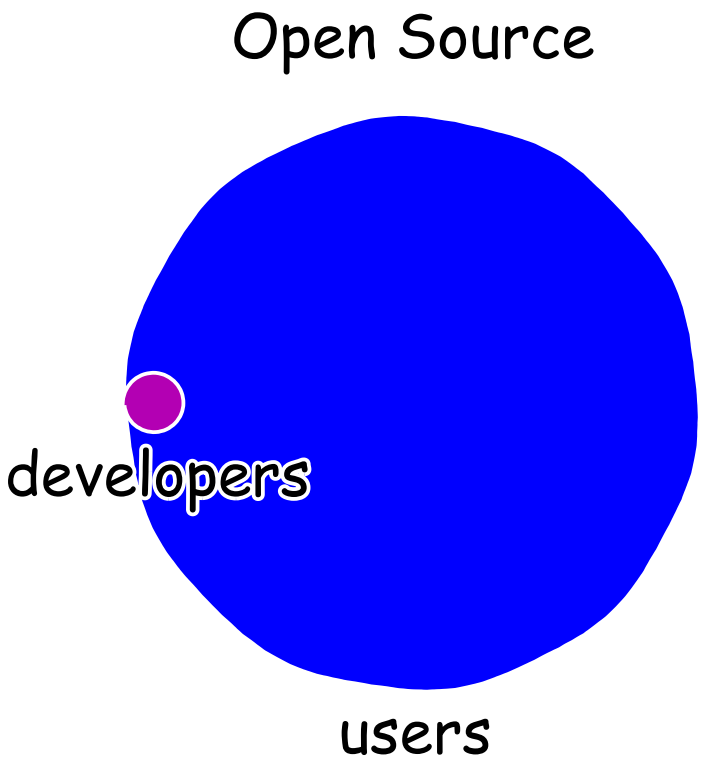

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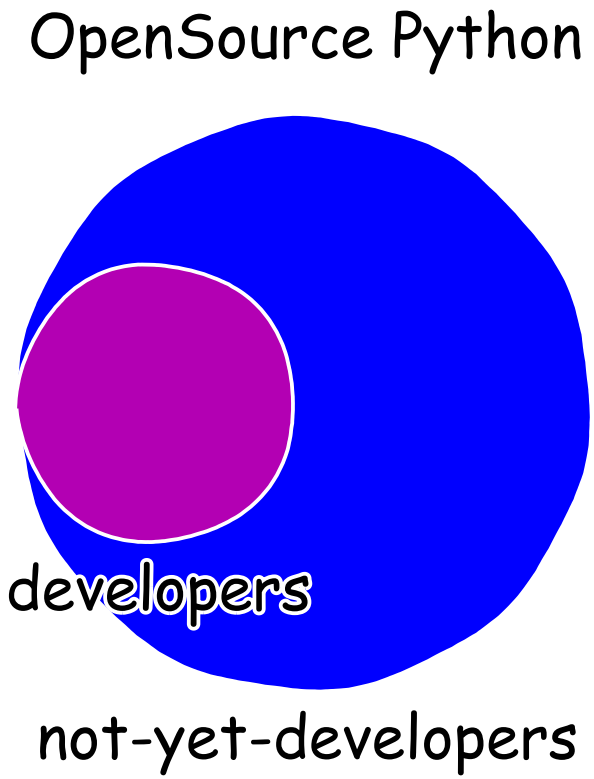

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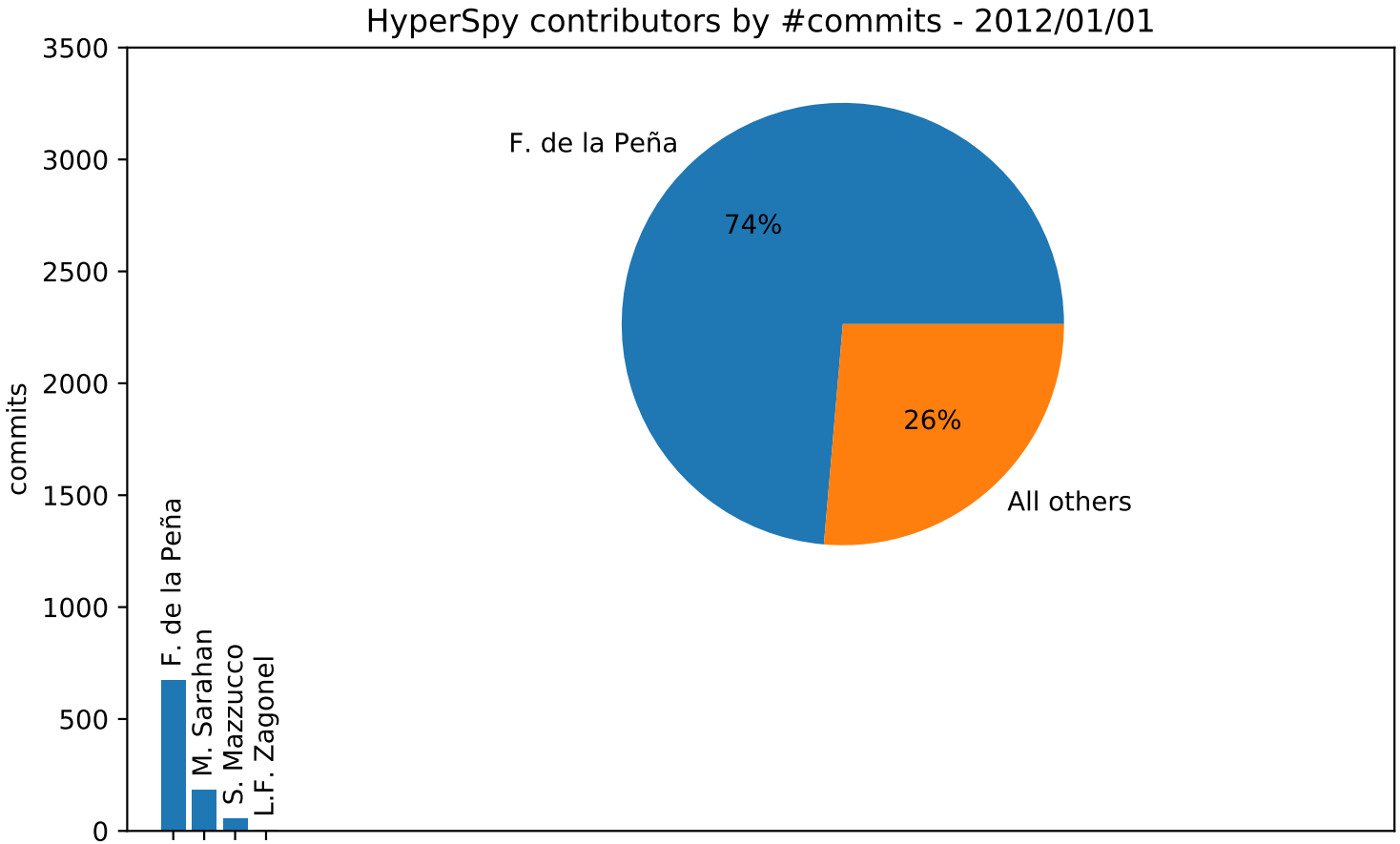

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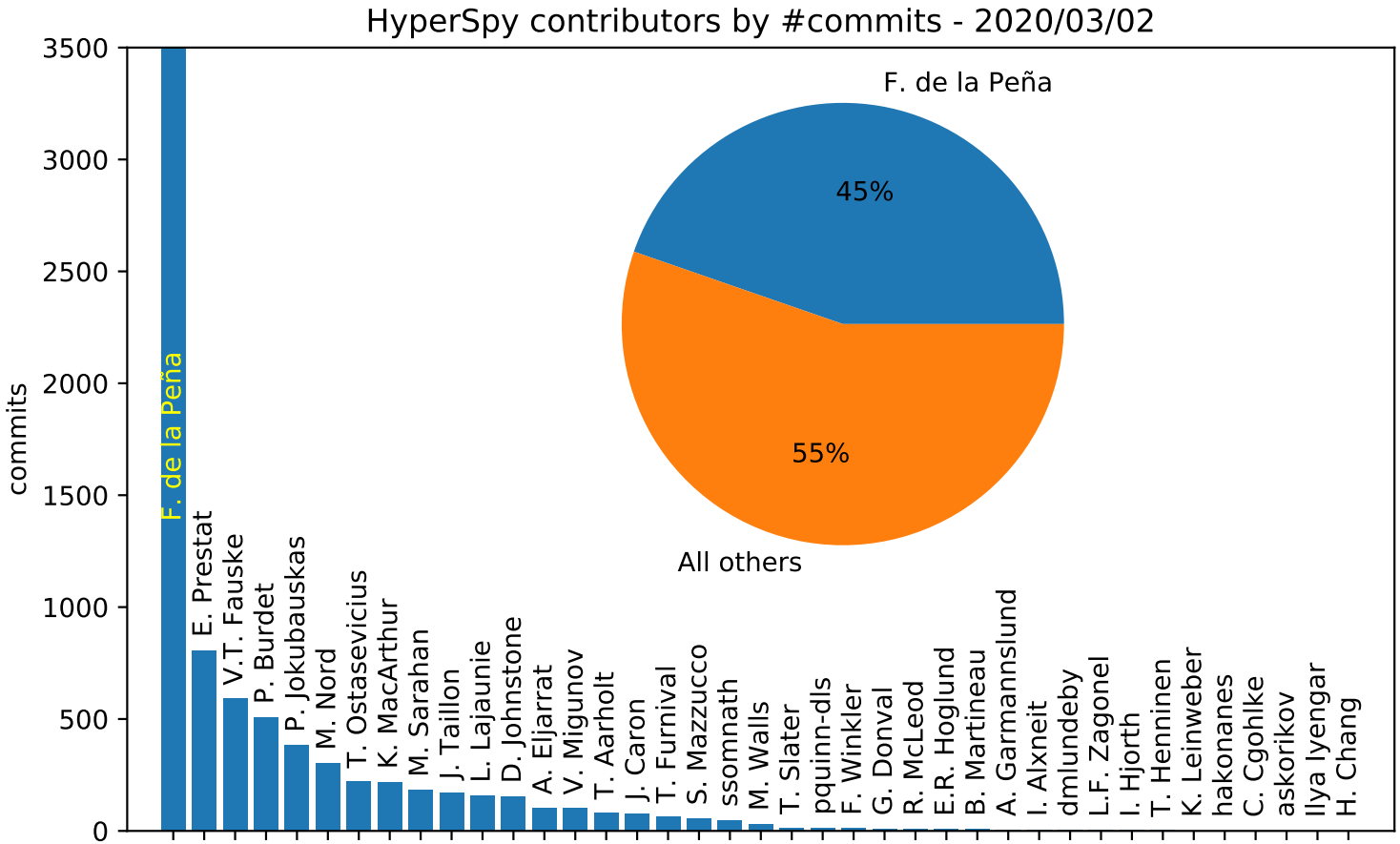

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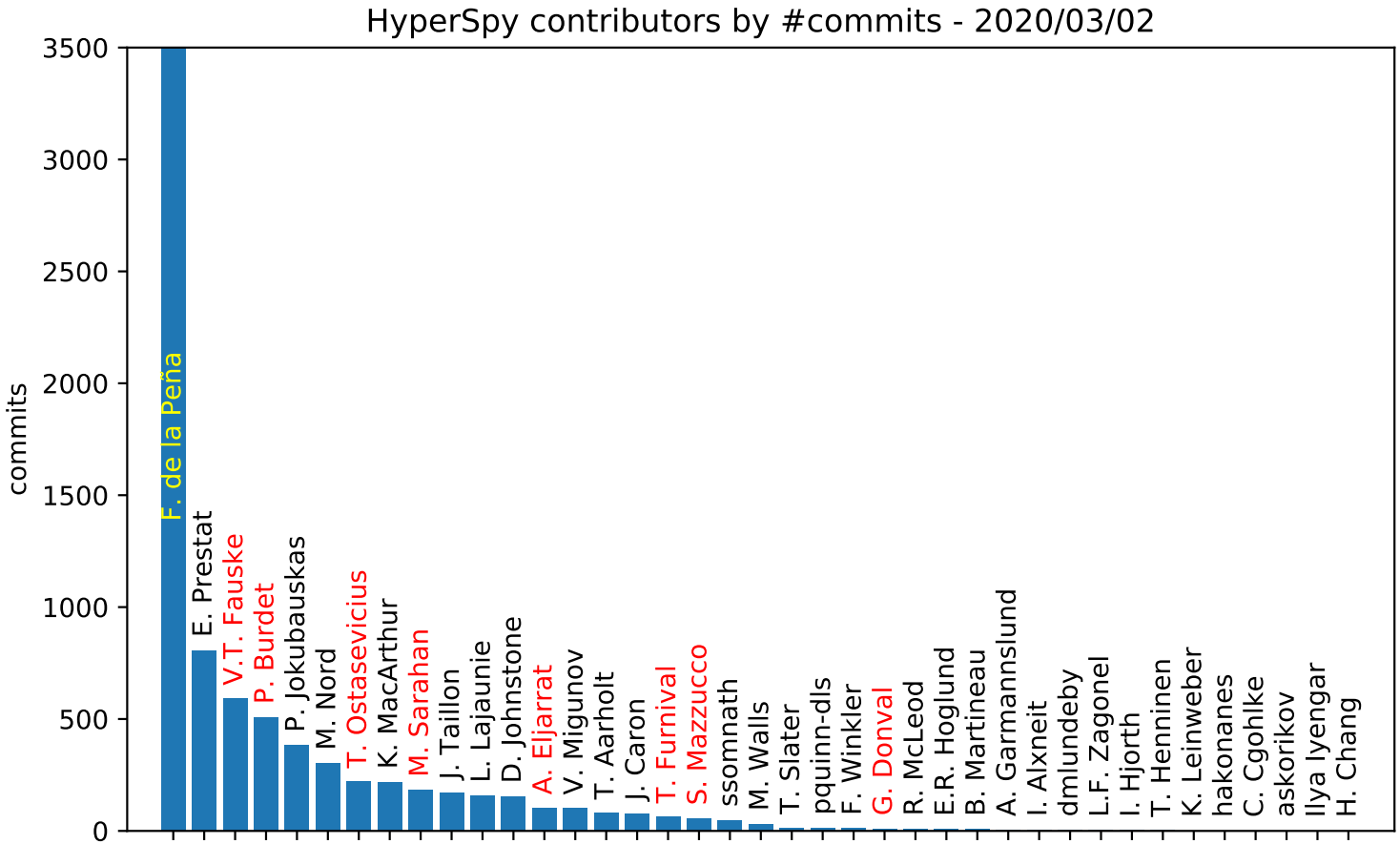

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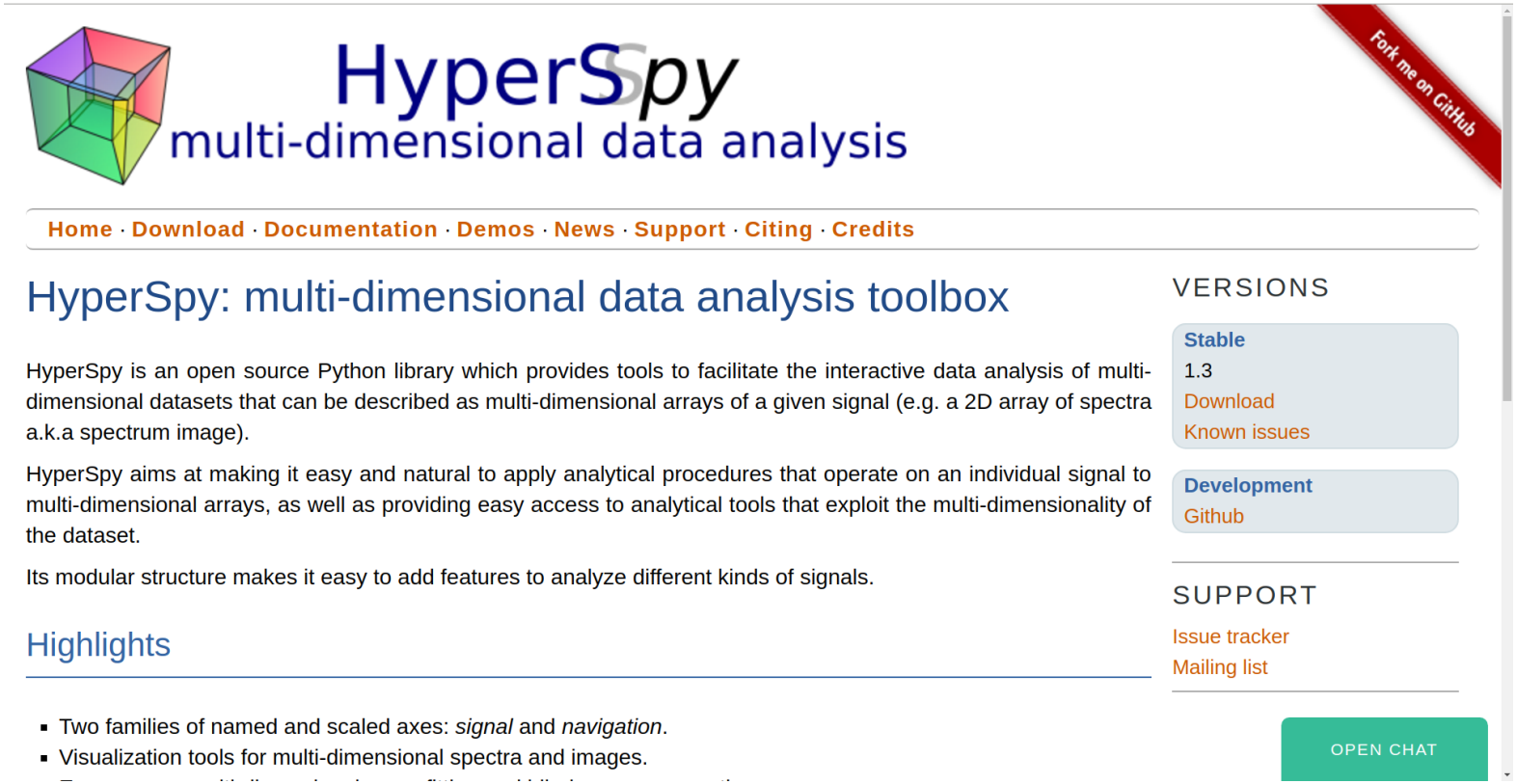

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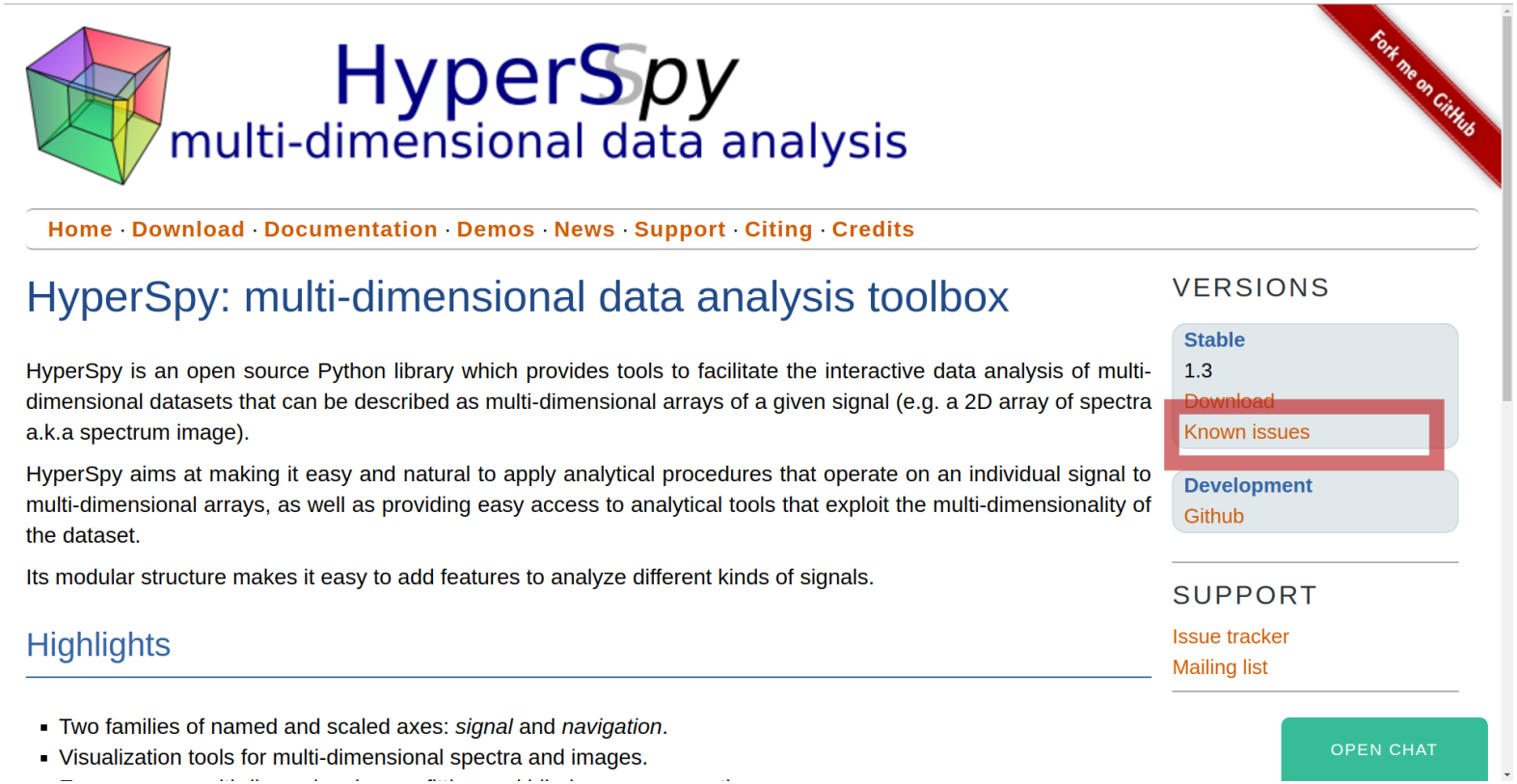

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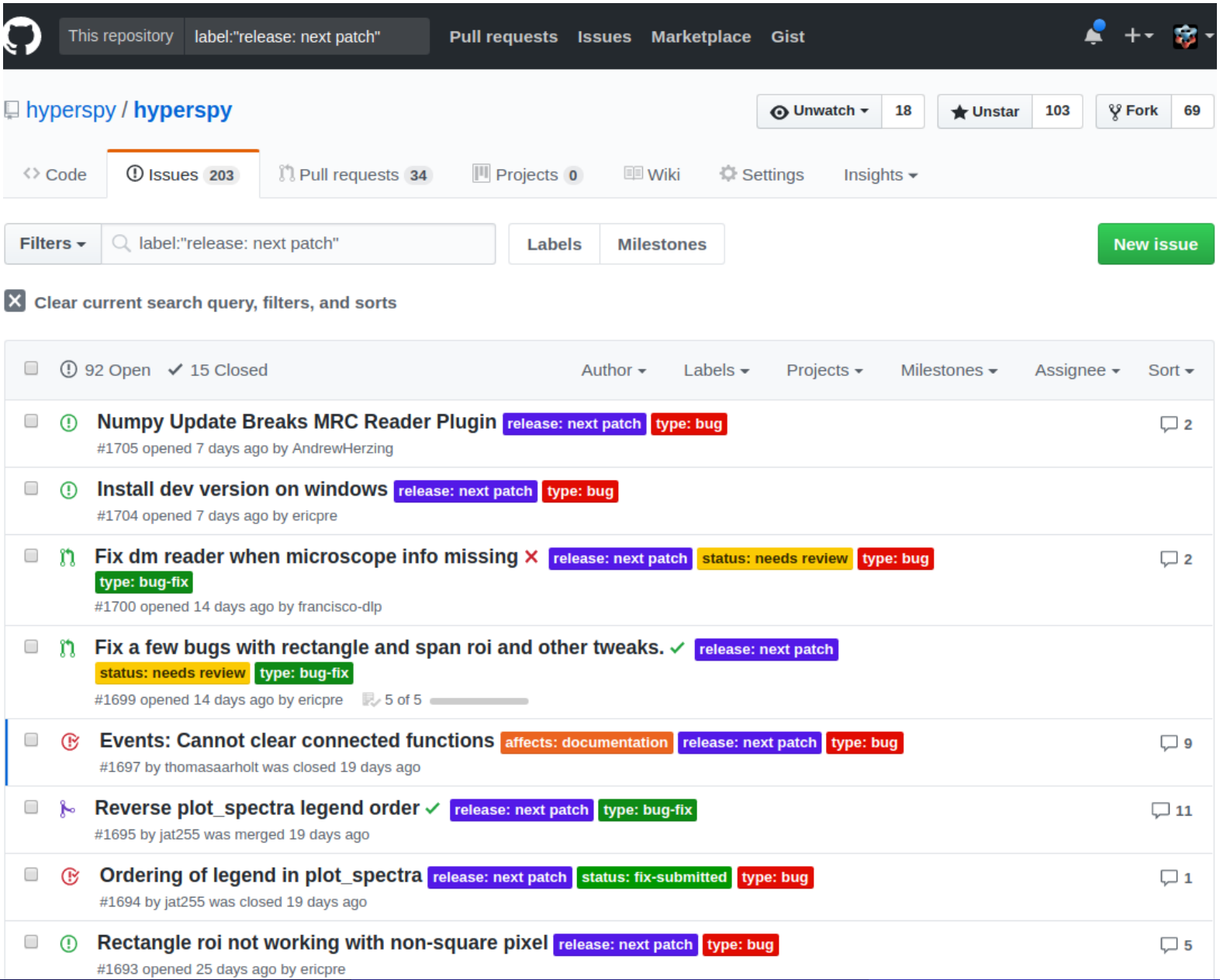

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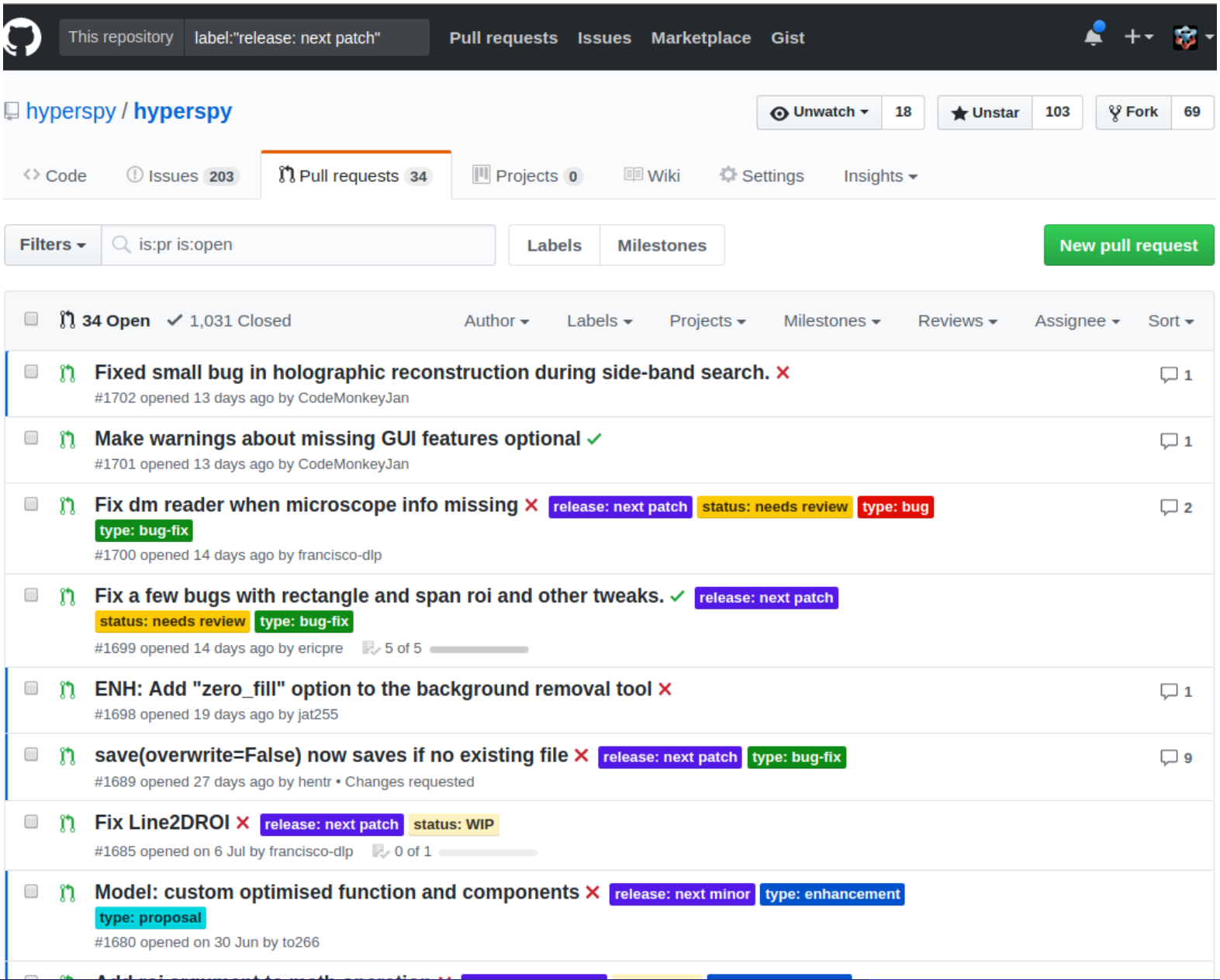

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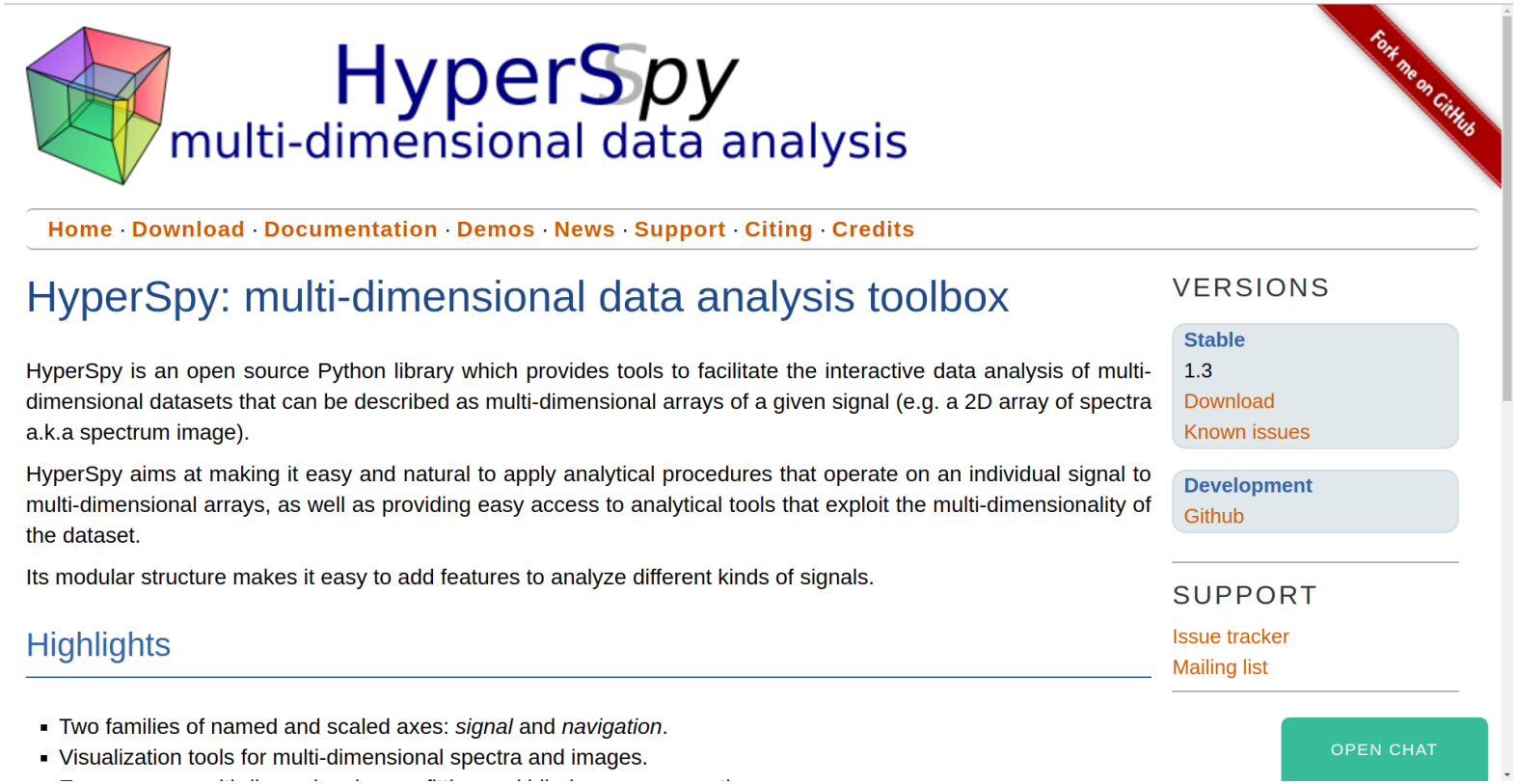

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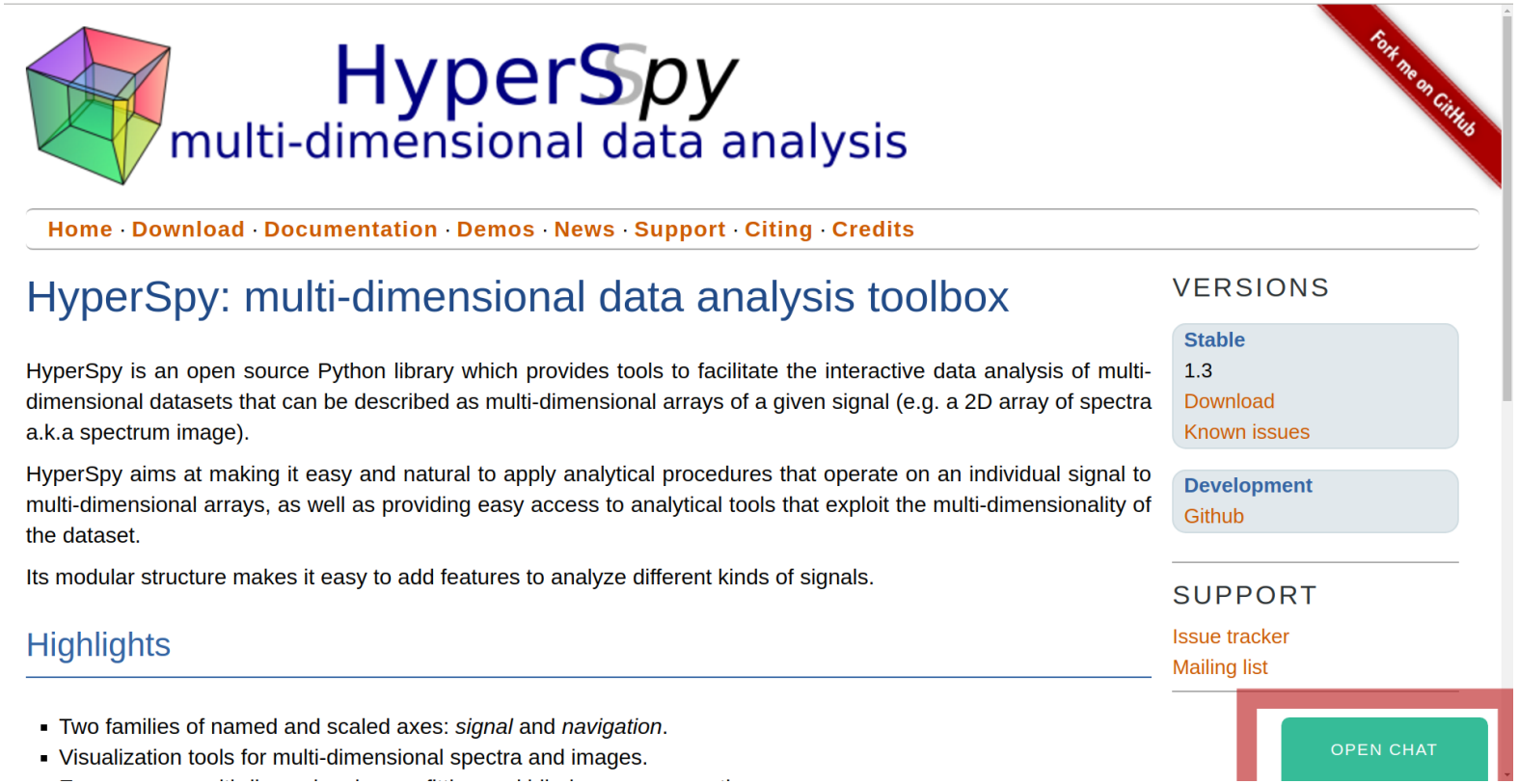

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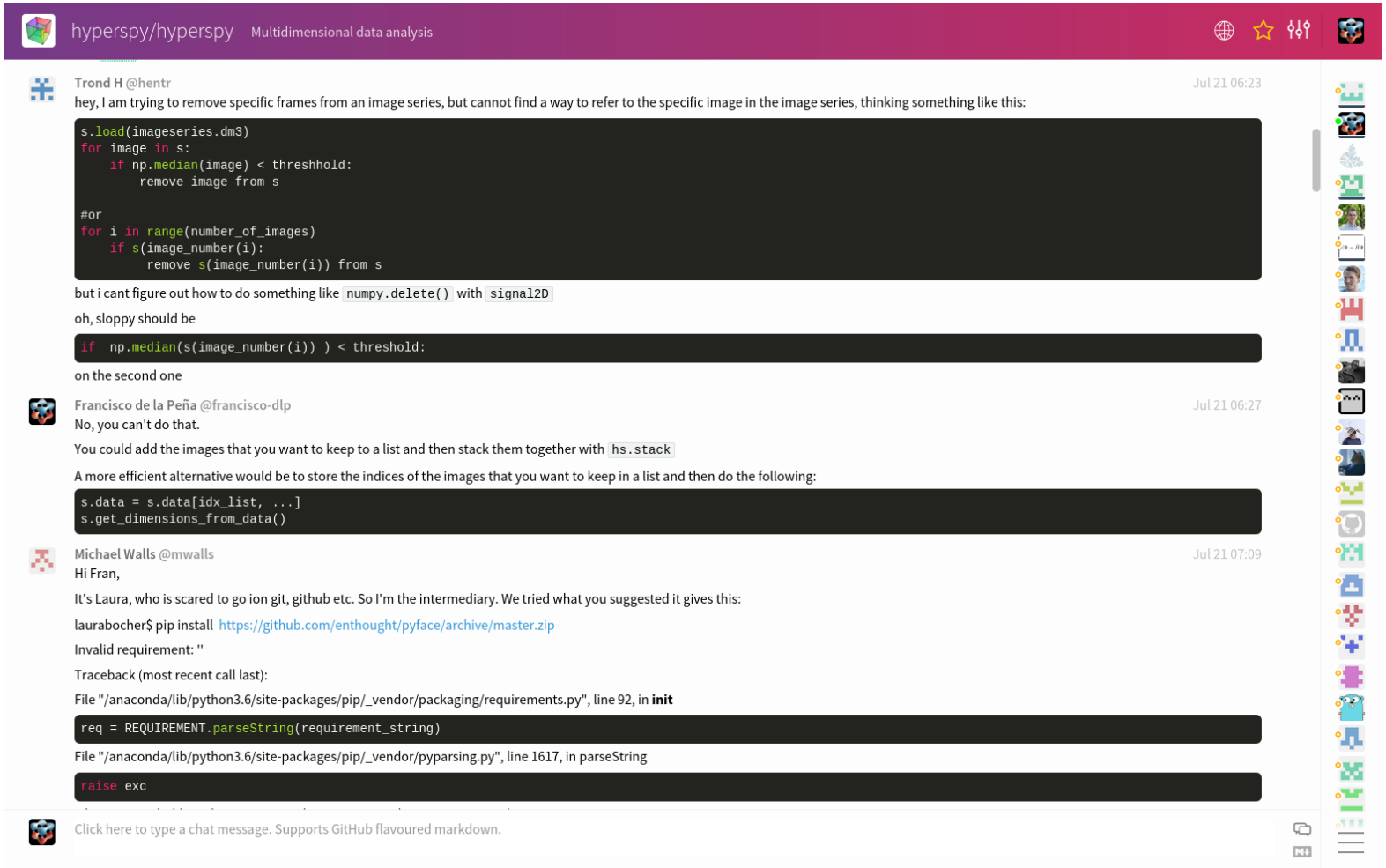

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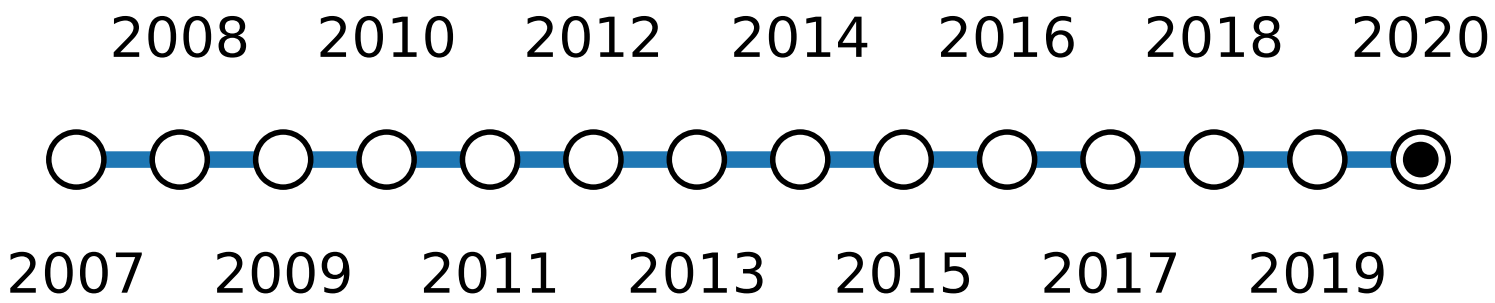

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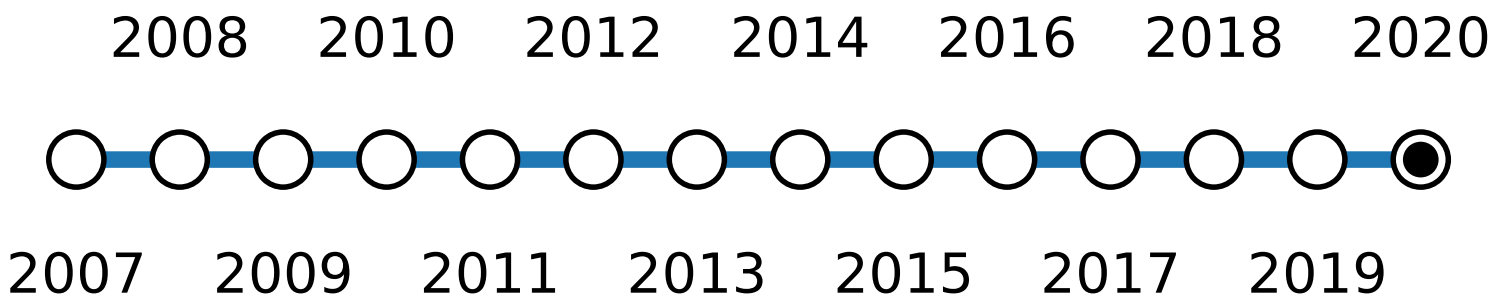

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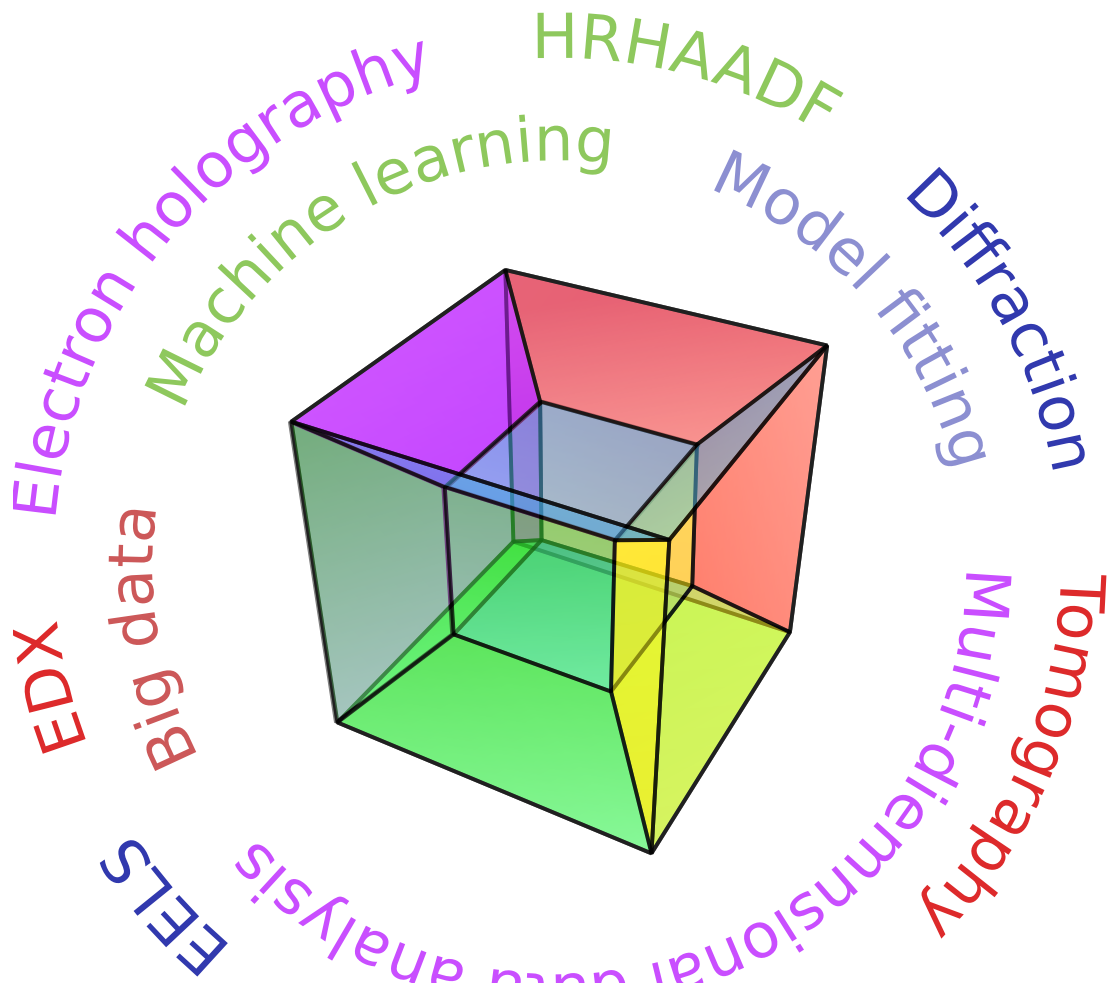
HyperSpy is . . .

A *community* that aims at *democratizing* advanced data processing and analysis of *multi-dimensional datasets* across scientific fields by developing the features and *syntax* of the Python package of the same name.

Less is more: splitting HyperSpy



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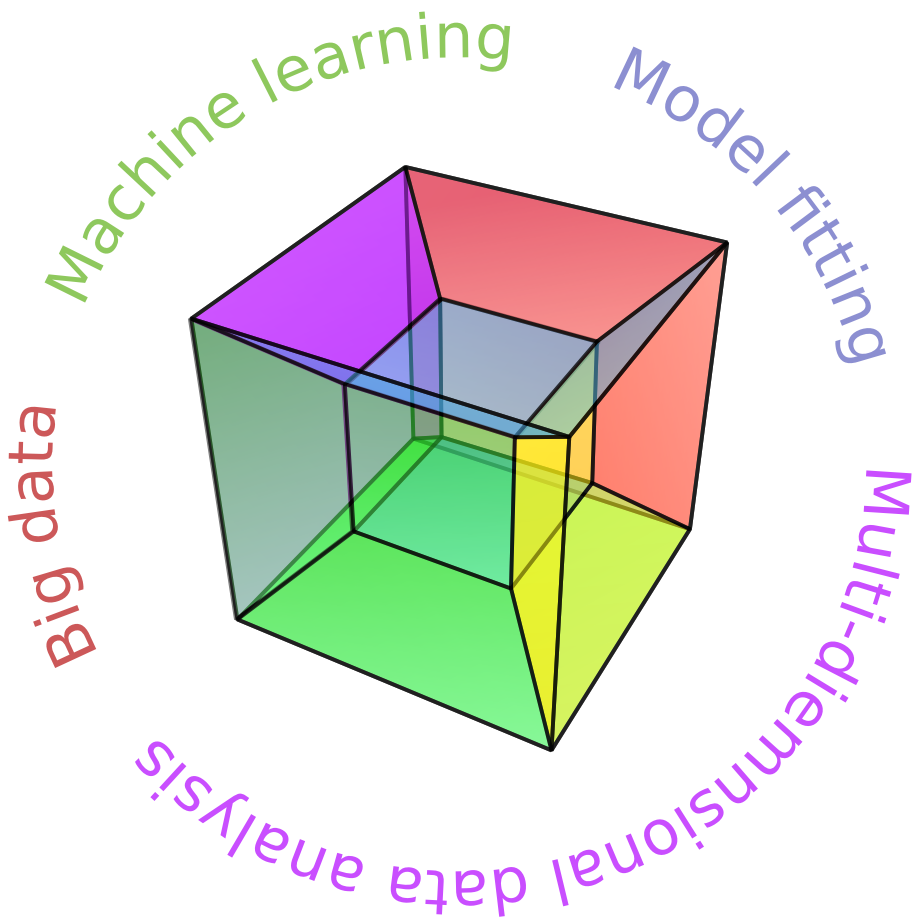

Conclusion

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- In academia: I hope no one scoops me

Conclusion

When you people have a new idea:

- In academia: I hope no one scoops me
- In Open Source: thanks goodness someone already thought of this!

Elizabeth Seiver @tweetotaler in Twitter

Thank you all for you attention