cachai

Python Meeting #12

CACHAI, a customizable visualization toolkit for science

DD-Beltran-F/cachai

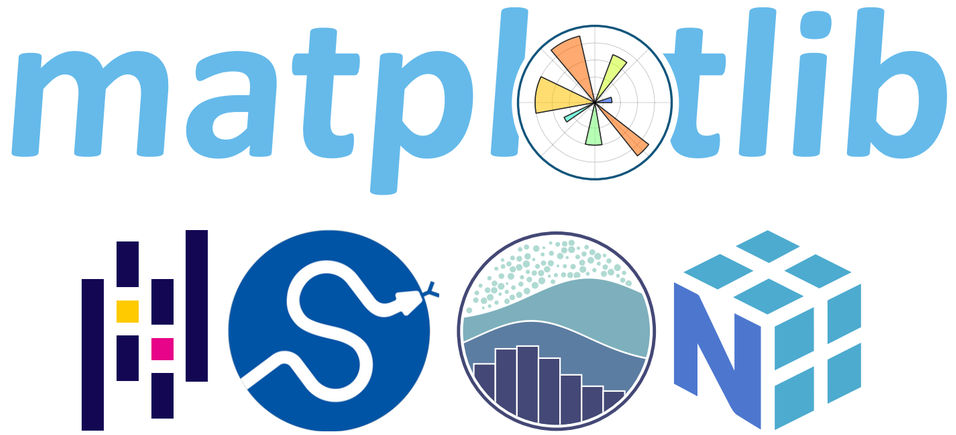
pypi.org/project/cachai

cachai.readthedocs.io

Diego Beltrán | **IA PUC**

What is `cachai`?

CACHAI stands for "***C**ustom **A**xes and **CH**arts **A**dvanced **I**nterface*". It is a Python package for **data visualization**, a fully customizable toolkit designed to produce polished, publication-ready plots built on top of *matplotlib*.



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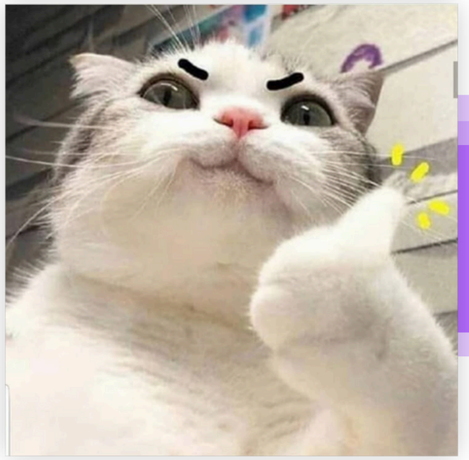

We want to give you access to creative, unusual (and even funny) plots!

Installing `cachai`

All official releases of CACHAI are published on ***PyPI***.
To install, simply run this in your console:

```
user@host:~$ pip install cachai
```

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```

You can also install it with the optional testing dependencies:

```
user@host:~$ pip install cachai[testing]
```

Modules of `cachai`

Plotting
`cachai.chplot`

References all of cachai's charts, providing a matplotlib-like interface for intuitive and easy plotting.

`chord(…)`
`michinoff(…)`
`polartext(…)`
`...`

Datasets
`cachai.data`

Allows you to access pre-created datasets hosted in the *cachai-datasets GitHub*.

`load_dataset(…)`
`get_dataset_repo()`
`get_dataset_names()`
`get_dataset_metadata(…)`
`clear_cache(…)`

Utilities
`cachai.utilities`

Contains supporting tools primarily designed for internal use, though some functions may be useful in other contexts.

`chsave(…)`
`map_from_curve(…)`
`get_bezier_curve(…)`
`mod_color(…)`
`...`

Gadgets
`cachai.gadgets`

Some additional graphical utilities.

`PolarText(…)`
`...`

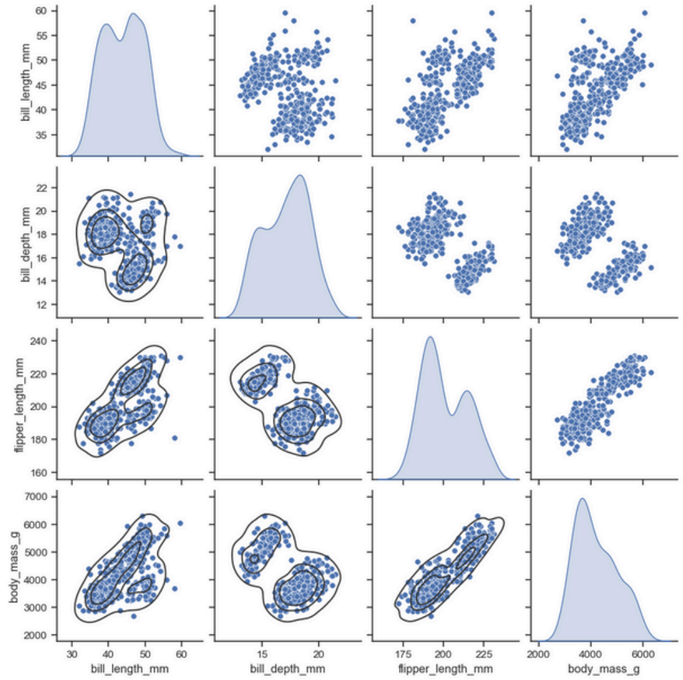
Tests

Verify the installation of cachai.

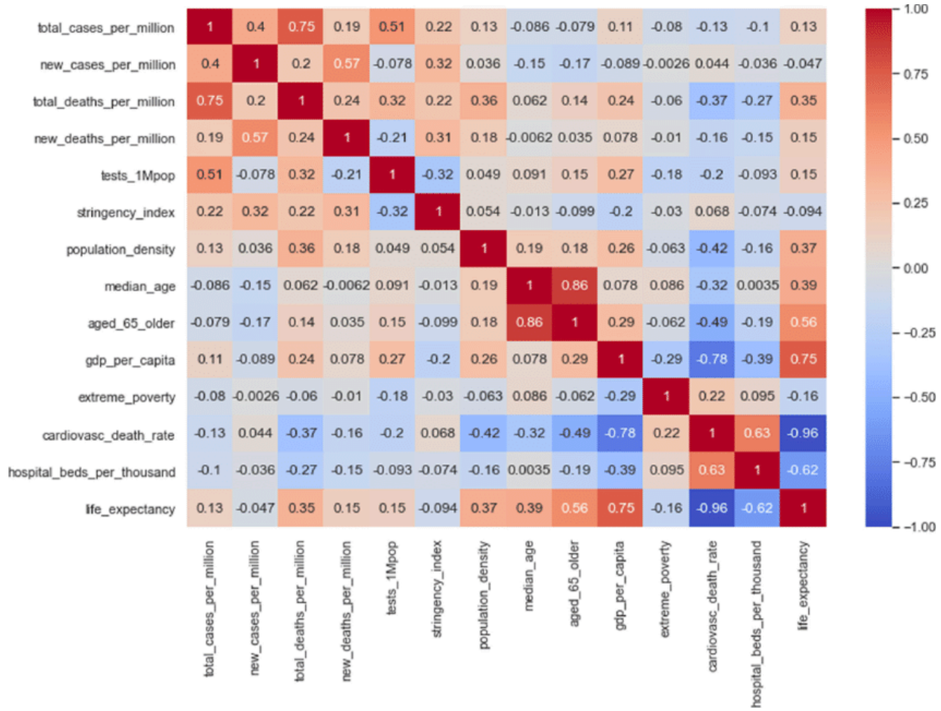
`get_available_tests()`
`run_tests(…)`

Chord Diagrams

A Chord Diagram visualize correlations. Common ways to do this include **Pair/Corner Plots** and **Heatmaps**. However, these can quickly become overcrowded (and take up a lot of space in a manuscript!) when dealing with many variables.



***seaborn* documentation (2025)**



Music et al. (2021)

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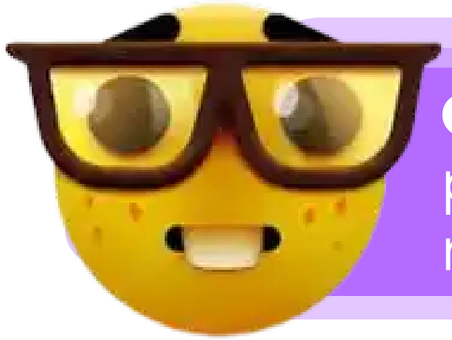
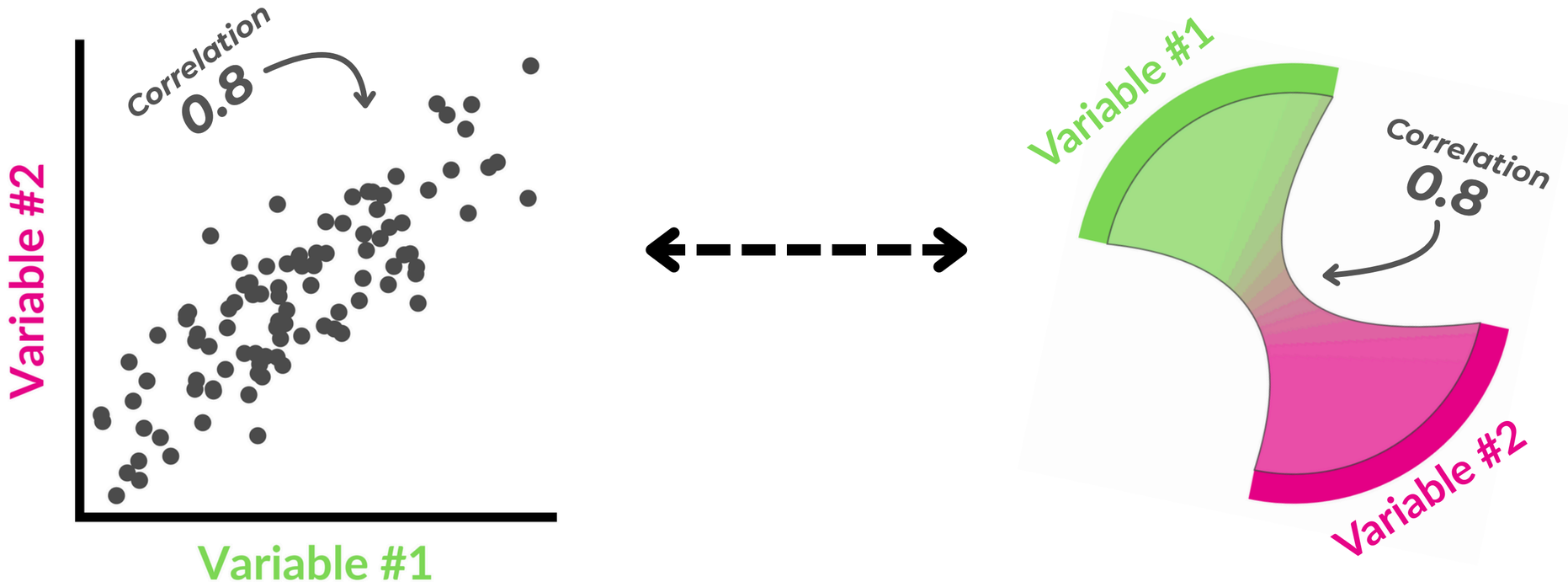


Chord diagrams solve this problem by providing a ***compact*** and ***intuitive*** view of all relationships at once.

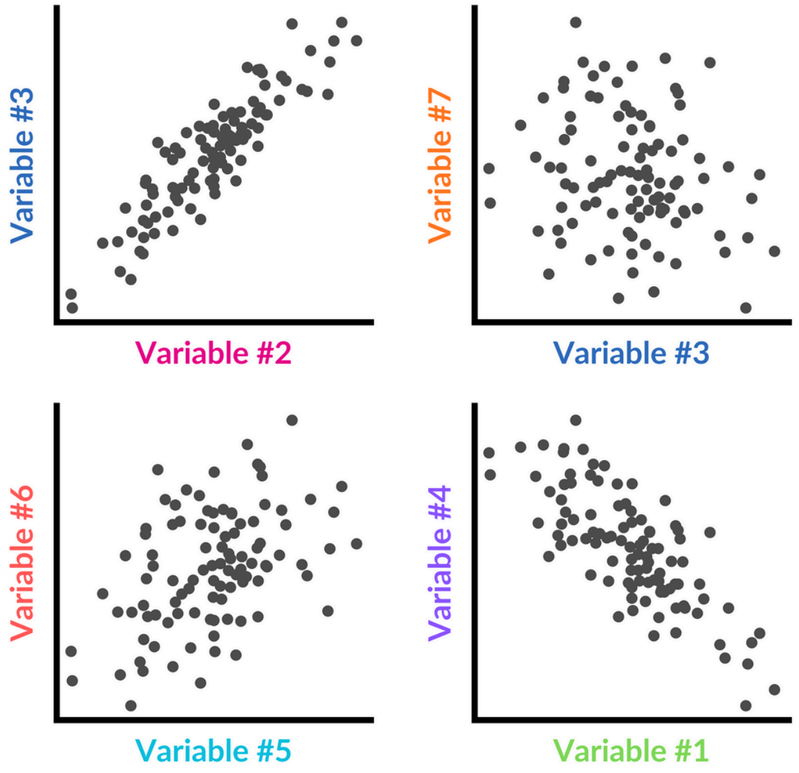
Chord Diagrams

A **Chord Diagram** visualize correlations between multiple variables by representing them as nodes arranged around a circle, and links (chords) connecting them.

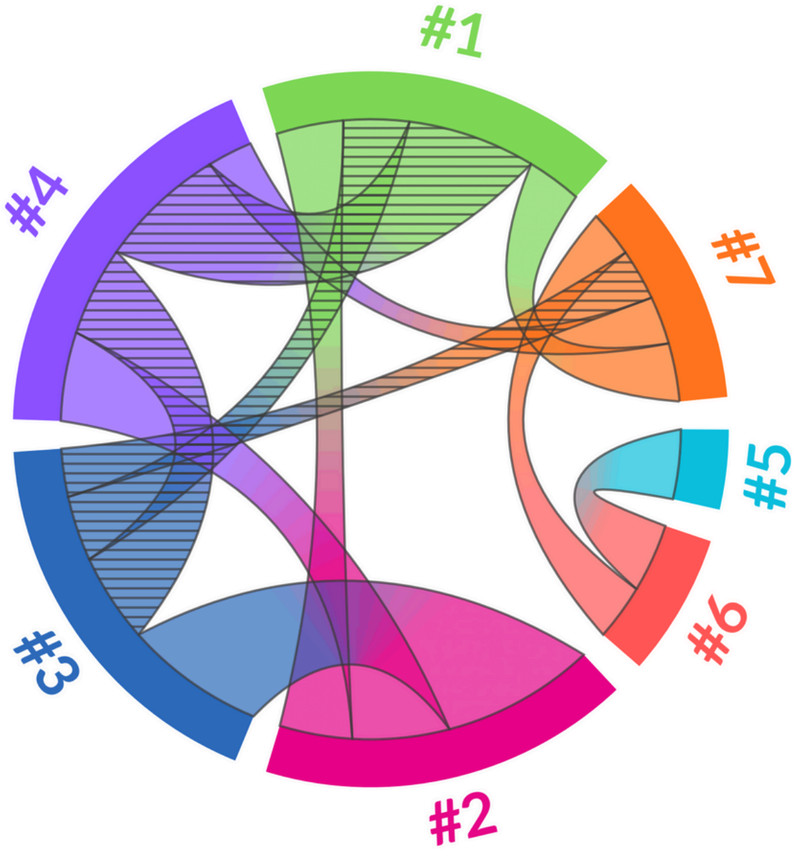


Chord Diagrams

Each chord's **thickness** and **pattern** (hatch) indicate the strength and sign of the relationship (e.g. correlation or anti-correlation).



And many more...



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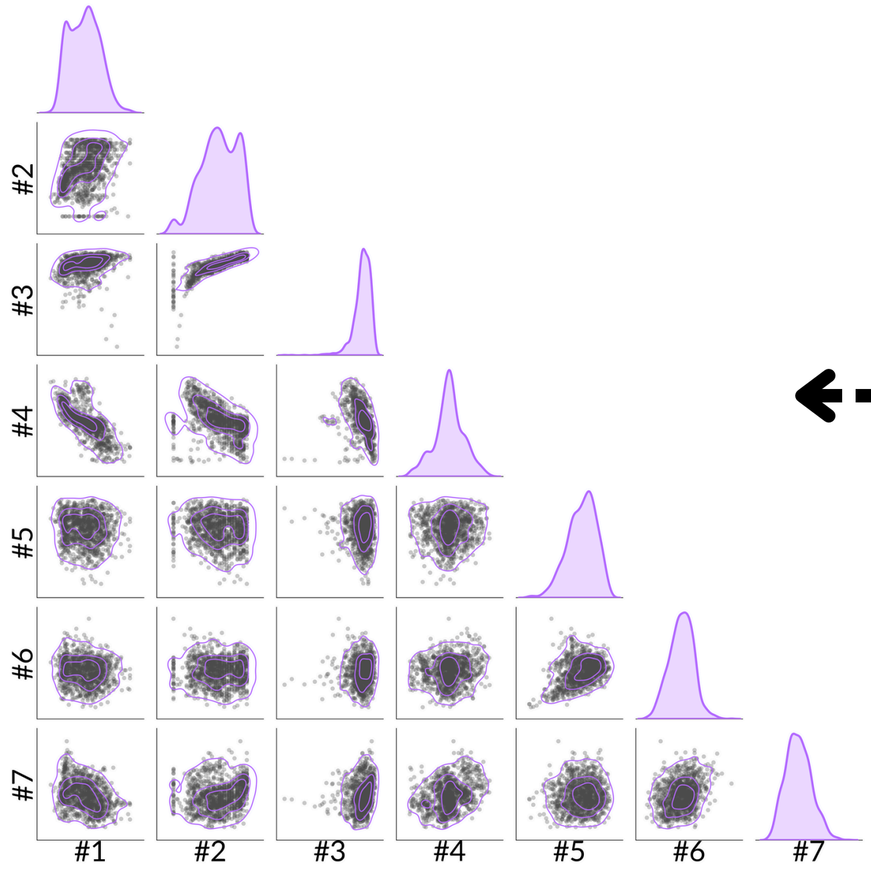

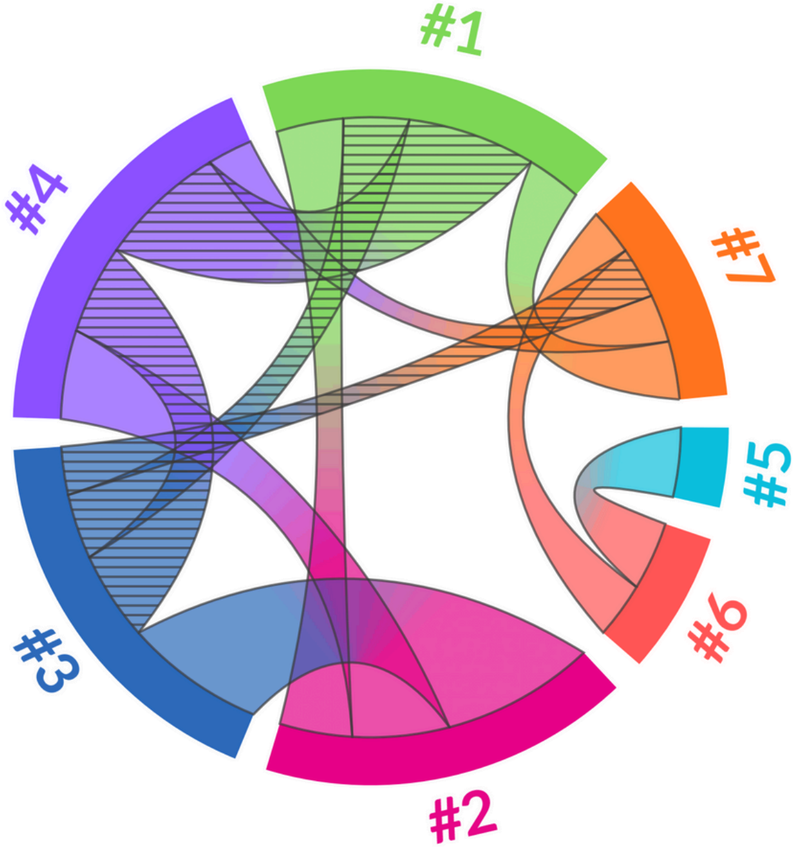

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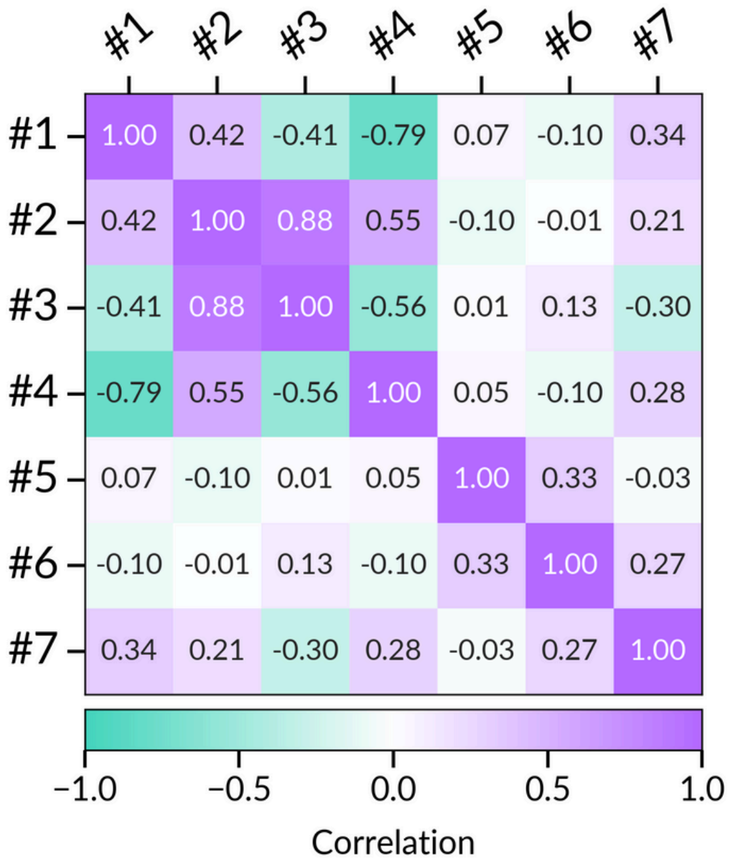
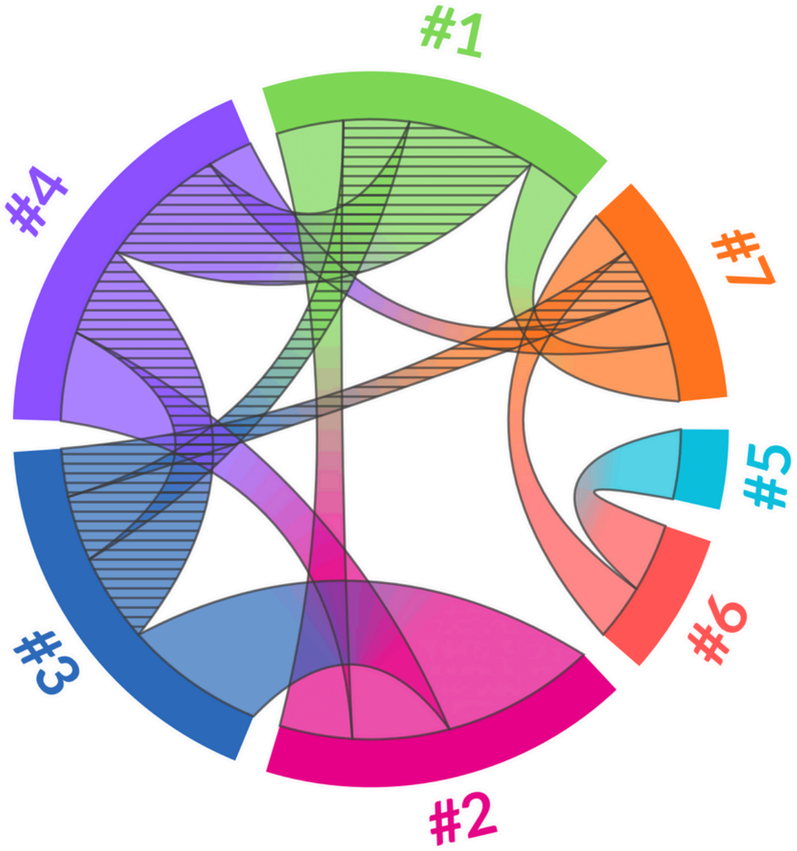




Chord Diagrams: Basic usage

notebook.ipynb

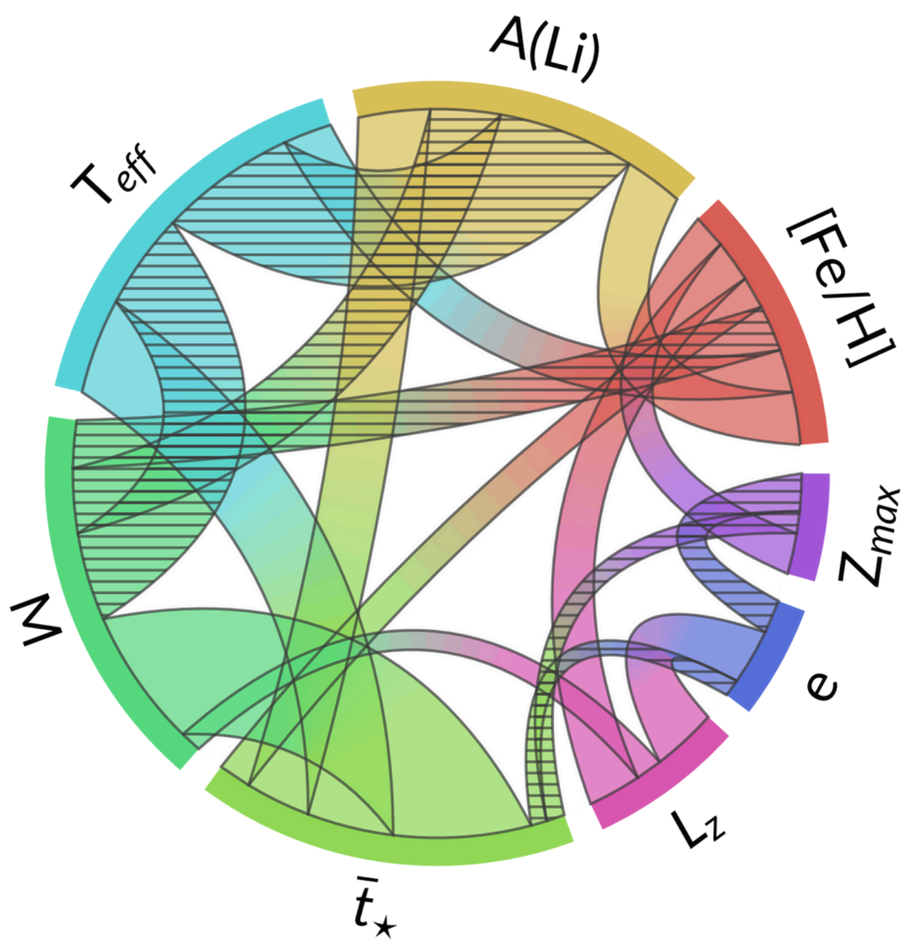
```
# Some imports
import cachai.data as chd
import cachai.chplot as chp

# Let's use a cachai dataset
data = chd.load_dataset('lithium')

# Now we calculate the correlation
# matrix
corr_matrix = data.corr('spearman')

# And that's it! Now we plot it
chp.chord(corr_matrix)
```

Output

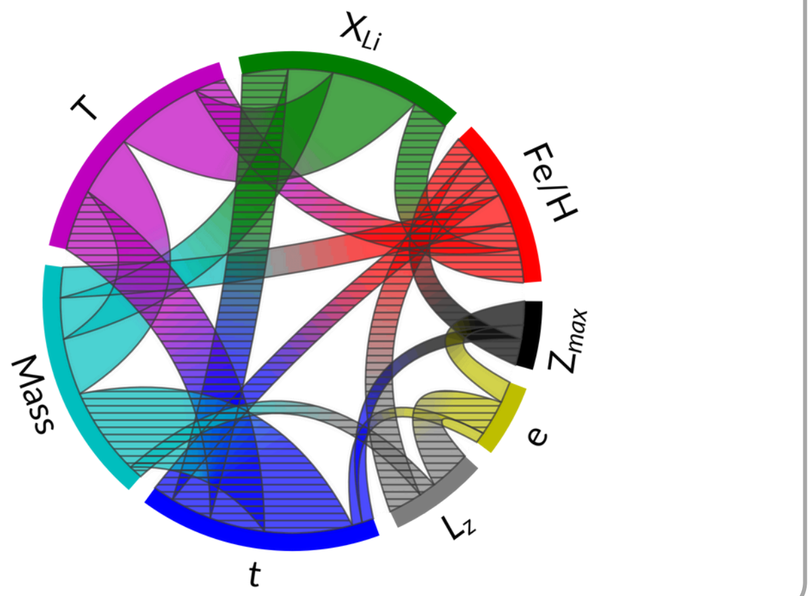


Chord Diagrams: Customization

notebook.ipynb

```
# Basic customization includes variable names and colors
names = ['Fe/H',r'X$_{Li}$','t','Mass','T','e',r'Z$_{max}$',r'$L_z$']
colors = ['r','g','b','c','m','y','k','gray']
chp.chord(corr_matrix, names, colors)
```

Output

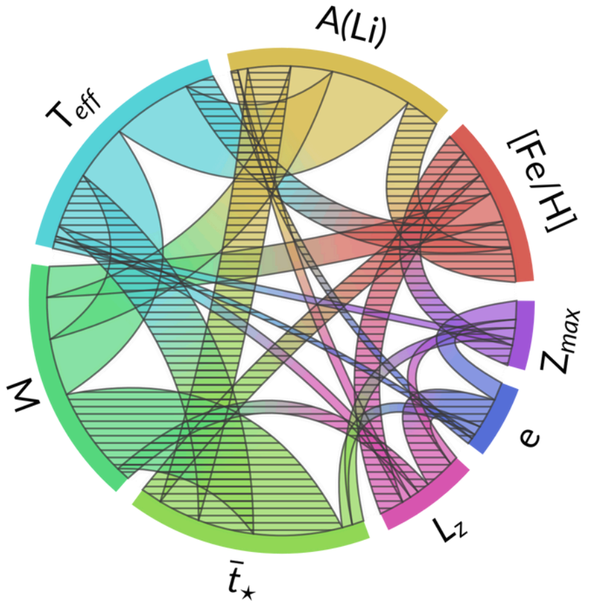


Chord Diagrams: Customization

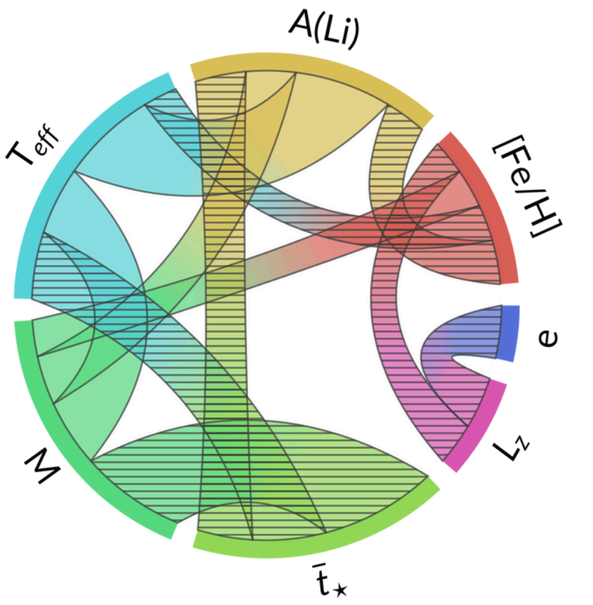
notebook.ipynb

```
# threshold / th : Minimum correlation value to display
chp.chord(corr_matrix, threshold=your_threshold)
```

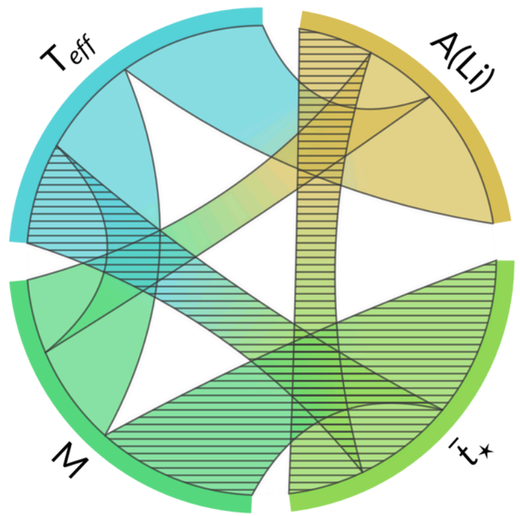
threshold=0.05



threshold=0.25



threshold=0.4



Chord Diagrams: Customization

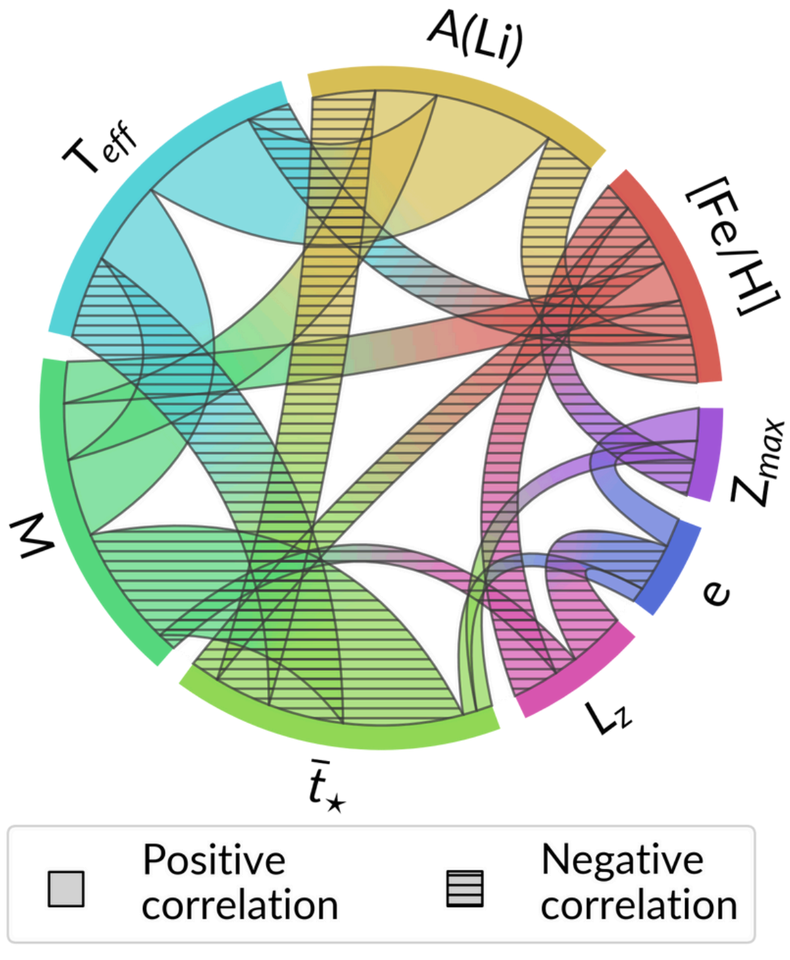
notebook.ipynb

```
# legend : Adds default positive and
# negative labels in the legend.

chp.chord(corr_matrix, legend=True)

plt.legend(
    loc='center',
    bbox_to_anchor=[0.5,0.0],
    ncols=2,
)
```

Output

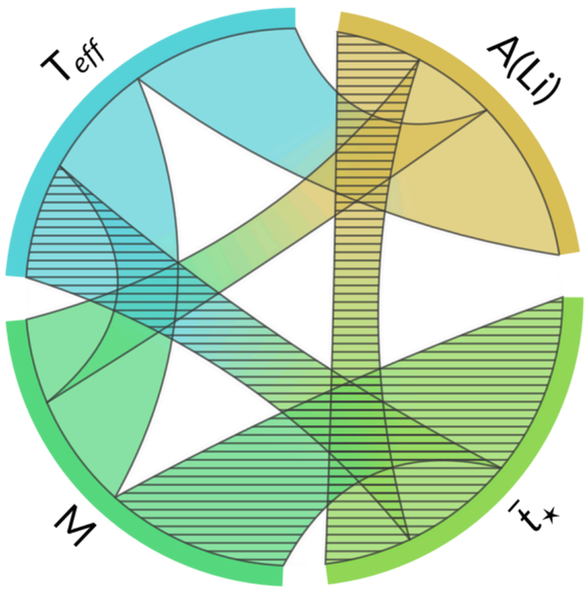


Chord Diagrams: Customization

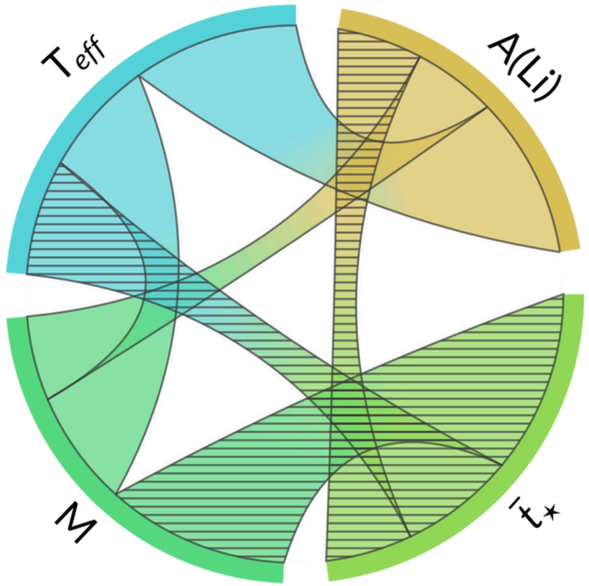
notebook.ipynb

```
# scale : Scale use to set chord's thickness, whether "linear" or "log"
chp.chord(corr_matrix, scale=your_scale)
```

scale='linear'



scale='log'



Chord Diagrams: Customization

notebook.ipynb

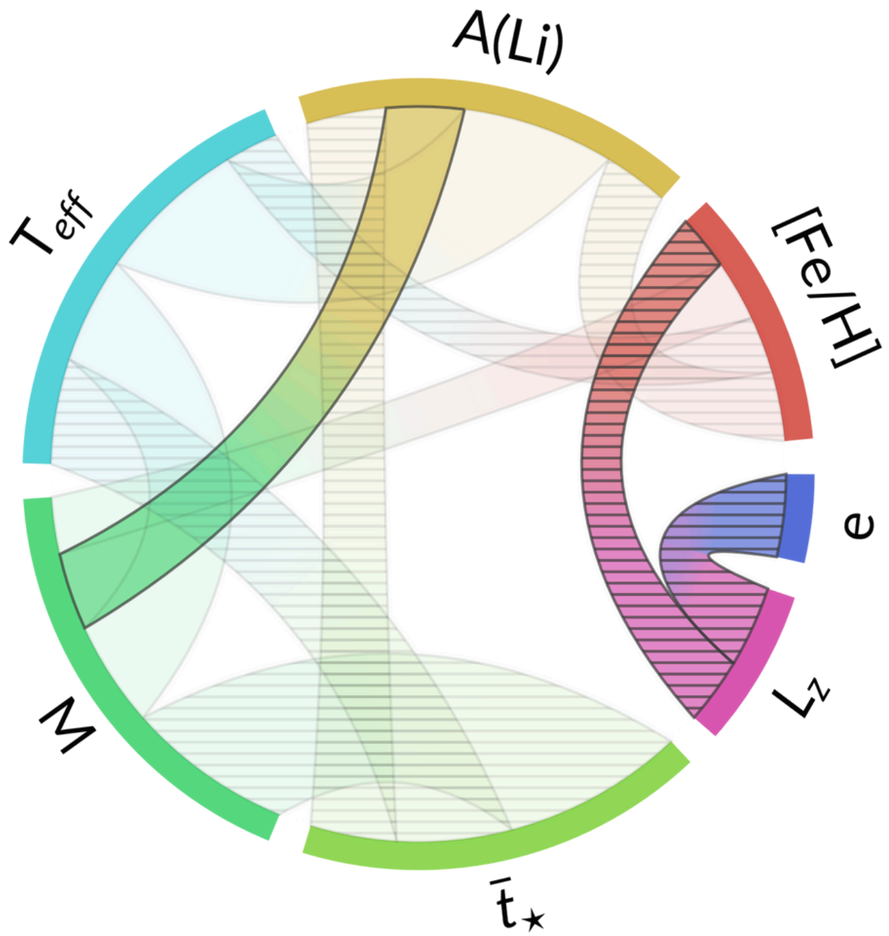
```
# We also have a highlighting method

# We need to return the chord object
my_chord = chp.chord(corr_matrix)

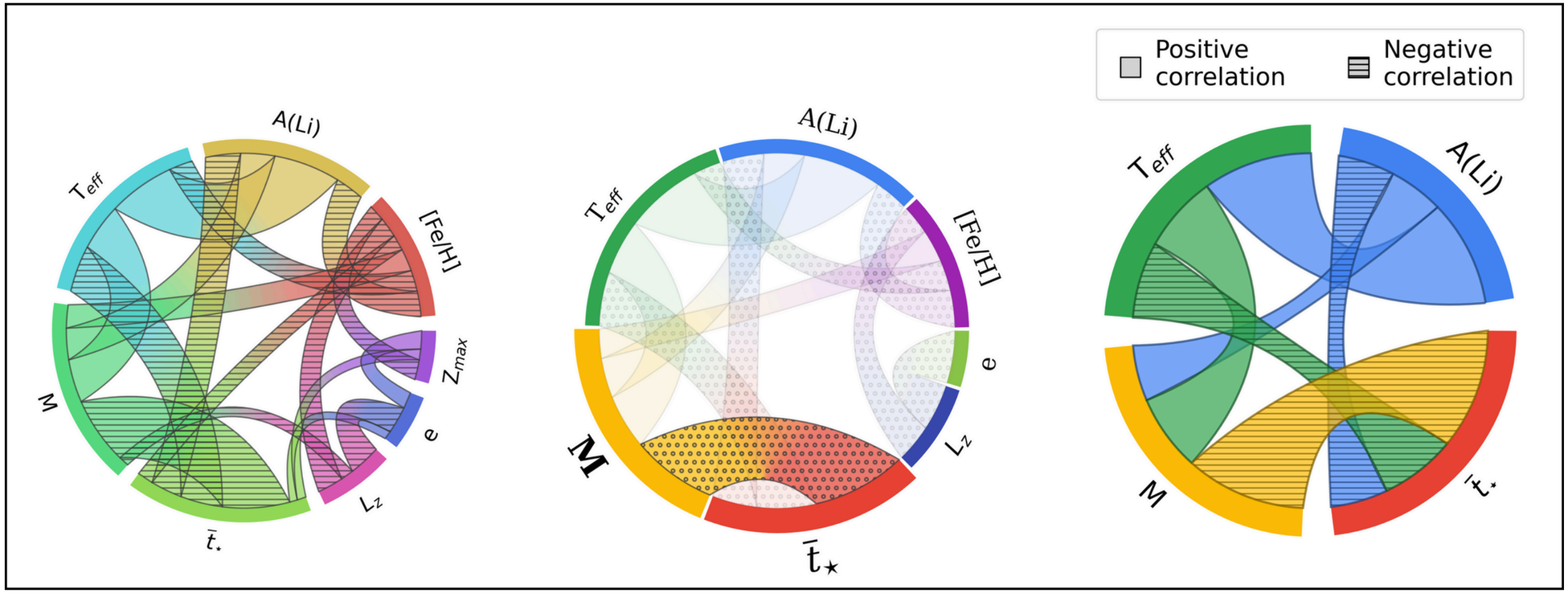
# Let's highlight the 6th node
# (node=5)
my_chord.highlight_node(5)

# And also highlight the 3rd chord
# (chord=2) of the 2nd node (node=1)
my_chord.highlight_chord(1,2)
```

Output



Chord Diagrams: More examples



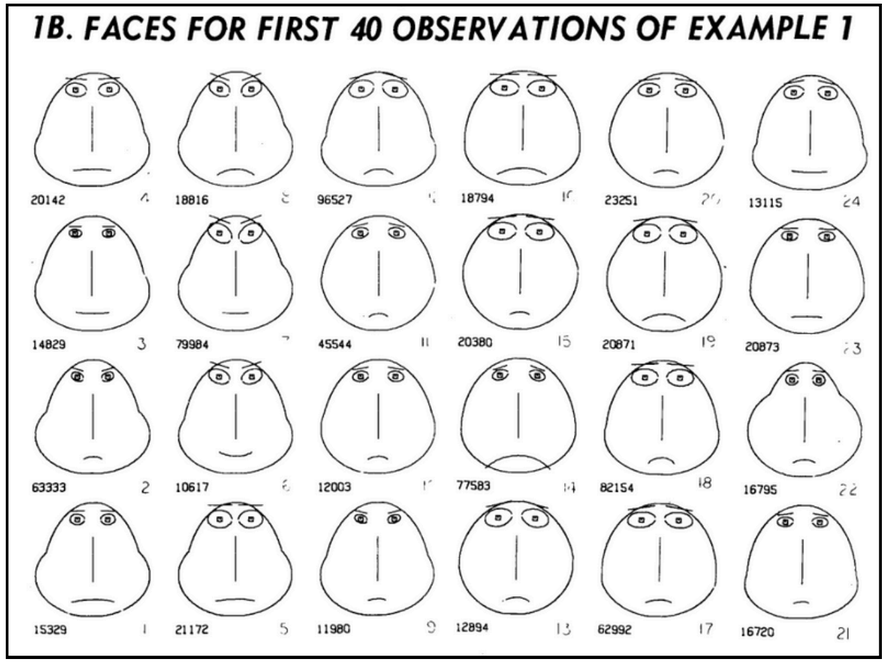
D. Beltrán & M. L. L. Dantas (2025)

Check out the examples section
in the documentation!

Work-in-progress

Michinoff Faces

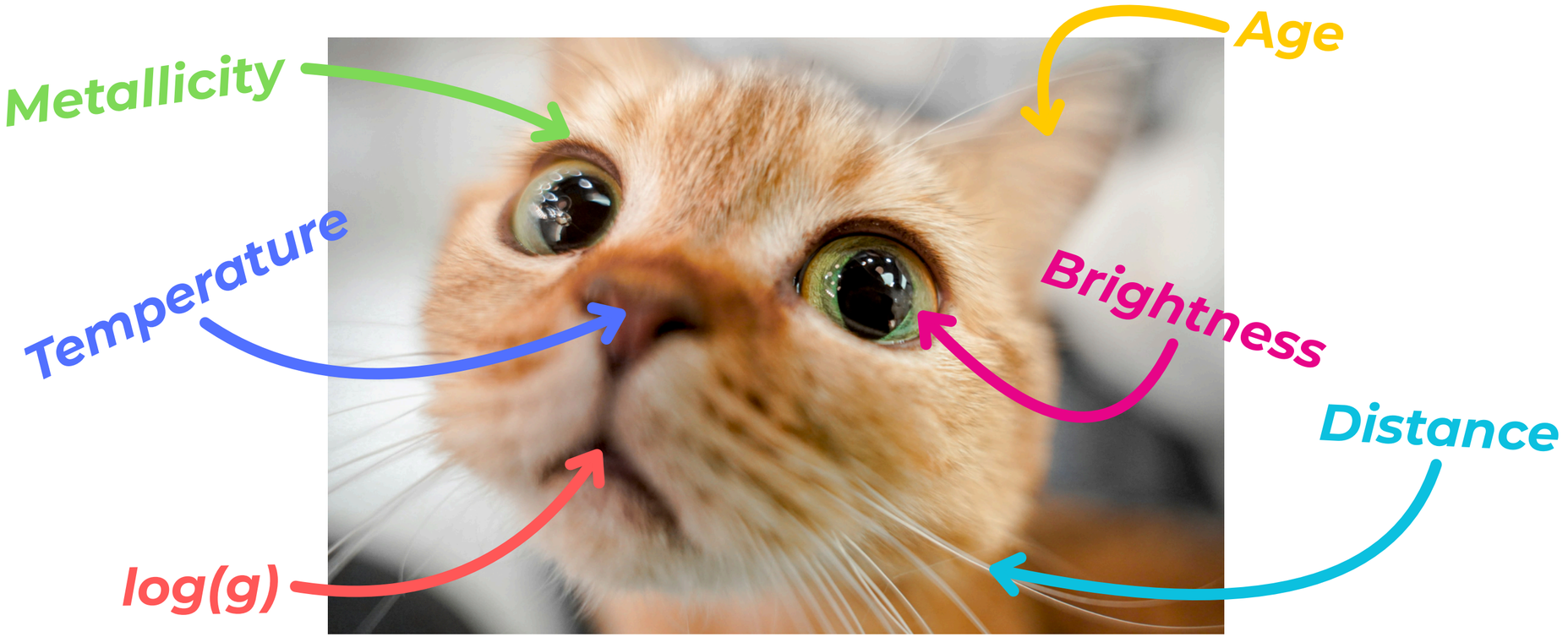
Chernoff faces visualize multivariate data by mapping each variable to a **facial feature**. Because humans are highly sensitive to facial differences, this method makes it easy to **spot patterns** and **compare observations**.



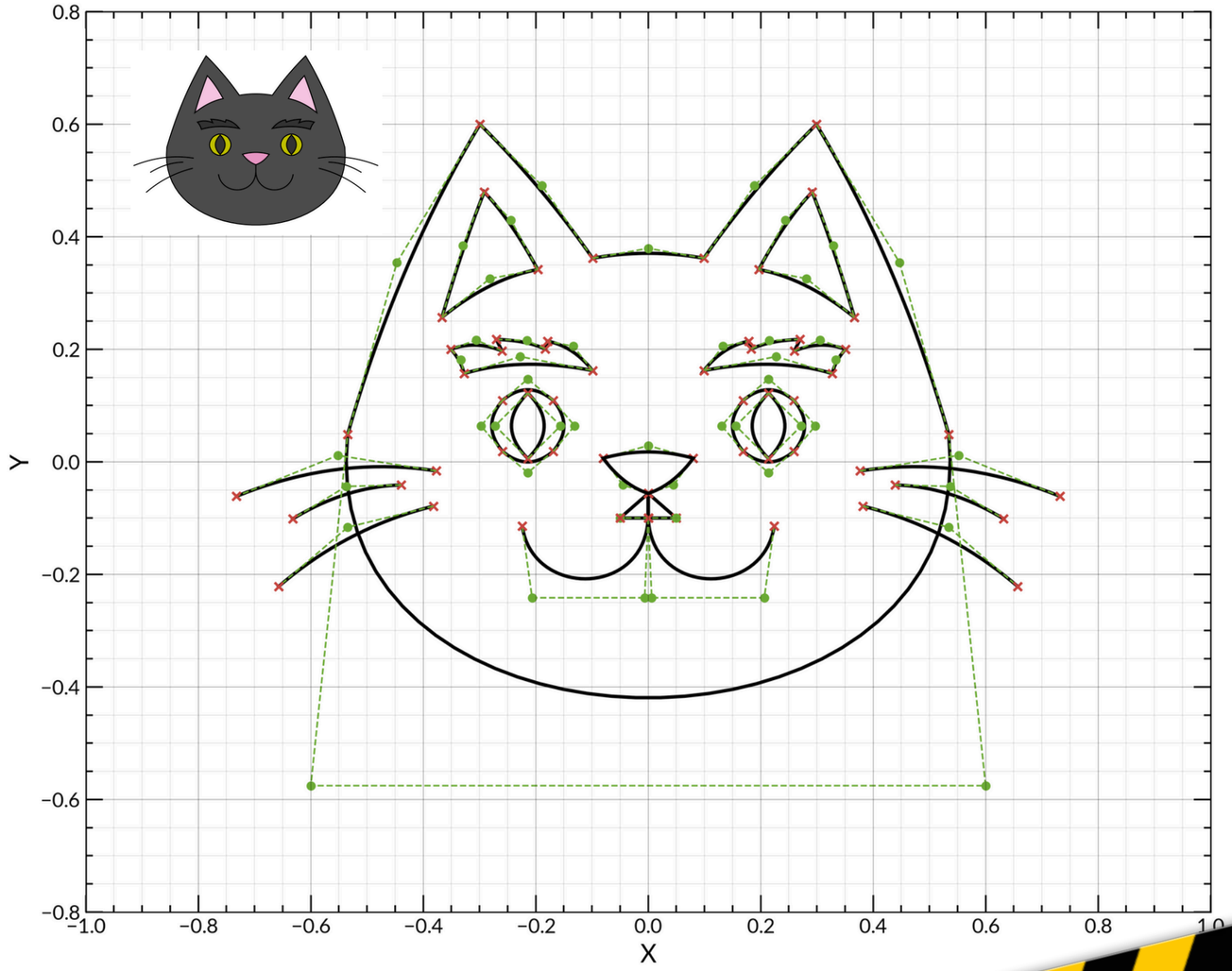
Chernoff, H. (1973)

Michinoff Faces

Michinoff faces follow the same idea, but replace the human face with a **cat face**. The name comes from *michi*, a colloquial word used in Latin America (including Chile) to mean “cat”.



Michinoff Faces: Construction



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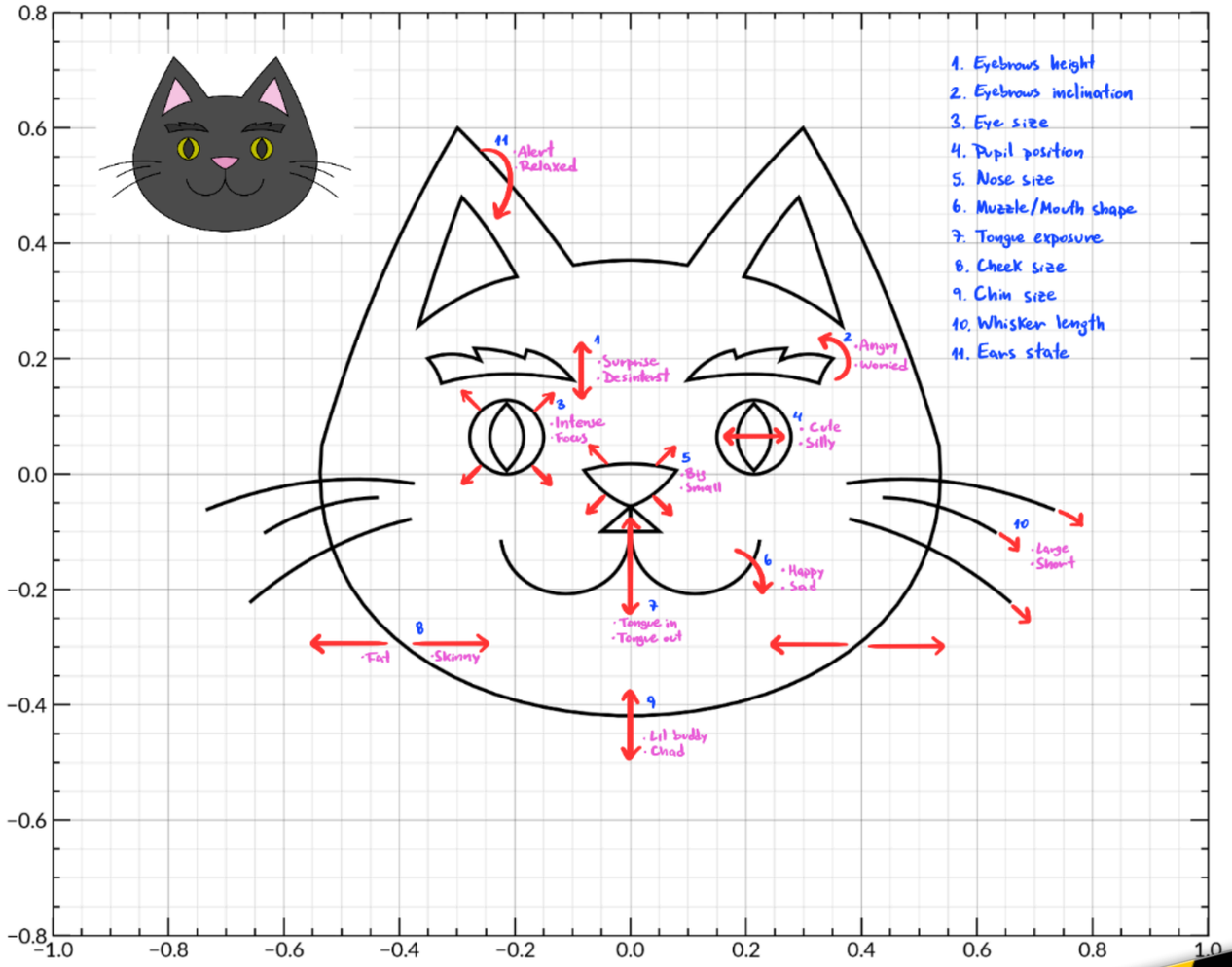

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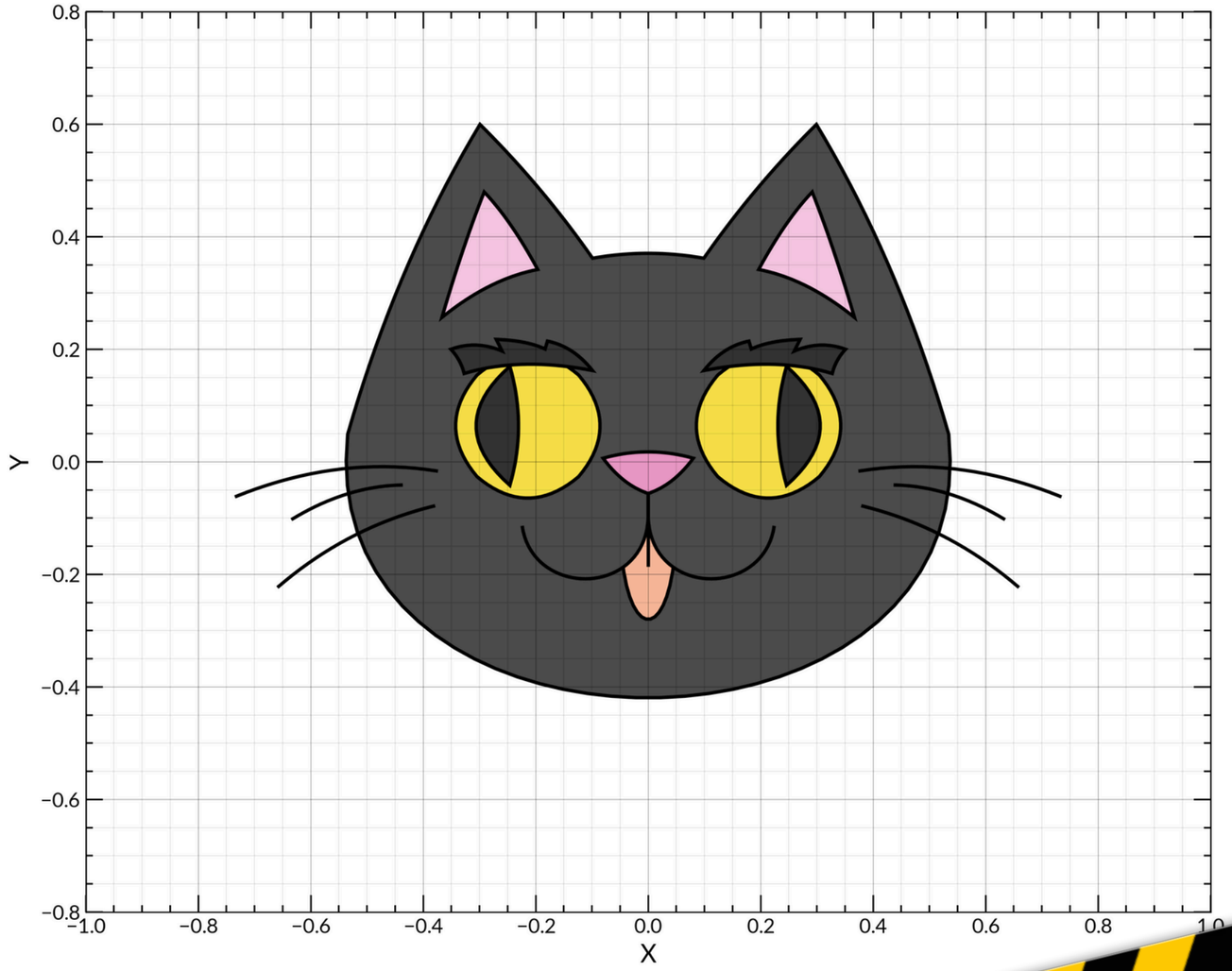

Michinoff Faces: *First tests*

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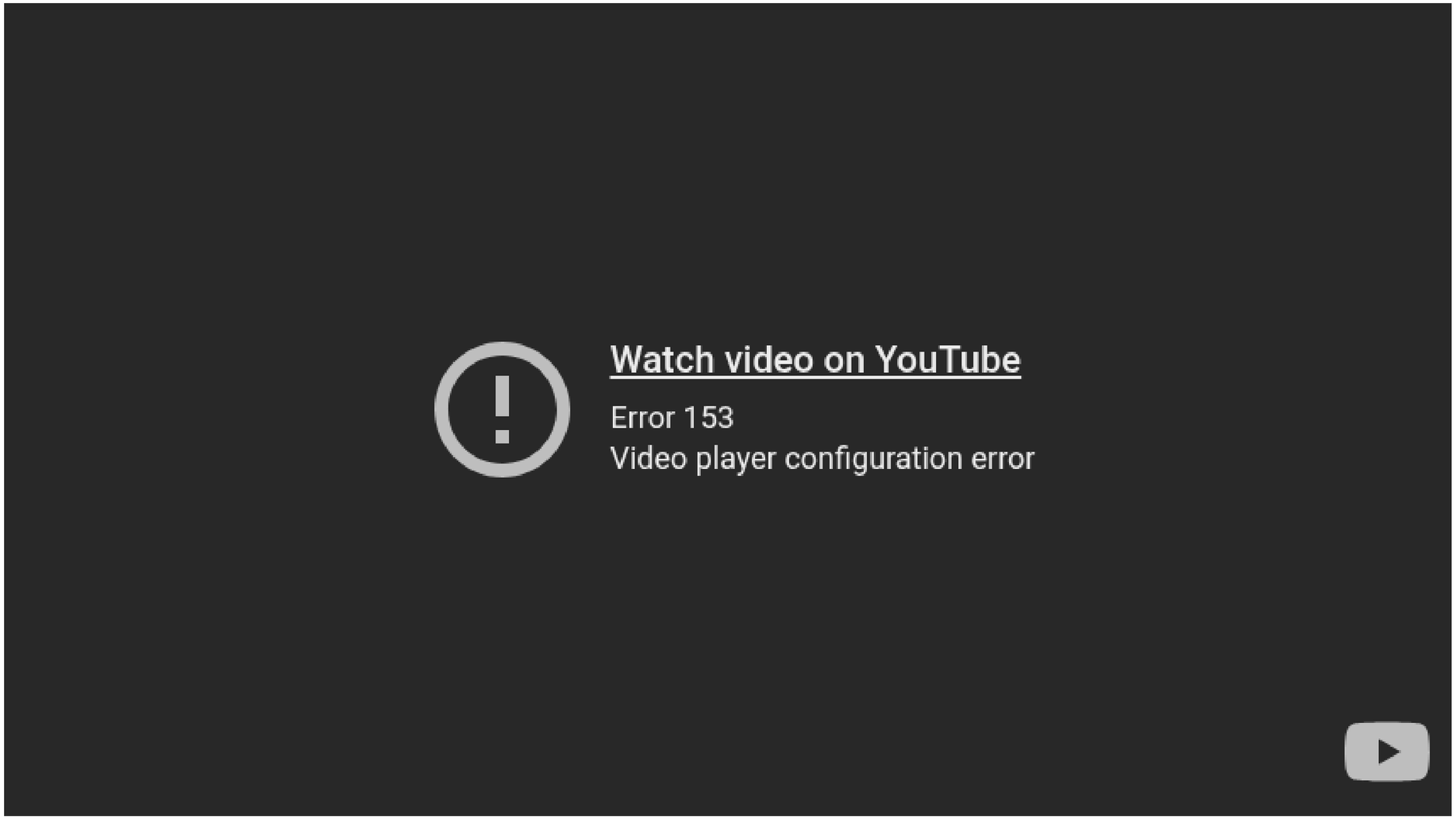

Link: https://youtu.be/ULfOqun6qyM

Michinoff Faces: Example

Let’s see what the three interstellar comets “look like” using the **Michinoff faces**.
Here is some data:

Name	v_∞ (km/s)	e	q (AU)	$B-V$ (mag)	r_n (km)	i (deg)	dM/dt (kg/s)
I1/’Oumuamua	26	1.2	0.25	0.70	0.06-0.11	122	$< 2\times10^{-3}$
I2/Borisov	32	3.4	2.00	0.82	0.20-0.50	44	160-250
I3/ATLAS	58	6.1	1.36	0.98	< 2.80	175	88-880

Michinoff Faces: Example

Let’s see what the three interstellar comets “look like” using the **Michinoff faces**.

Here is some data:

Eye size *Pupil* *Tongue* *Face color* *Chin* *Eyebrow inclination* *Ears*

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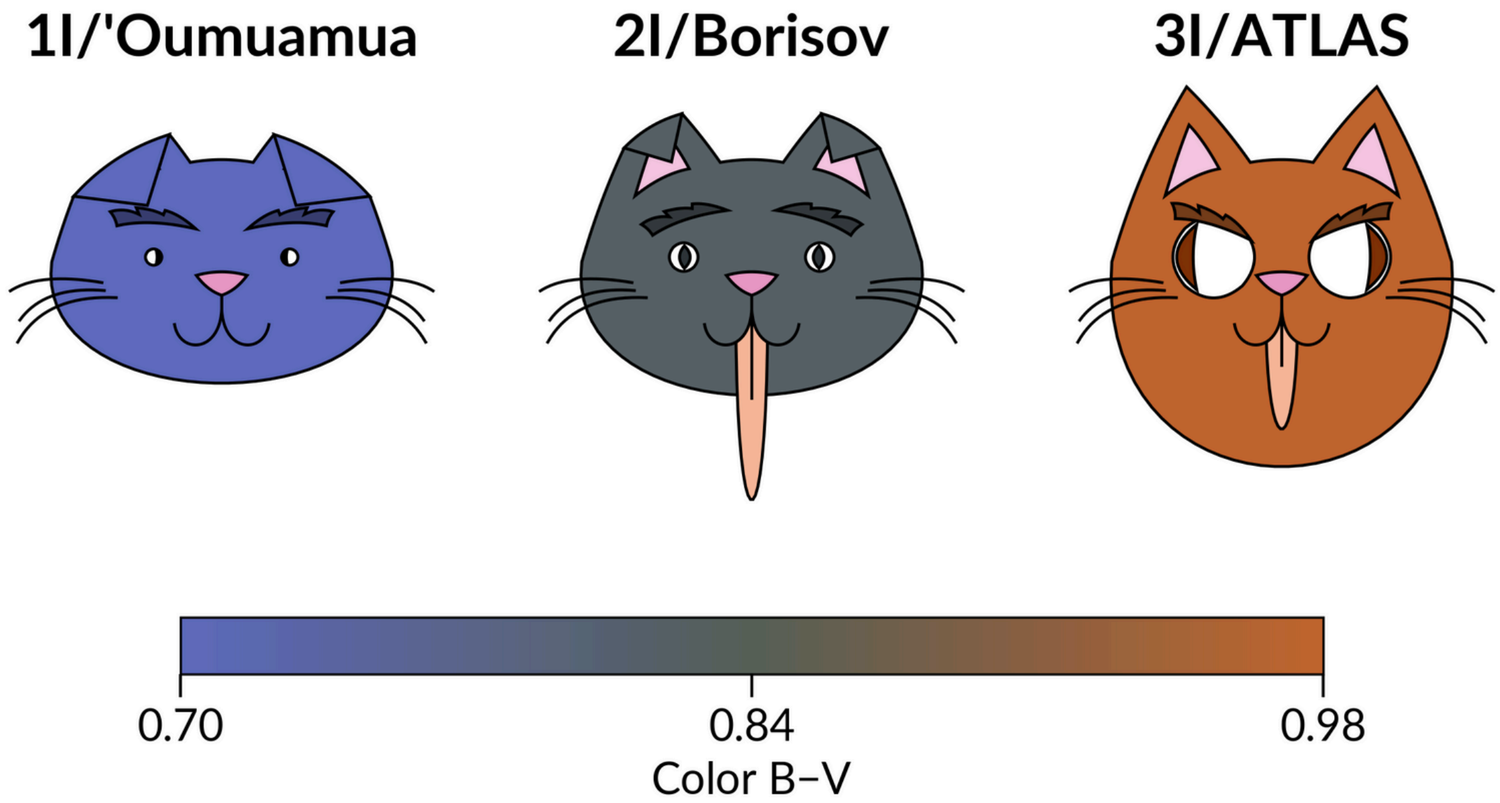
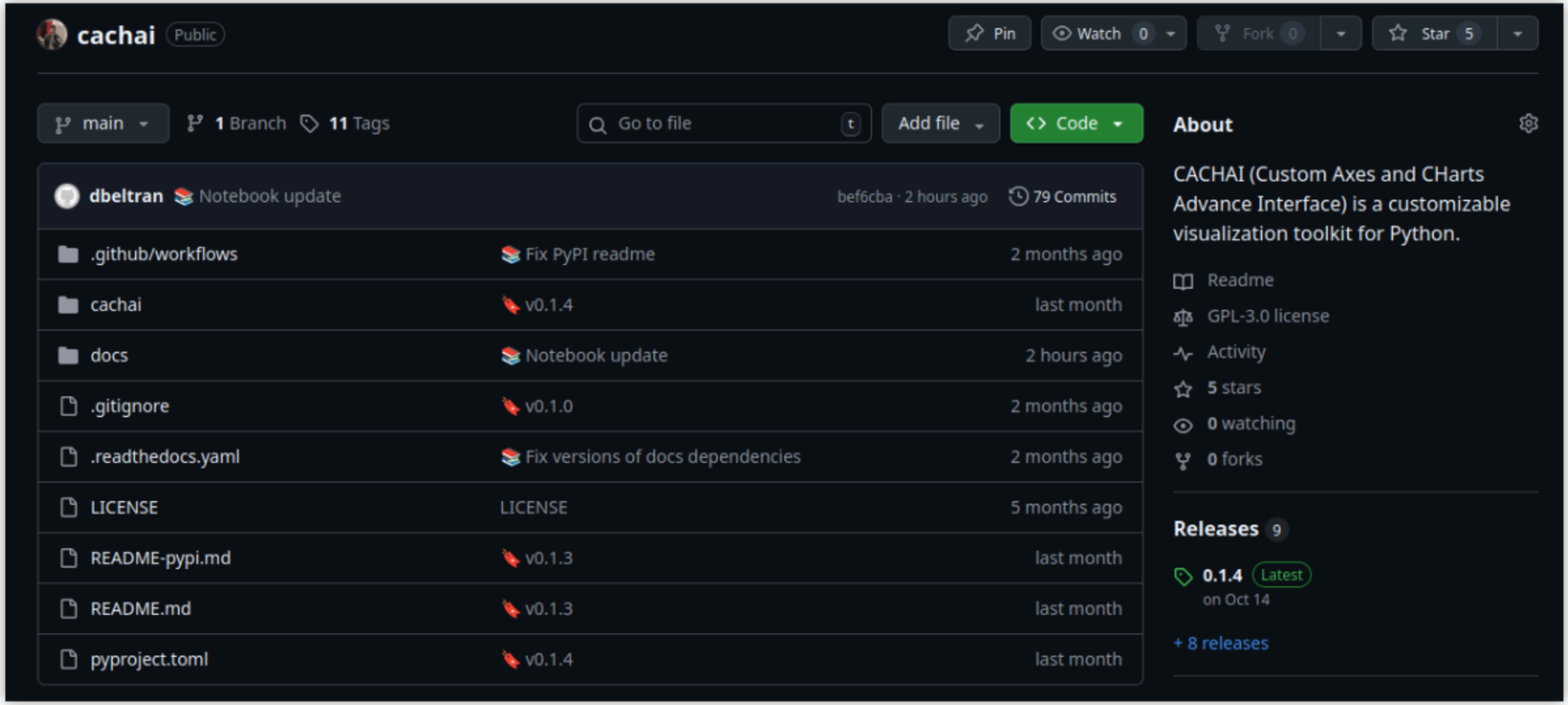


Project links

GitHub: github.com/DD-Beltran-F/cachai



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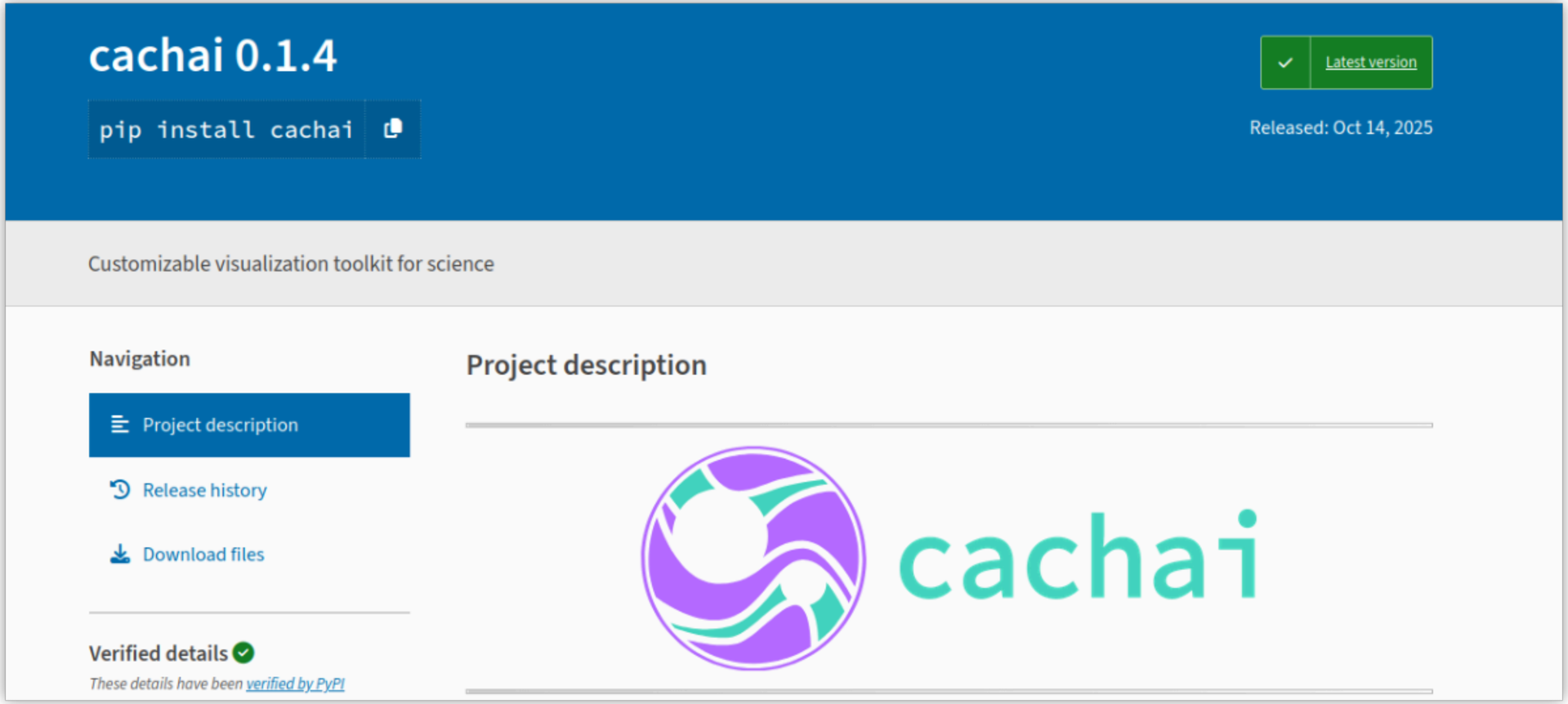
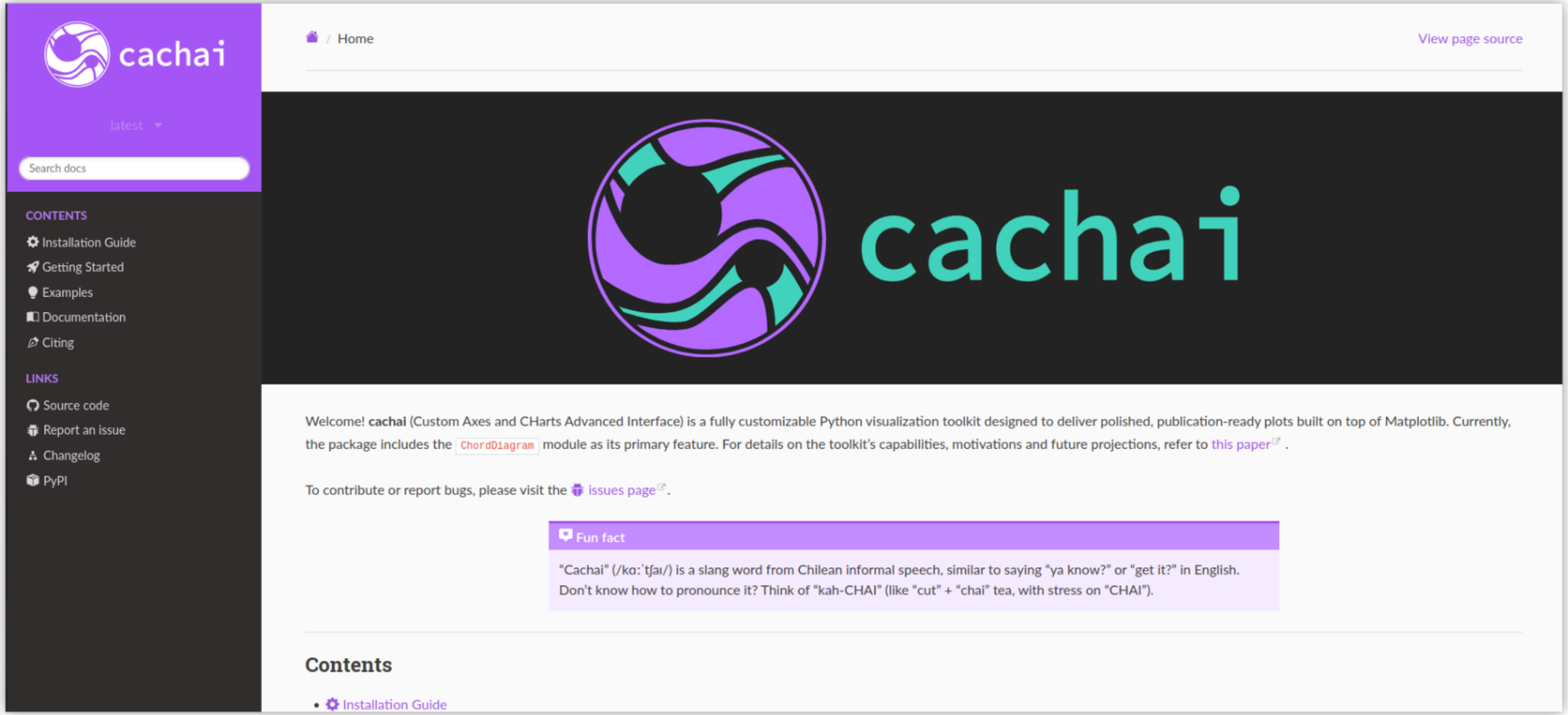


Project links

Read *the* Docs: cachai.readthedocs.io



It would mean a lot to me if cachai is useful to anyone :)
If you decide to use it, please consider citing this article:

CACHAI's First Module: A Fully Customizable Chord Diagram for Astronomy and Beyond - IOPscience

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iopscience.iop.org / Aug 11

DOI: 10.3847/2515-5172/adf8d

Python Meeting #12

Thank you very much for your time and attention!