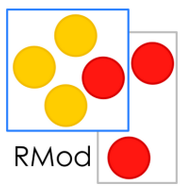
[PolyMath]

version 1.0 ⟶ v2.0

Oleksandr Zaitsev, **Sebastian Jordan Montaño**,
Serge Stinckwich, Hemal Varambhia, etc.

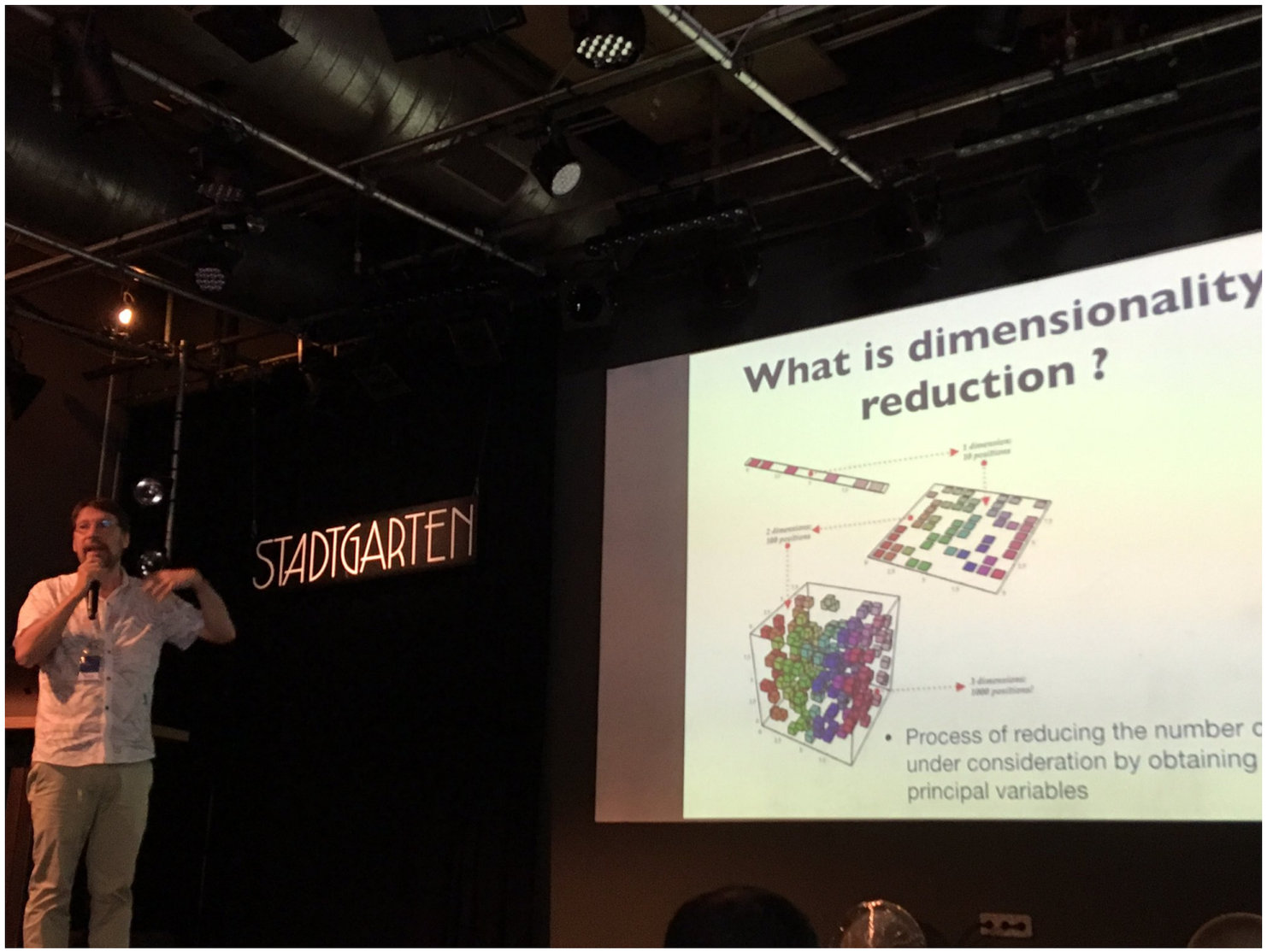


In a nutshell:

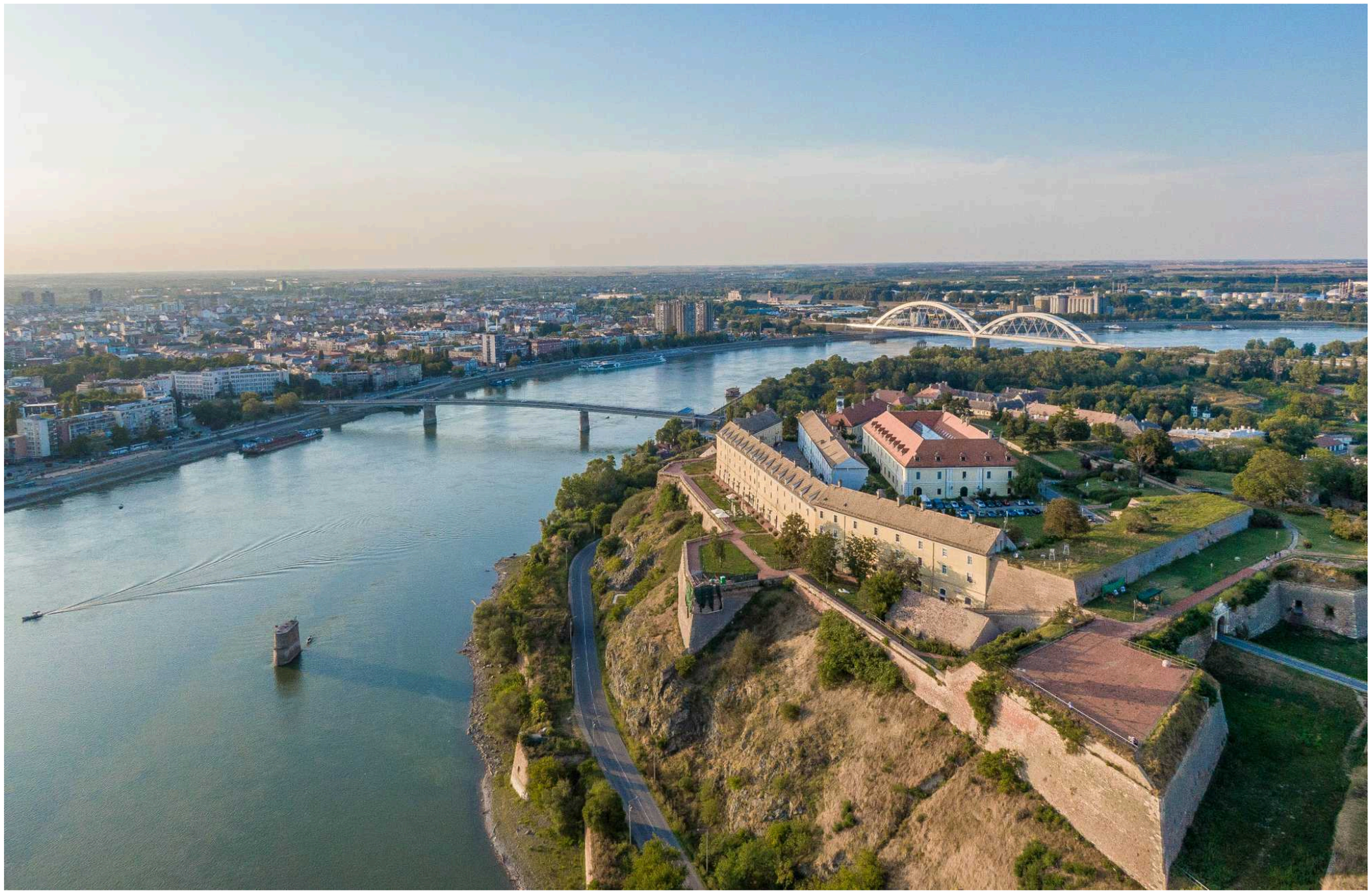
PolyMath is a library for
scientific computing in Pharo.

(it's a math library)

On ESUG 2019 in Cologne,
Serge Stinckwich presented PolyMath v1.0



Time flies :)



Now we are here

So today we will:

1. Remind you what is PolyMath
2. Discuss what lies ahead
3. Tell you how to support us

PolyMath

Part 1:

PolyMath - Who are we?

We are not mathematicians

Contributors (between v1.0 and now)

Serge Stinckwich

Hemal Varambhia

Oleksandr Zaitsev

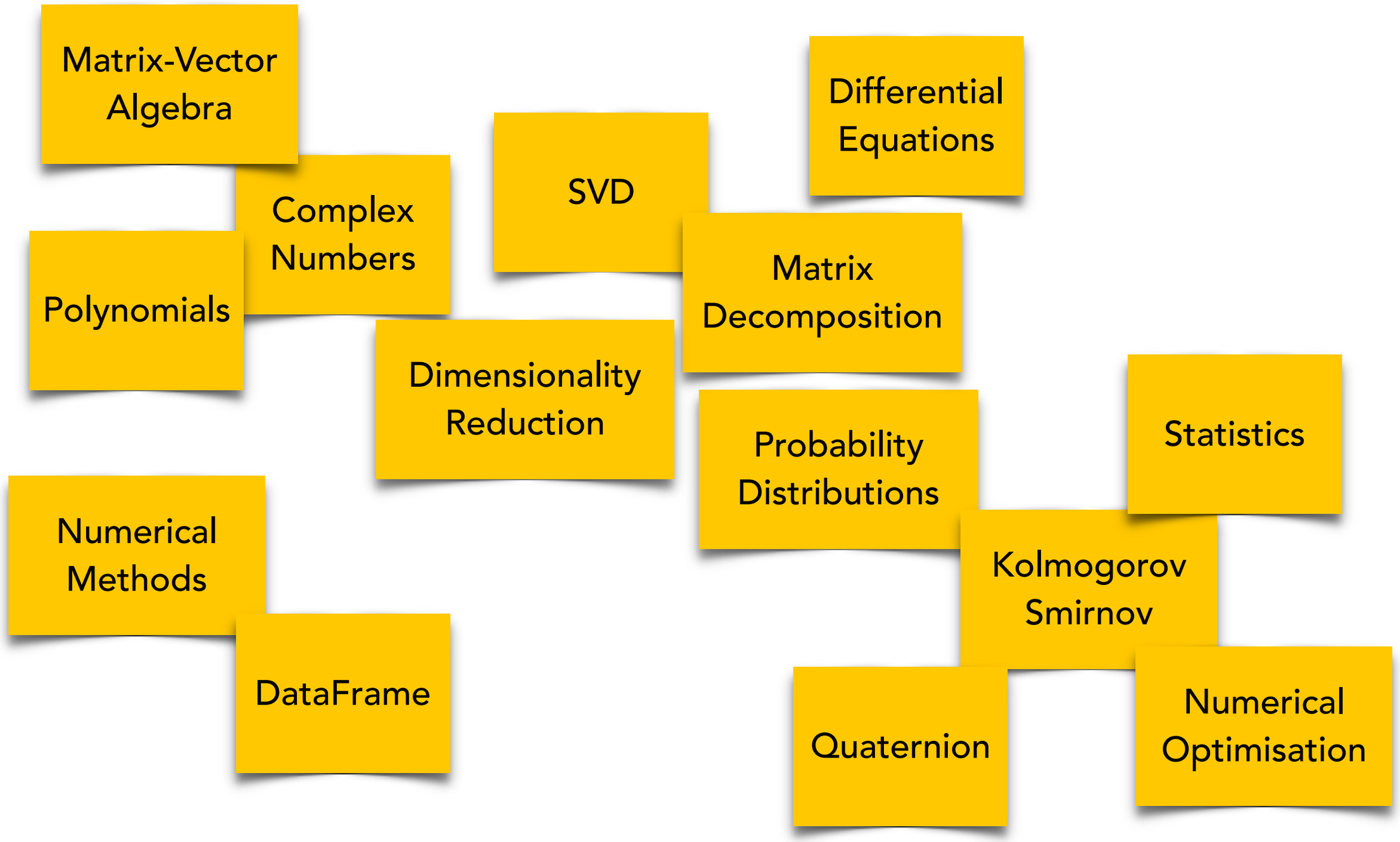
Yvan Guifo

Rakshit

Sebastian Jordan Montaño

Hernan Moralez Durand

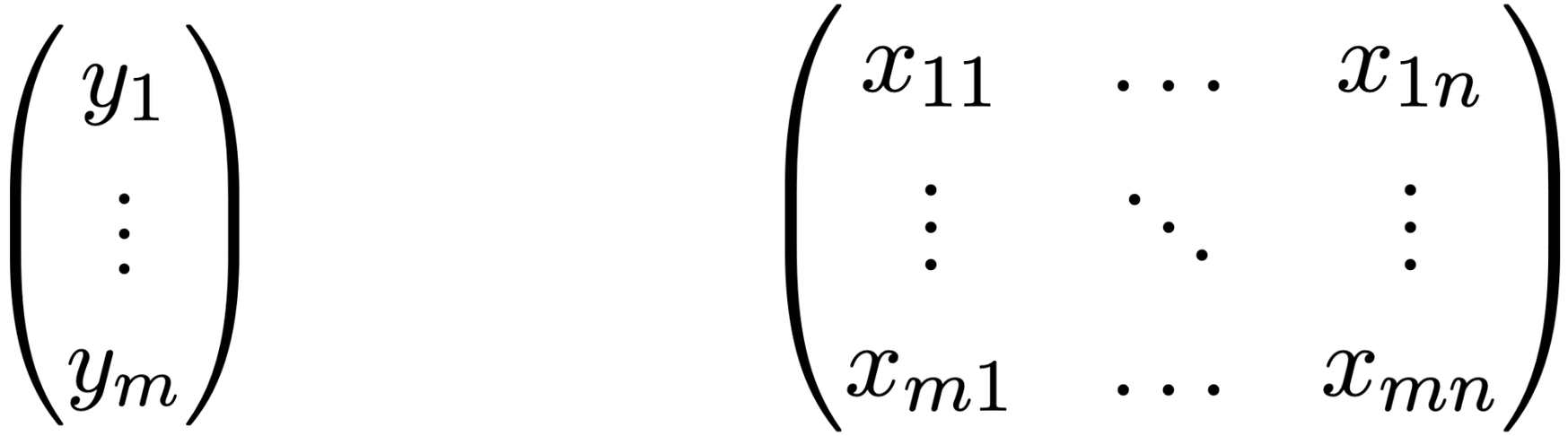
Some Packages & Algorithms



Getting Started with PolyMath

```
Metacello new
    repository: 'github://PolyMathOrg/PolyMath';
    baseline: 'PolyMath';
    load.
```

Two Data Structures



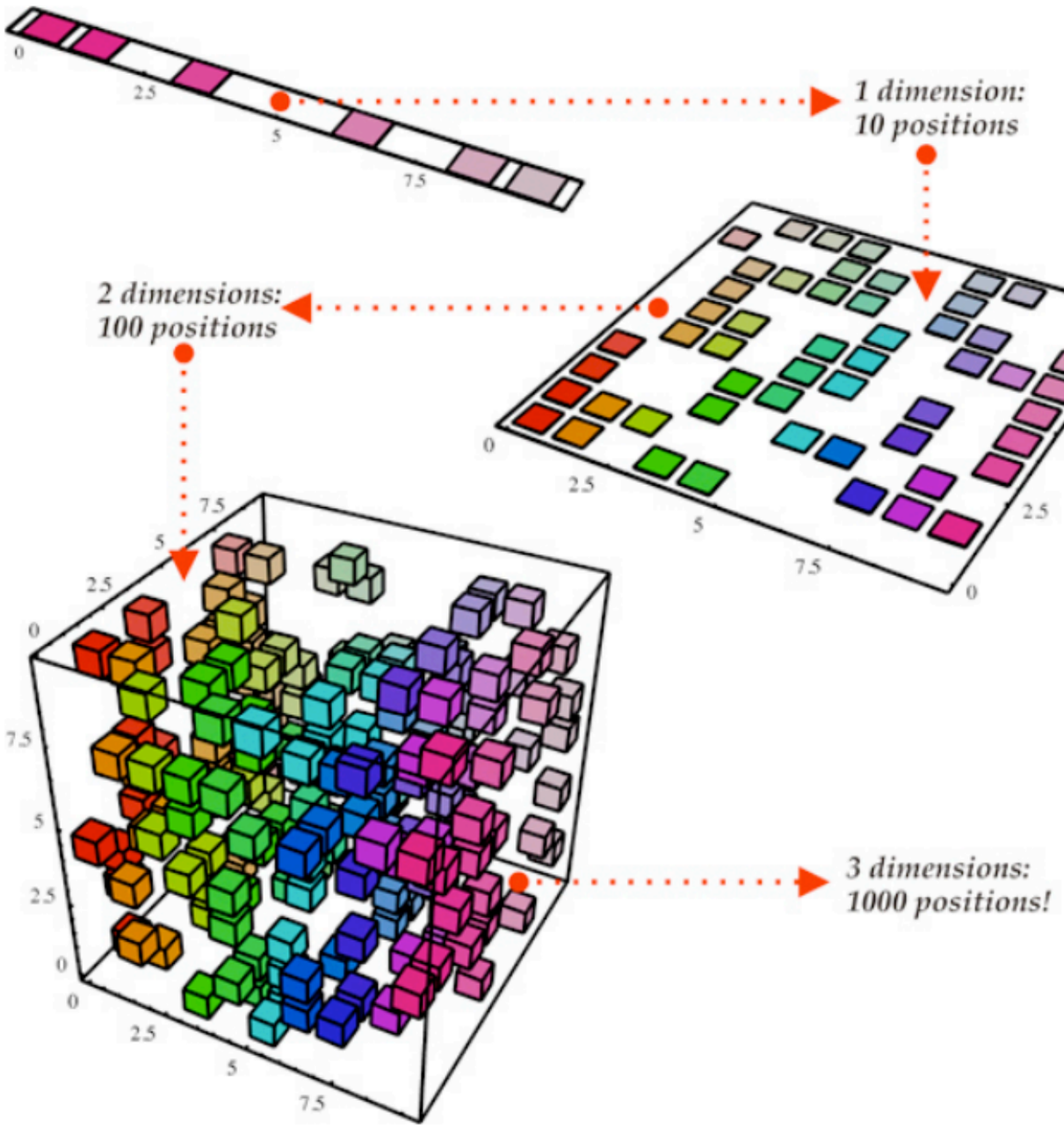
Vector

```
vector := PMVector withAll:
    #(1 4 3 -1).
```

Matrix

```
matrix := PMMatrix rows: #(
    (1 0 0)
    (0 1 0)
    (0 0 1)).
```

Dimensionality Reduction with PCA

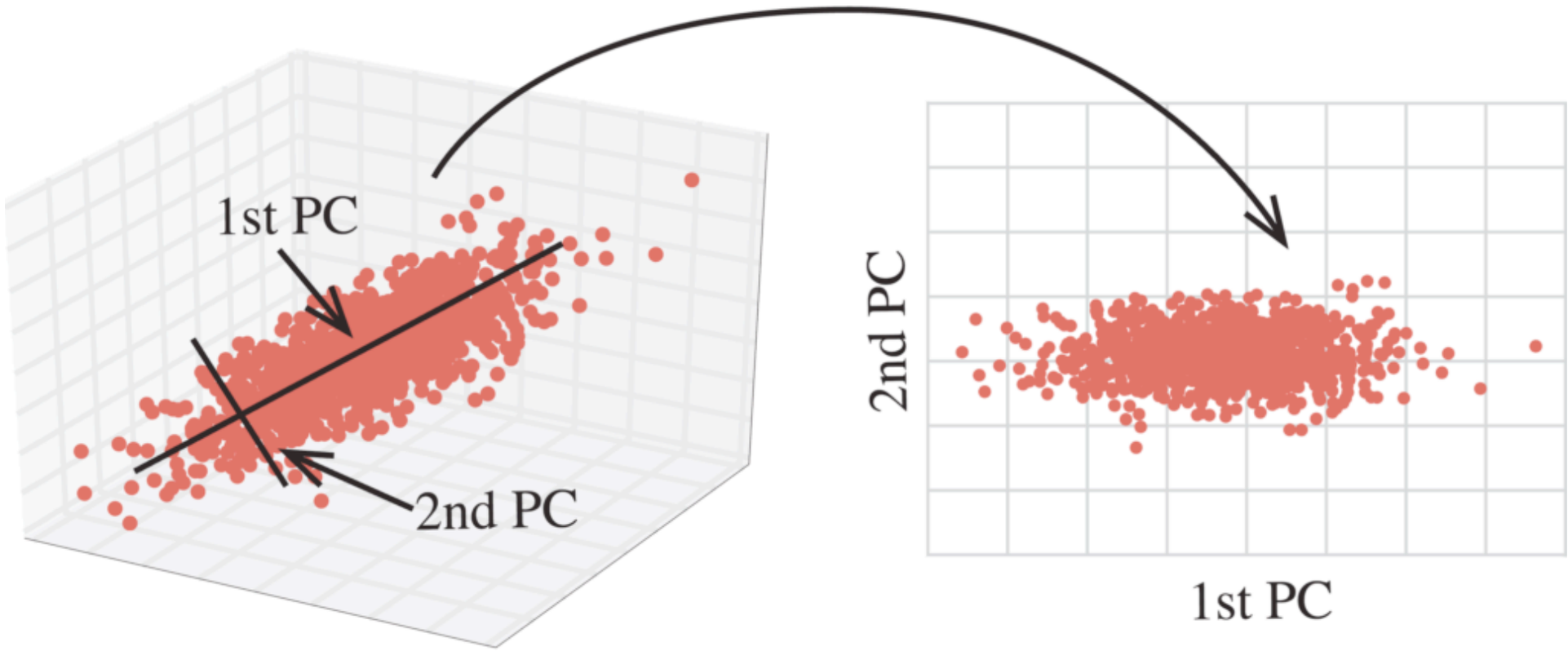


Dimensionality Reduction with PCA

- Used in machine learning, statistics to solve the dimensionality curse.

- Dimensionality reduction approach that perform a linear mapping of the data to a lower-dimensional space, in such a way that the variance of the data in low-dimensional representation is maximised.

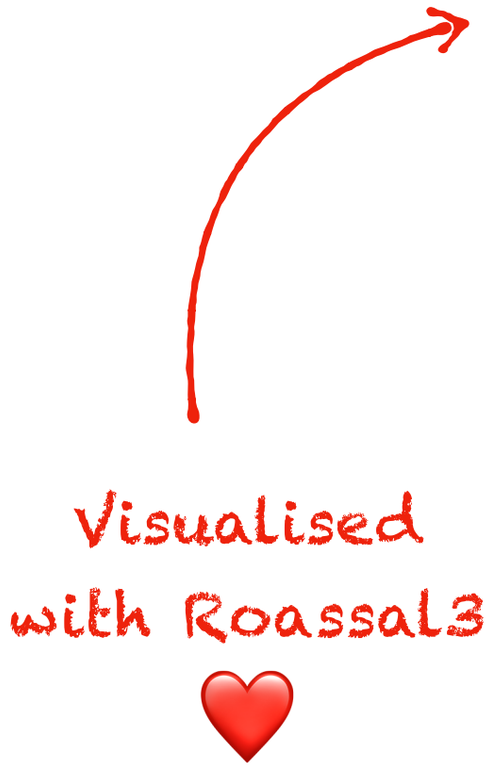
Dimensionality Reduction with PCA

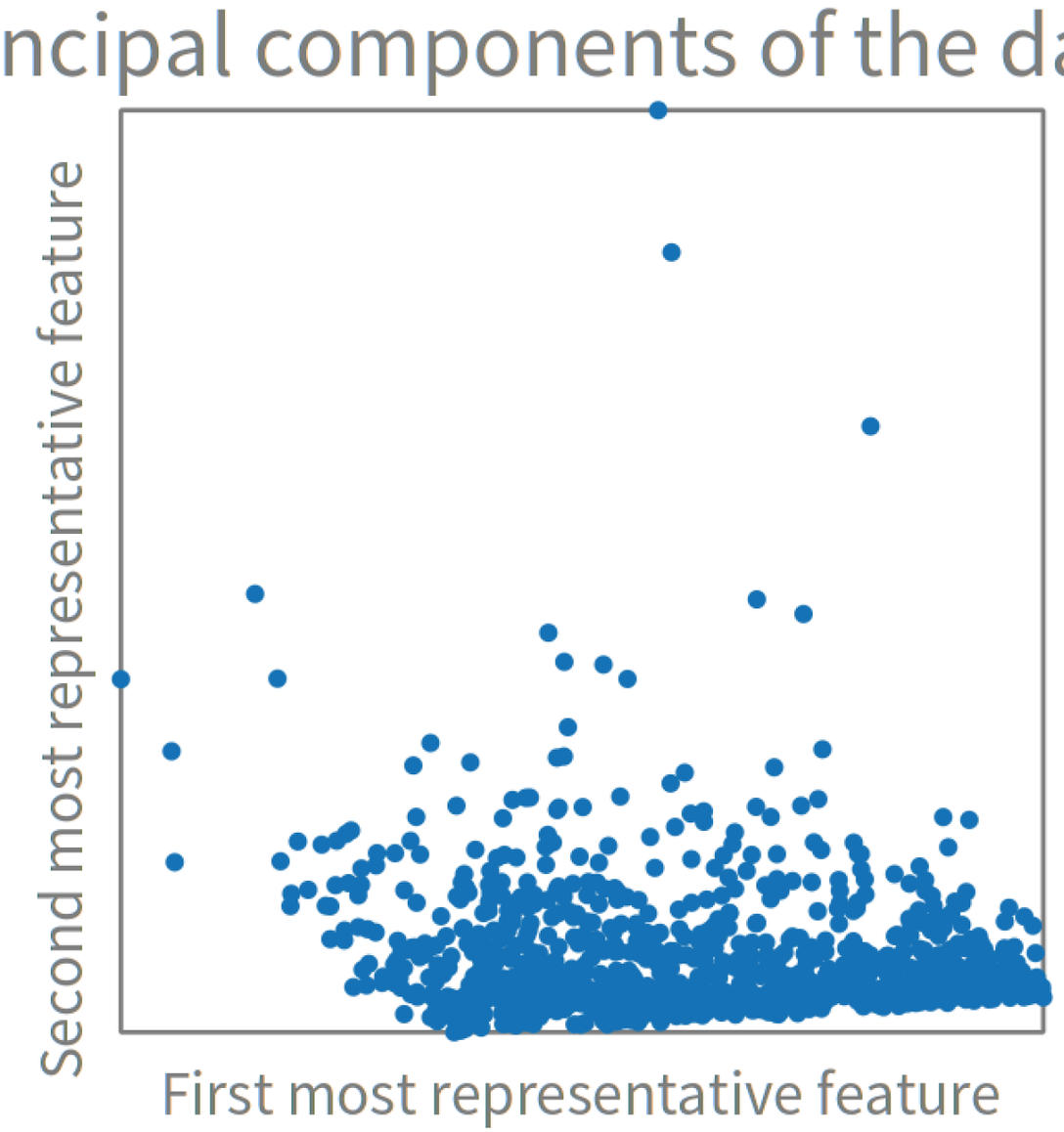


Dimensionality Reduction with PCA

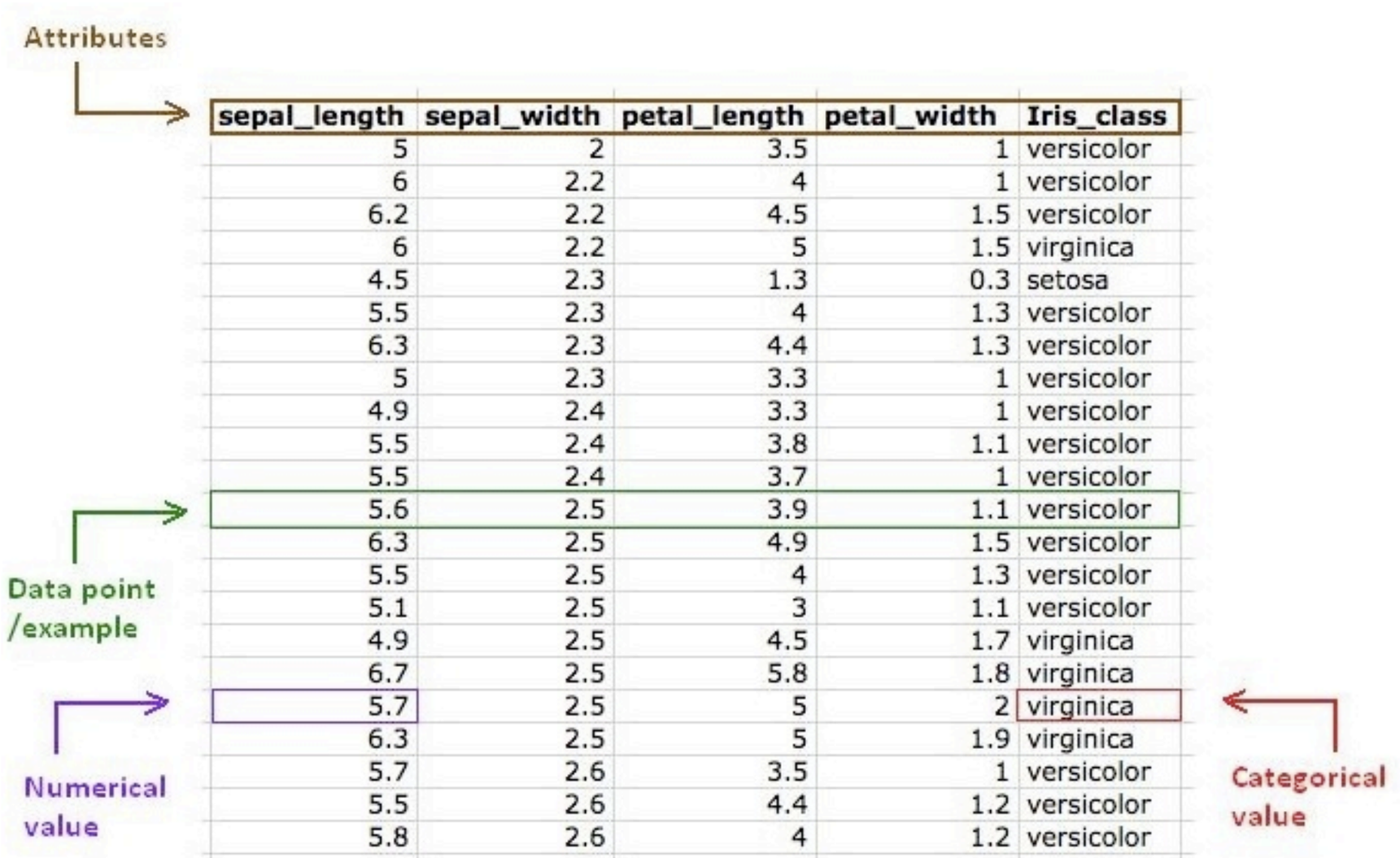
```
"Principal Component Analysis"
"Initializing PolyMath Matrix"
polyMathMatrix := PMMatrix rows: data.
pca := PMPrincipalComponentAnalyserSVD new.

"Reduce to 2 dimensions"
pca componentsNumber: 2.
"Fit the algorithm"
pca fit: polyMathMatrix.

"Transform the matrix"
principalComponents := pca transform: polyMathMatrix.
"Get the principal components"
firstPrincipalComponent := principalComponents rows collect: [ :each | each first].
secondPrincipalComponent := principalComponents rows collect: [ :each | each second].
```

Dimensionality Reduction with PCA





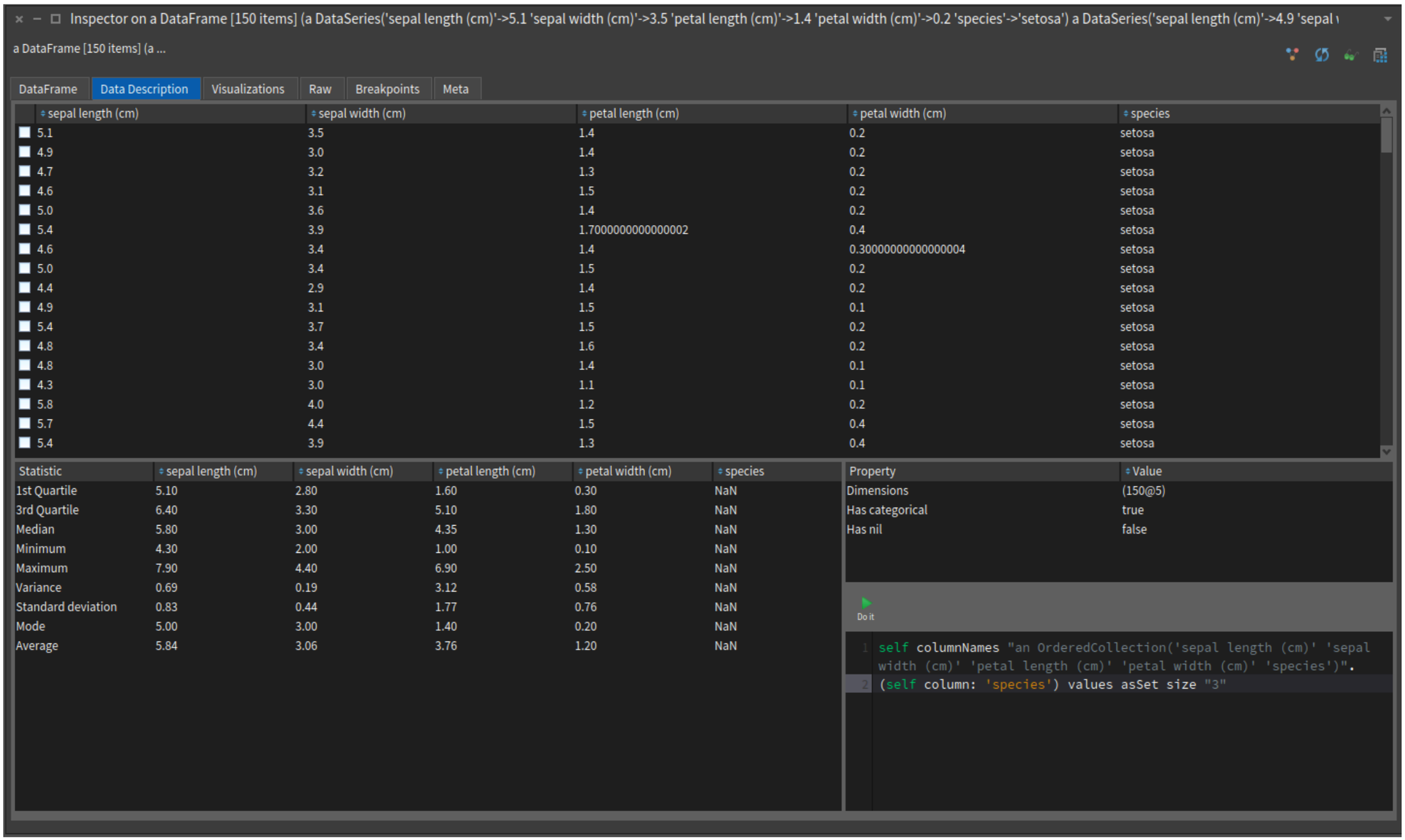
DataFrame



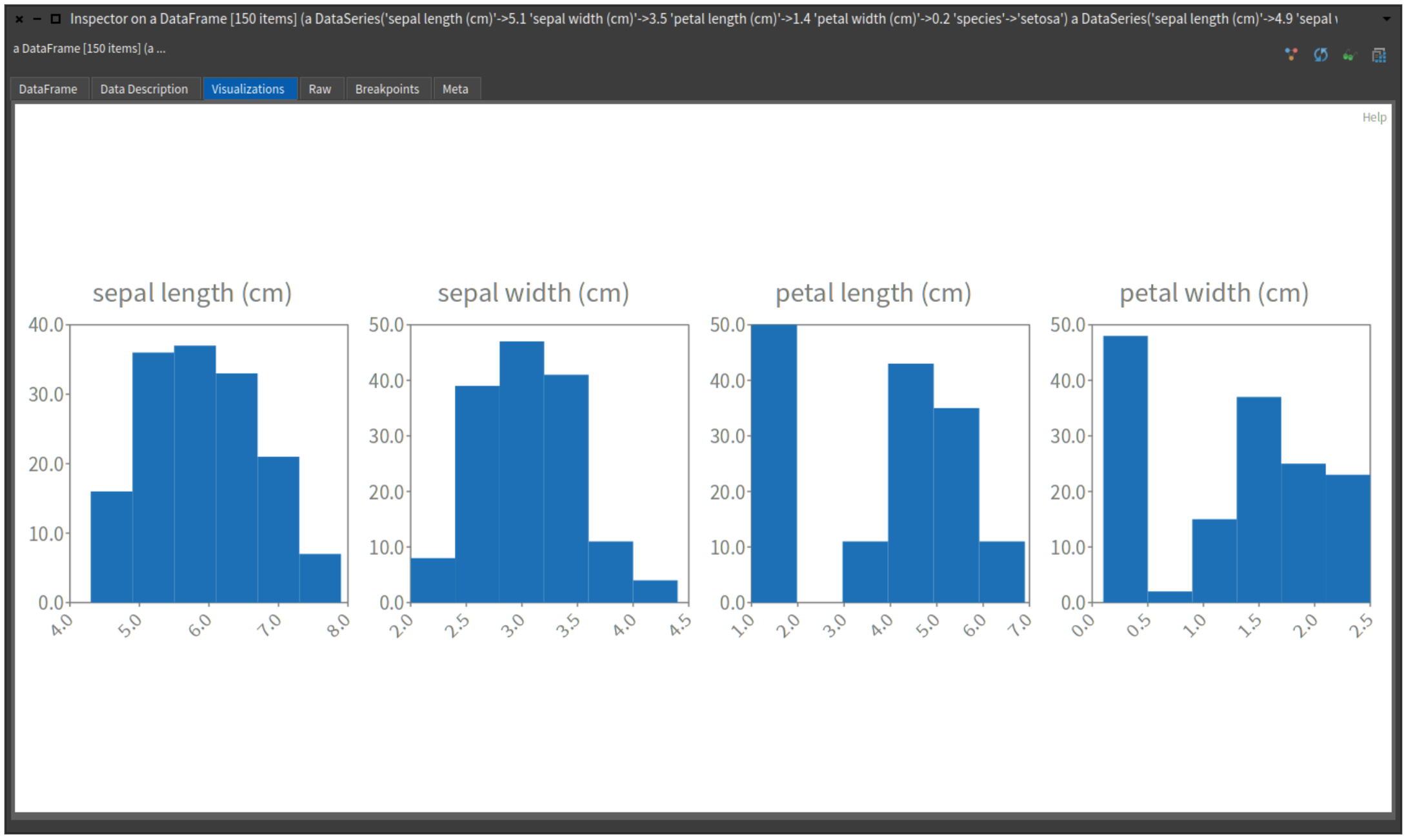
sepal_length	sepal_width	petal_length	petal_width	Iris_class
5	2	3.5	1	versicolor
6	2.2	4	1	versicolor
6.2	2.2	4.5	1.5	versicolor
6	2.2	5	1.5	virginica
4.5	2.3	1.3	0.3	setosa
5.5	2.3	4	1.3	versicolor
6.3	2.3	4.4	1.3	versicolor
5	2.3	3.3	1	versicolor
4.9	2.4	3.3	1	versicolor
5.5	2.4	3.8	1.1	versicolor
5.5	2.4	3.7	1	versicolor
5.6	2.5	3.9	1.1	versicolor
6.3	2.5	4.9	1.5	versicolor
5.5	2.5	4	1.3	versicolor
5.1	2.5	3	1.1	versicolor
4.9	2.5	4.5	1.7	virginica
6.7	2.5	5.8	1.8	virginica
5.7	2.5	5	2	virginica
6.3	2.5	5	1.9	virginica
5.7	2.6	3.5	1	versicolor
5.5	2.6	4.4	1.2	versicolor
5.8	2.6	4	1.2	versicolor

```
irisDataFrame := DataFrame readFromCsv: 'iris.csv'.
irisDataFrame inspect
```

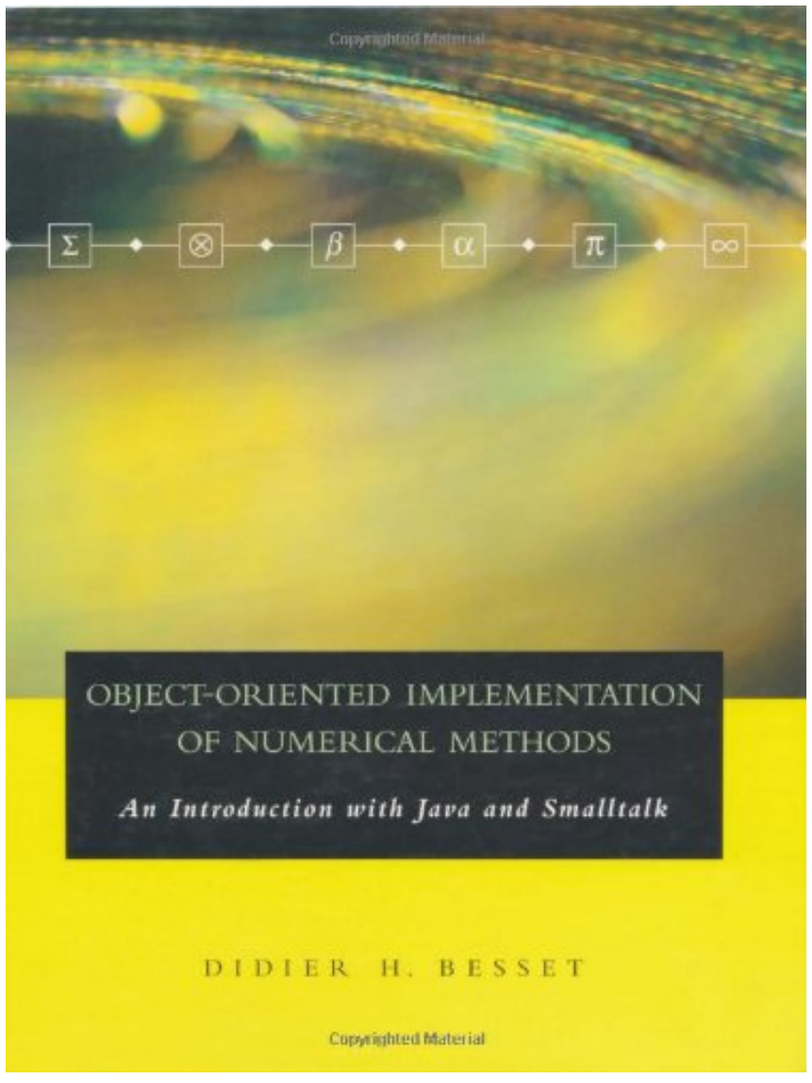
DataFrame


Inspector on a DataFrame [150 items] (a DataSeries('sepal length (cm)'->5.1 'sepal width (cm)'->3.5 'petal length (cm)'->1.4 'petal width (cm)'->0.2 'species'->'setosa') a DataSeries('sepal length (cm)'->4.9 'sepal
a DataFrame [150 items] (a ...
DataFrame
Data Description
Visualizations
Raw
Breakpoints
Meta
sepal length (cm) sepal width (cm) petal length (cm) petal width (cm) species
5.1 3.5 1.4 0.2 setosa
4.9 3.0 1.4 0.2 setosa
4.7 3.2 1.3 0.2 setosa
4.6 3.1 1.5 0.2 setosa
5.0 3.6 1.4 0.2 setosa
5.4 3.9 1.7000000000000002 0.4 setosa
4.6 3.4 1.4 0.30000000000000004 setosa
5.0 3.4 1.5 0.2 setosa
4.4 2.9 1.4 0.2 setosa
4.9 3.1 1.5 0.1 setosa
5.4 3.7 1.5 0.2 setosa
4.8 3.4 1.6 0.2 setosa
4.8 3.0 1.4 0.1 setosa
4.3 3.0 1.1 0.1 setosa
5.8 4.0 1.2 0.2 setosa
5.7 4.4 1.5 0.4 setosa
5.4 3.9 1.3 0.4 setosa
Statistic sepal length (cm) sepal width (cm) petal length (cm) petal width (cm) species
1st Quartile 5.10 2.80 1.60 0.30 NaN
3rd Quartile 6.40 3.30 5.10 1.80 NaN
Median 5.80 3.00 4.35 1.30 NaN
Minimum 4.30 2.00 1.00 0.10 NaN
Maximum 7.90 4.40 6.90 2.50 NaN
Variance 0.69 0.19 3.12 0.58 NaN
Standard deviation 0.83 0.44 1.77 0.76 NaN
Mode 5.00 3.00 1.40 0.20 NaN
Average 5.84 3.06 3.76 1.20 NaN
Property Value
Dimensions (150@5)
Has categorical true
Has nil false
Do it
self columnNames "an OrderedCollection('sepal length (cm)' 'sepal width (cm)' 'petal length (cm)' 'petal width (cm)' 'species')".
(self column: 'species') values asSet size "3"

DataFrame


Inspector on a DataFrame [150 items] (a DataSeries('sepal length (cm)'->5.1 'sepal width (cm)'->3.5 'petal length (cm)'->1.4 'petal width (cm)'->0.2 'species'->'setosa') a DataSeries('sepal length (cm)'->4.9 'sepal
a DataFrame [150 items] (a ...
DataFrame
Data Description
Visualizations
Raw
Breakpoints
Meta
Help
sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)

PolyMath Book



"Object-Oriented Implementation of Numerical Methods. An Introduction with Java and Smalltalk"

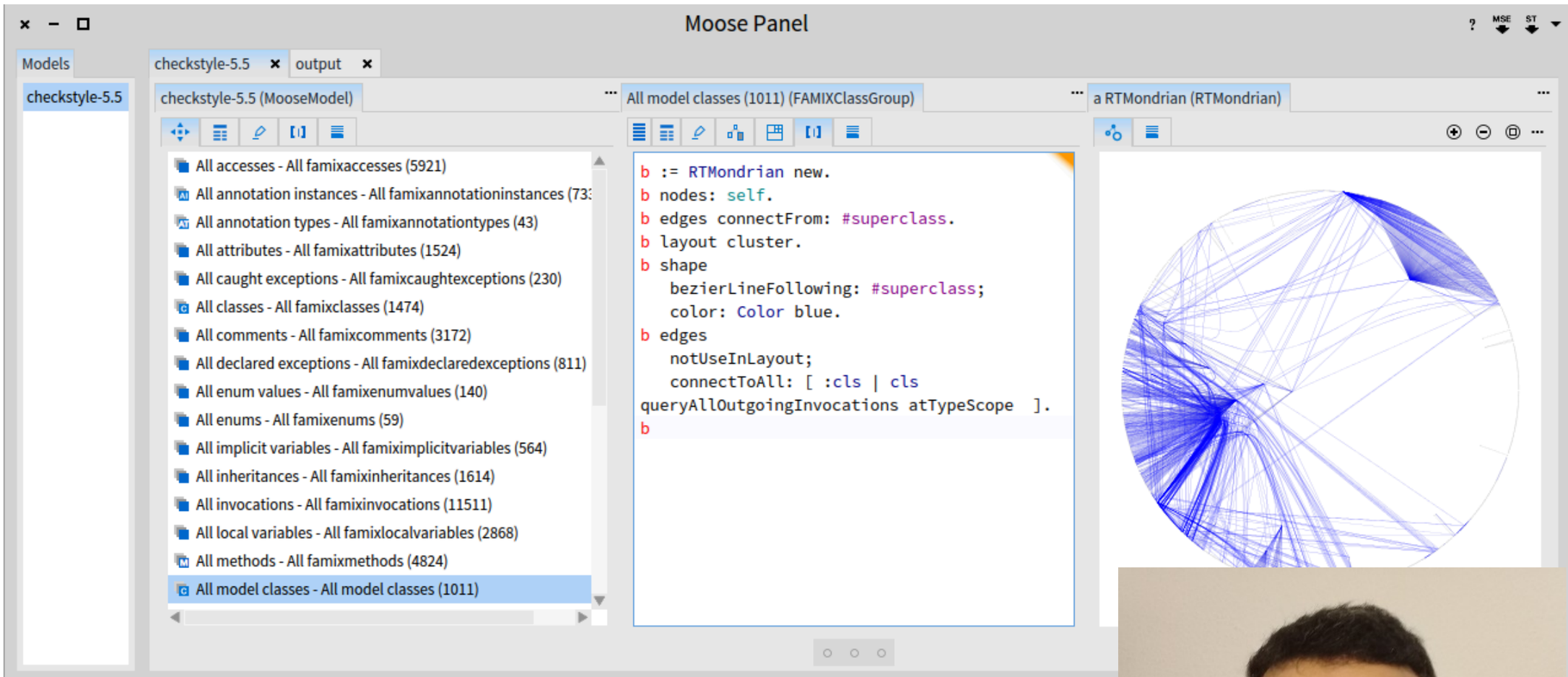
by Didier B. Besset

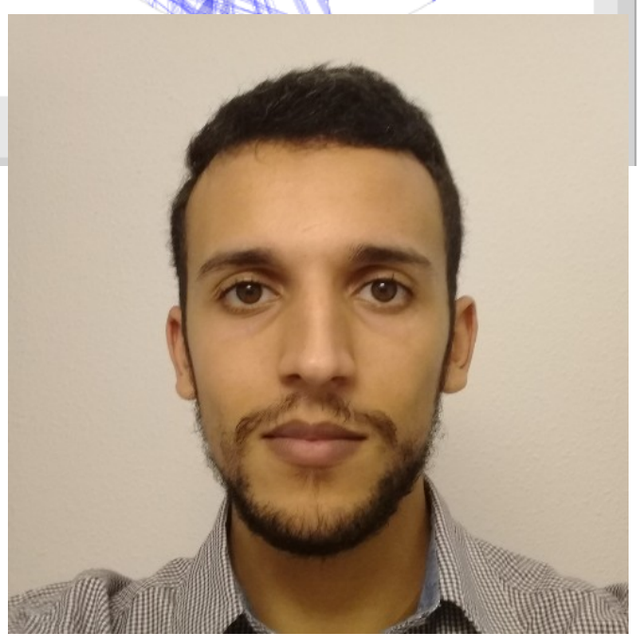
[PolyMath]

Part 2:

The future

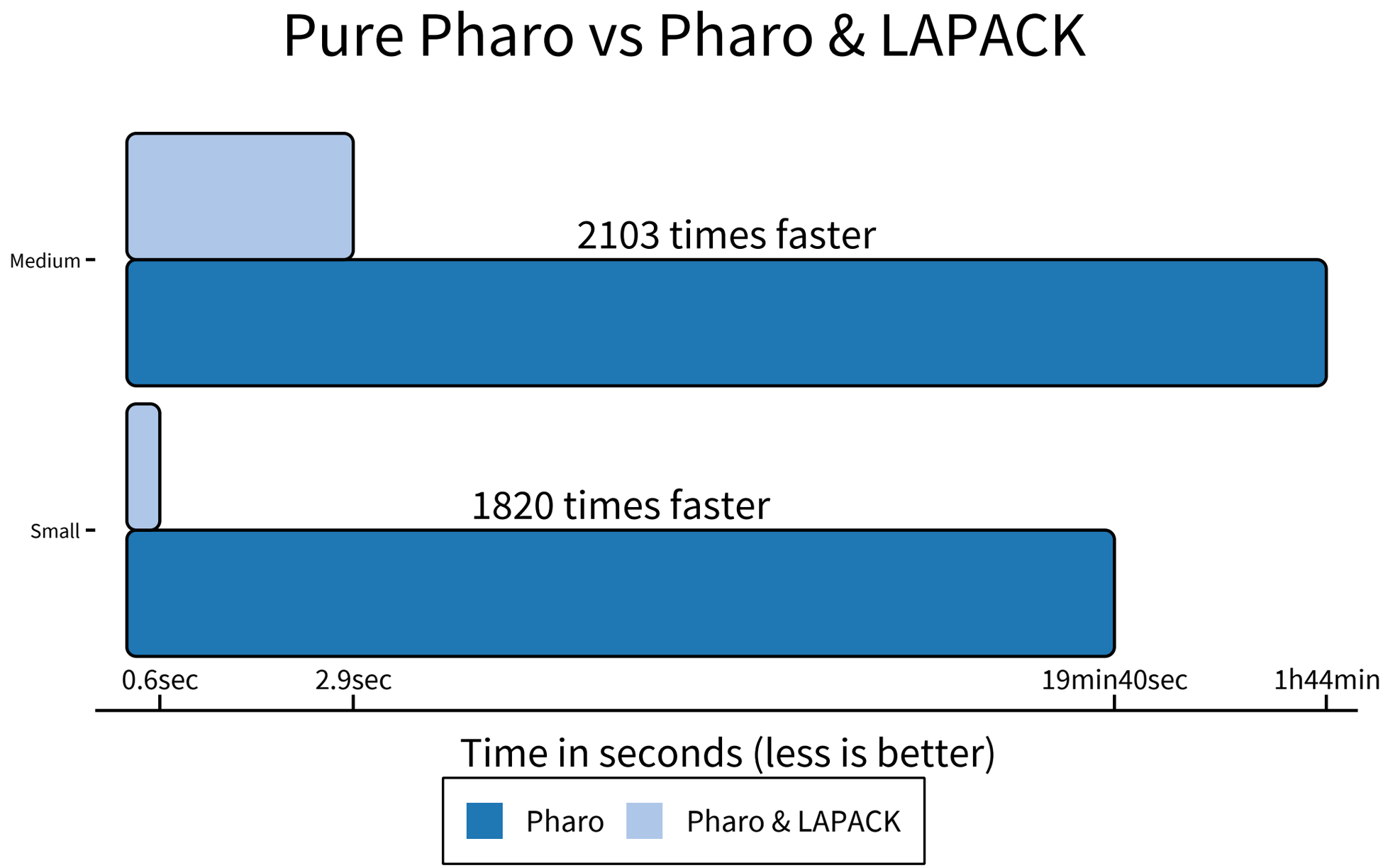
Goal 1: Decoupling Packages



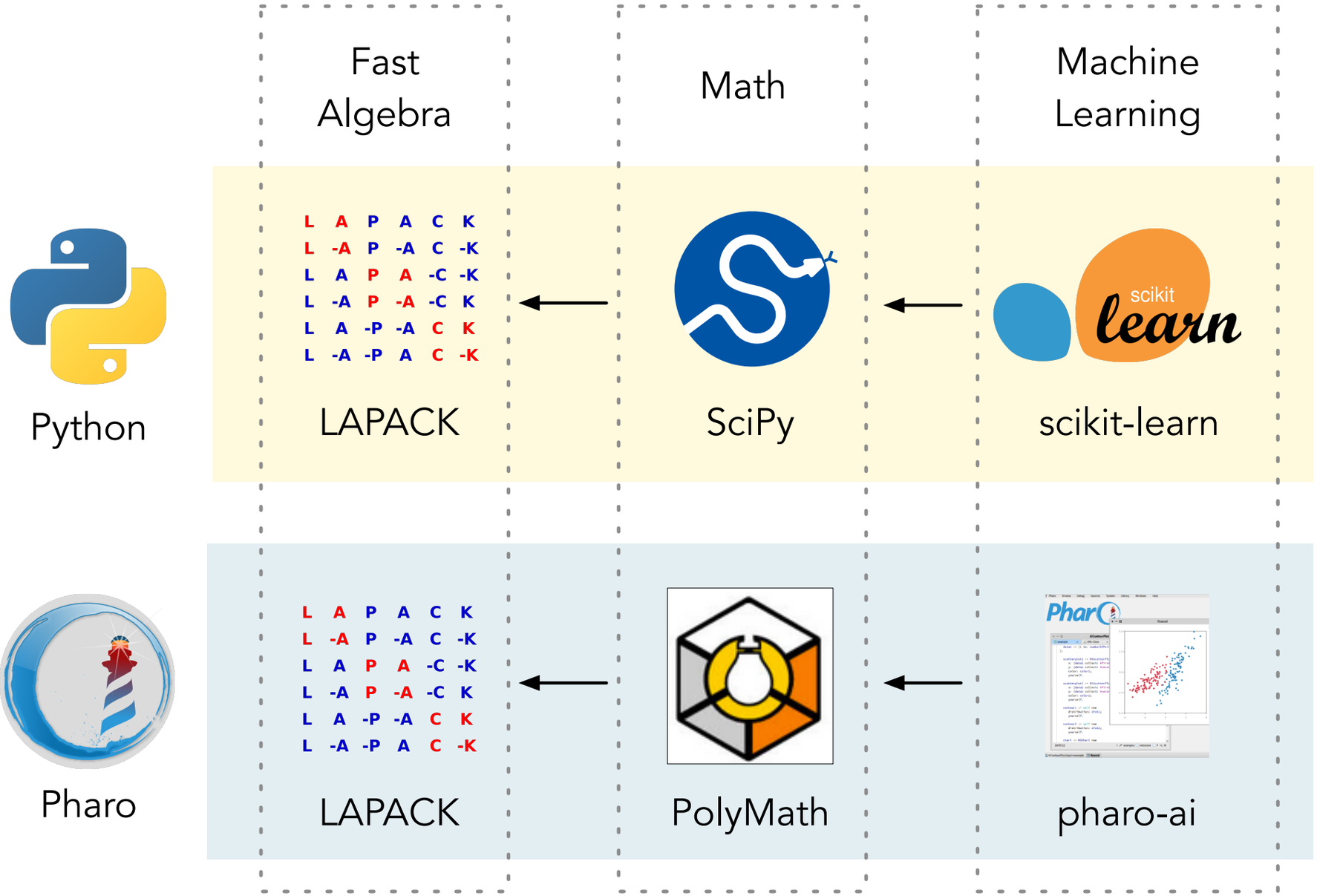


Goal 2: Making PolyMath Faster

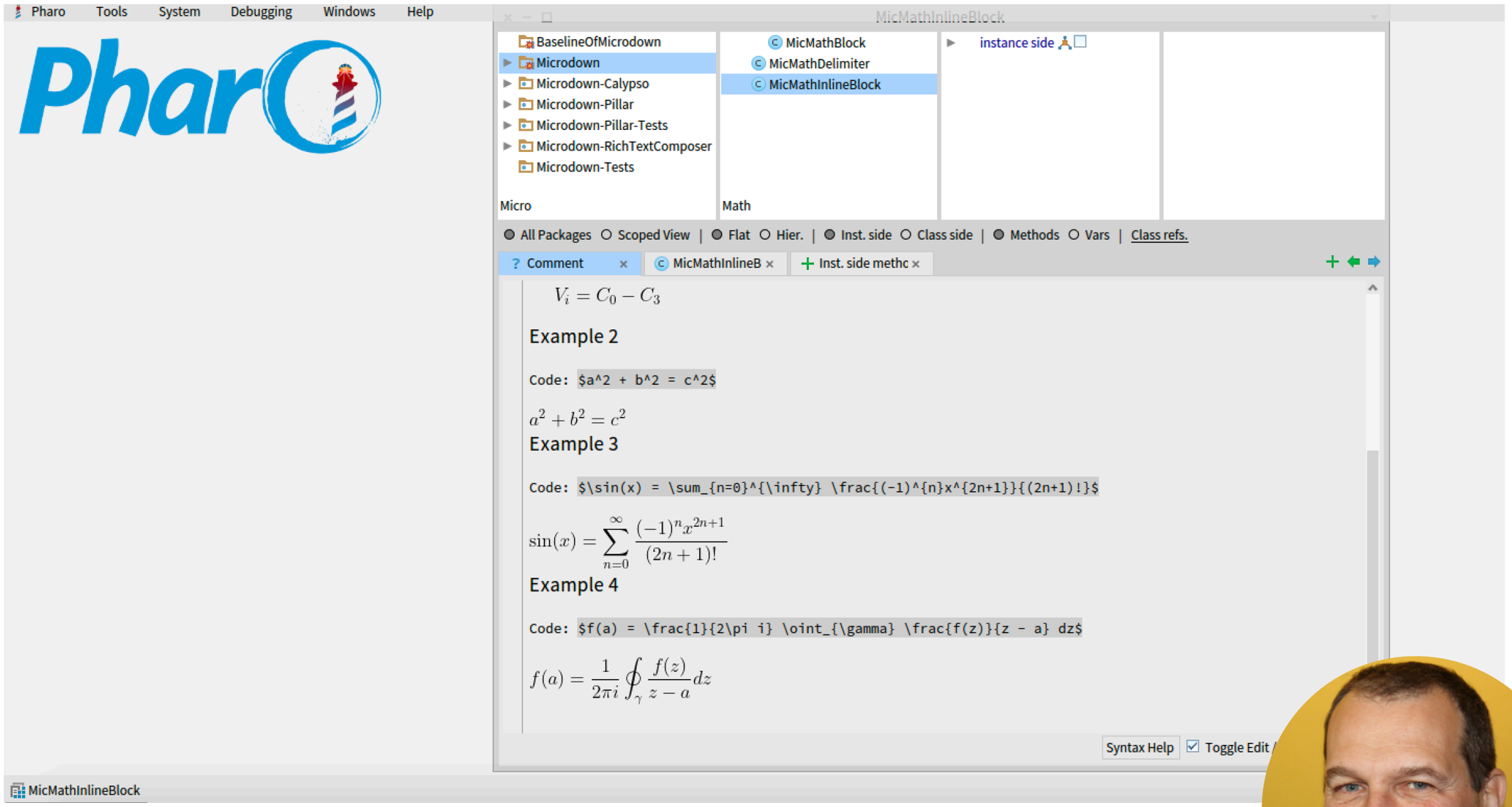
Help



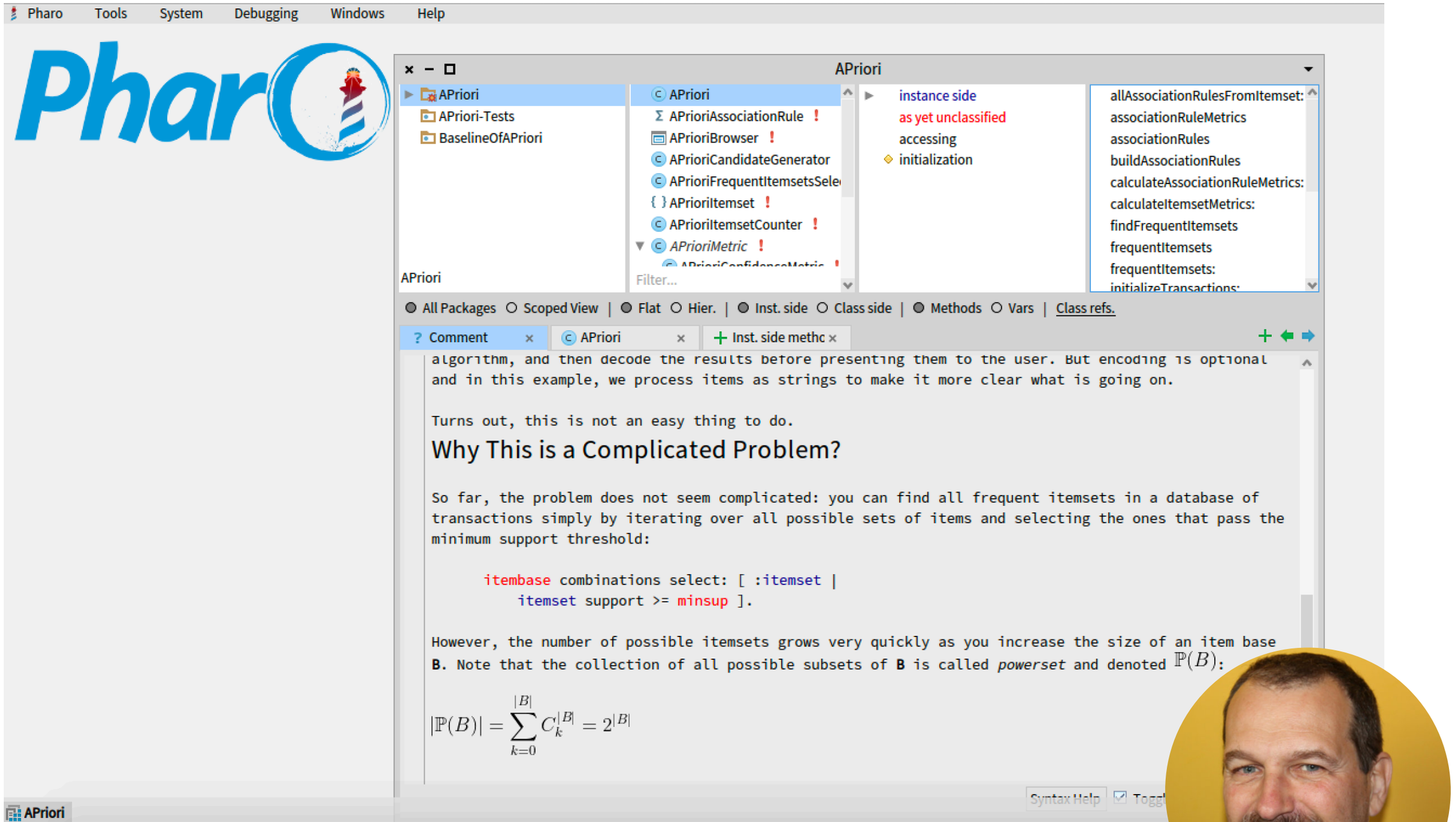
Goal 3: More Integration with pharo-ai



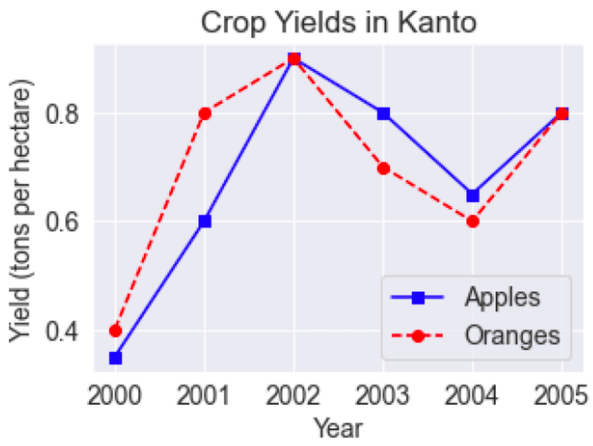
Goal 4: Document Using Microdown

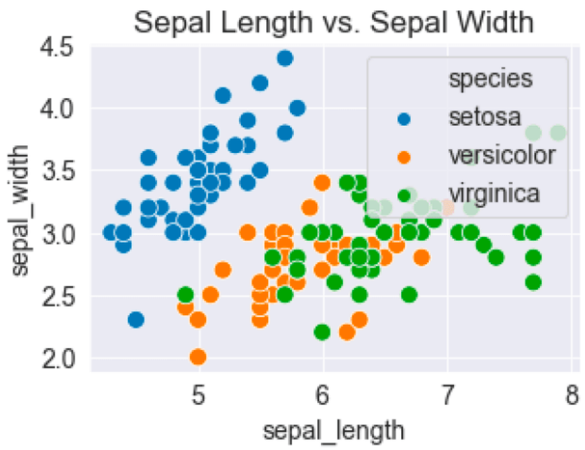


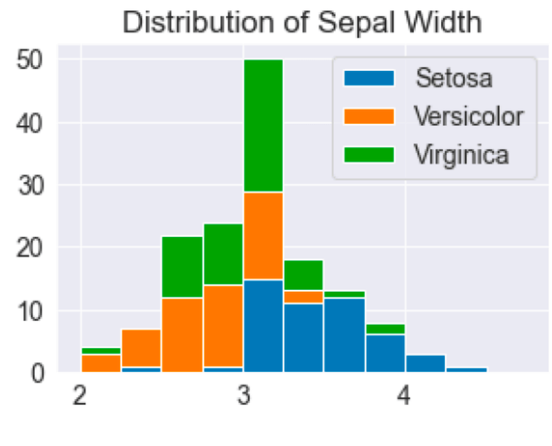
Goal 4: Document Using Microdown

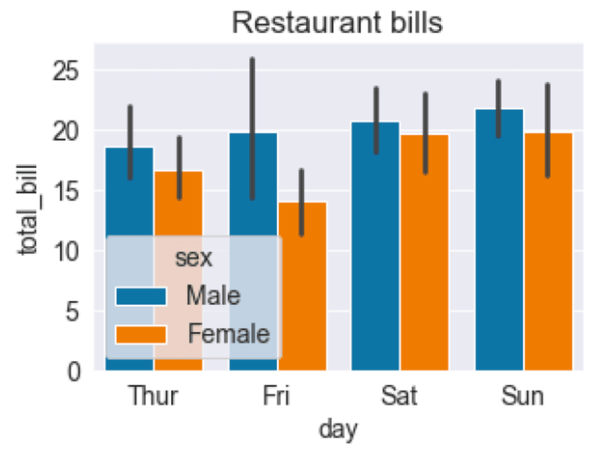


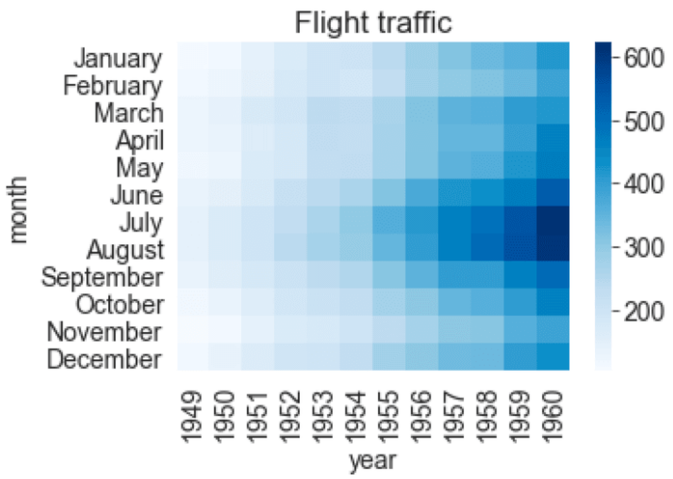
Goal 5: Roassal Charting

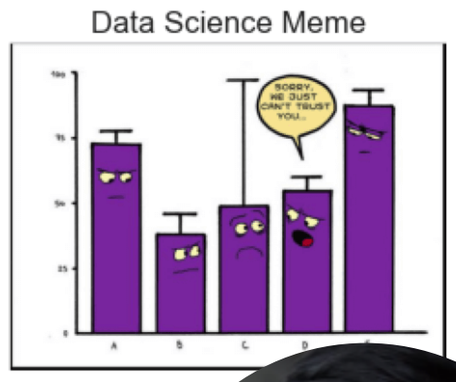




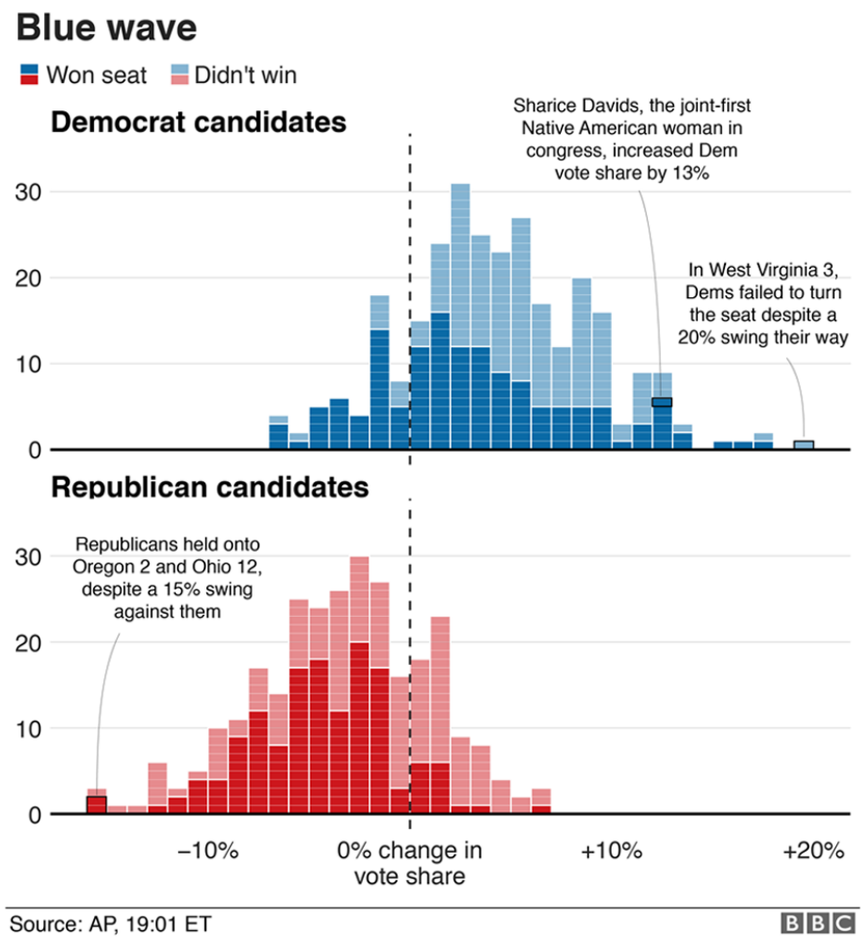


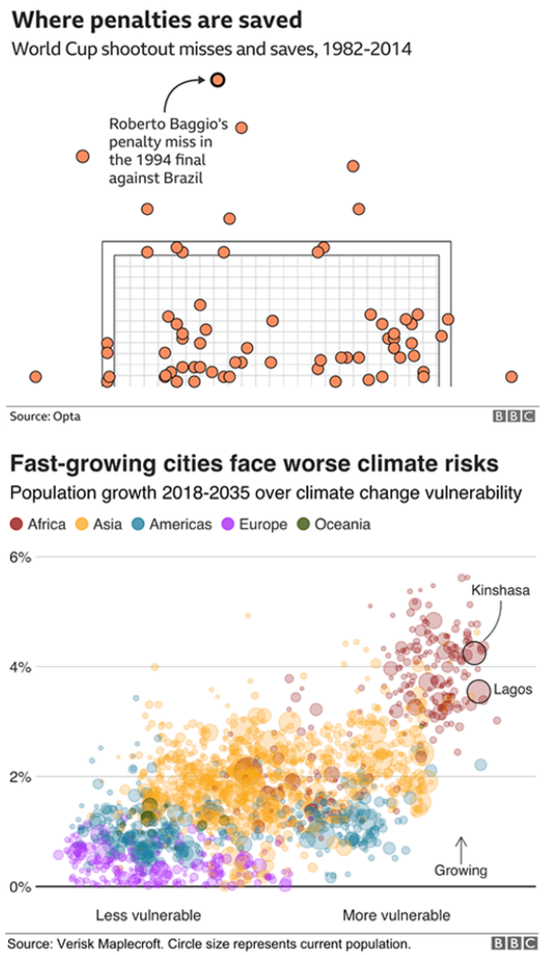


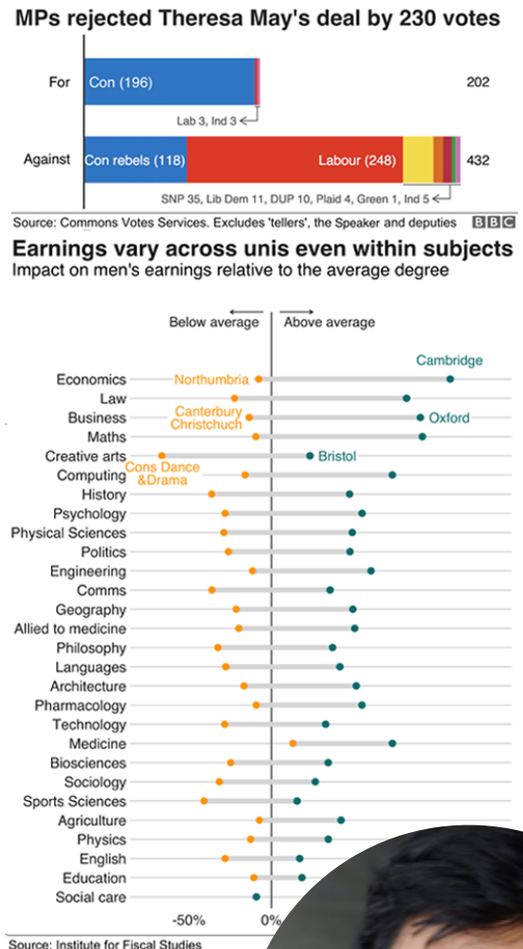




Goal 5: Roassal Charting







Goal 6: Notebooks

jupyter Optical Coherence Tomography-Copy1 Last Checkpoint: Last Sunday at 6:14 PM (autosaved)

File Edit View Insert Cell Kernel Navigate Widgets LaTeX_envs Help

Run Code

Contents

1.3.3 Fourier Domain OCT (FDOCT)

In FDOCT, the different wavelengths are collected on a spectrometer, with N_{pix} pixels, and spectral resolution δ_r.

Returning again to Eq. (8) (see, e.g., Izatt and Choma (Izatt J.A., Choma M.A. (2008) Theory of Optical Coherence Tomography. In: Drexler W., Fujimoto J.G. (eds) Optical Coherence Tomography. Biological and Medical Physics, Biomedical Engineering. Springer, Berlin, Heidelberg; doi: https://doi.org/10.1007/978-3-540-77550-8_2; alternate link: https://www.researchgate.net/publication/226178102_Theory_of_Optical_Coherence_Tomography/download)):

$$I_D(k) = \frac{Q}{4} S(k) \left[R_R + \sum_{n=1}^{N} R_n \right] \quad \text{" DC terms "}$$

$$+ \frac{Q}{2} S(k) \left[\sum_{n=1}^{N} \sqrt{R_R R_n} \cos\left[2k(z_R - z_n)\right] \right] \quad \text{" Cross - correlation terms "}$$

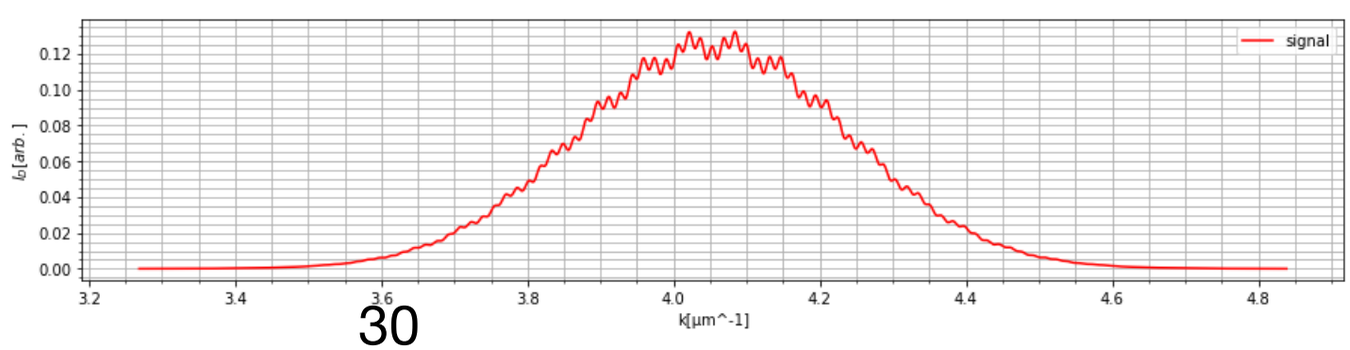
$$+ \frac{Q}{2} S(k) \left[\sum_{n \neq m=1} \sqrt{R_n R_m} \cos\left[2k(z_n - z_m)\right] \right]. \quad \text{" Autocorrelation terms "}$$

In the FDOCT configuration, z_R is held fixed.

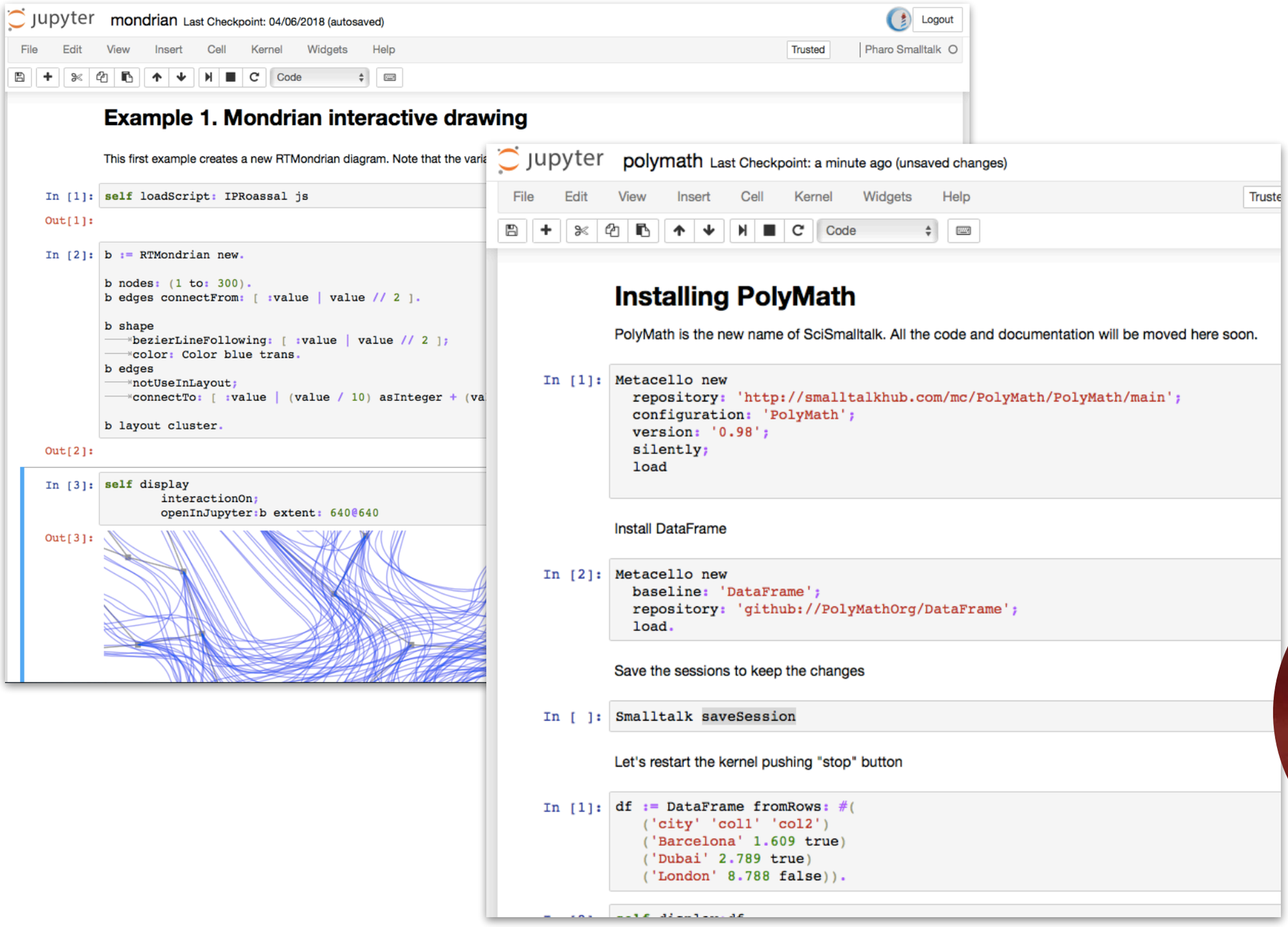
In [23]:
```
lambda_0 = 1.5500
k_0 = 2.0*np.pi/lambda_0
Dlambda_0 = 0.100
Dk = 2.0*np.pi*Dlambda_0/lambda_0**2.0

k_range = np.linspace(-3.0*Dk+k_0, +3.0*Dk+k_0, 10000)

TD_OCT_signal = 0.25*0.5*(np.exp(-((k_range - k_0)/Dk)**2.0)) \
                + 0.5*np.sqrt(0.5*2.0E-4)*(np.exp(-((k_range - k_0)/Dk)**2.0)) \
                  *np.cos(2.0*k_range*(50.0)) \
                + 0.5*np.sqrt(0.5*1.5E-4)*(np.exp(-((k_range - k_0)/Dk)**2.0)) \
                  *np.cos(2.0*k_range*(200.0))
```

In [26]:
```
fig_disp
```

Out[26]:



Goal 6: Notebooks



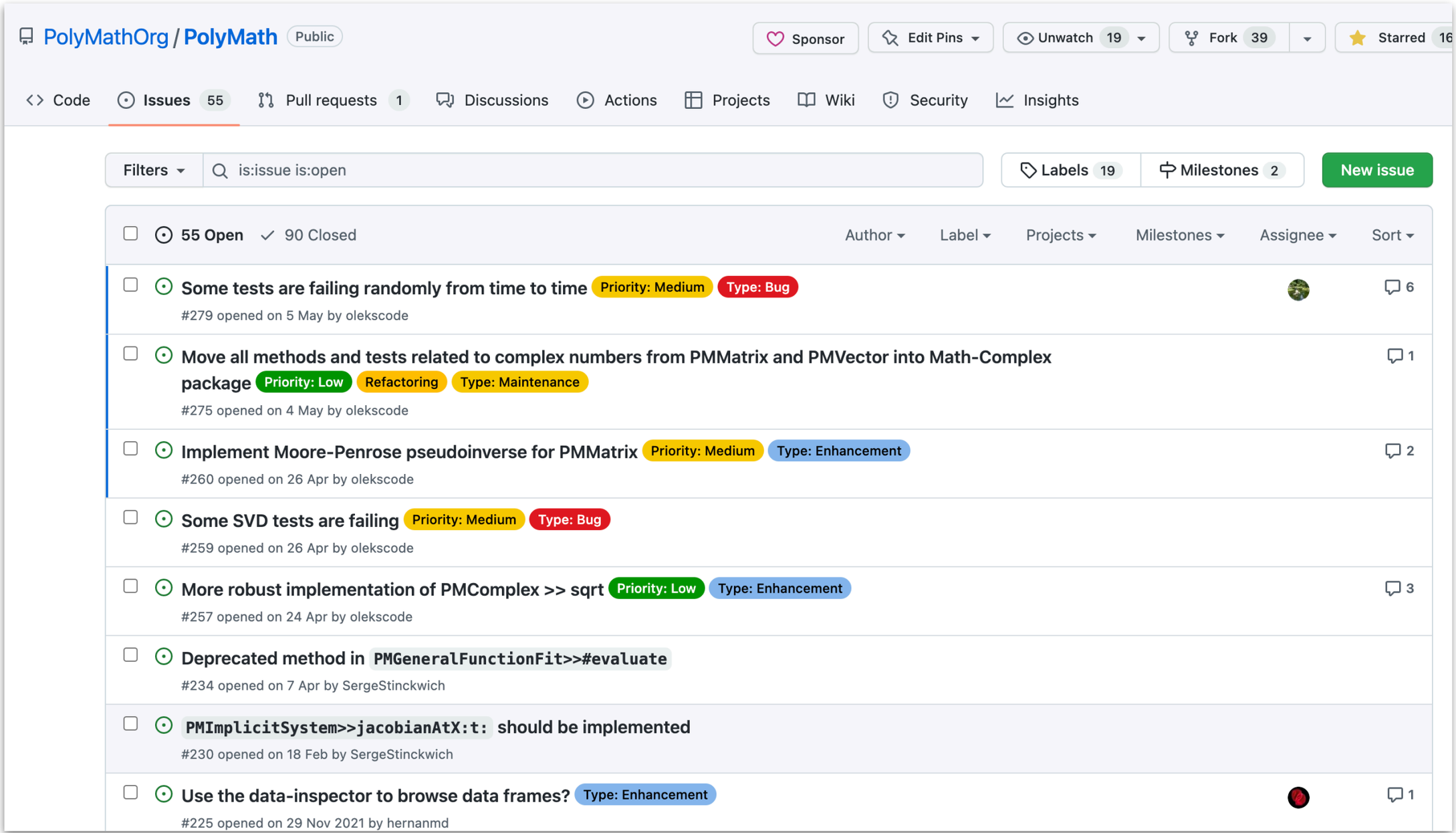
PolyMath

Part 3:

How to

support us

Contribute!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Fork 39
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Discussions
Actions
Projects
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Security
Insights
Filters
is:issue is:open
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Milestones 2
New issue
55 Open
90 Closed
Author
Label
Projects
Milestones
Assignee
Sort
Some tests are failing randomly from time to time
Priority: Medium
Type: Bug
#279 opened on 5 May by olekscode
6
Move all methods and tests related to complex numbers from PMMatrix and PMVector into Math-Complex package
Priority: Low
Refactoring
Type: Maintenance
#275 opened on 4 May by olekscode
1
Implement Moore-Penrose pseudoinverse for PMMatrix
Priority: Medium
Type: Enhancement
#260 opened on 26 Apr by olekscode
2
Some SVD tests are failing
Priority: Medium
Type: Bug
#259 opened on 26 Apr by olekscode
More robust implementation of PMComplex >> sqrt
Priority: Low
Type: Enhancement
#257 opened on 24 Apr by olekscode
3
Deprecated method in PMGeneralFunctionFit>>#evaluate
#234 opened on 7 Apr by SergeStinckwich
PMImplicitSystem>>jacobianAtX:t: should be implemented
#230 opened on 18 Feb by SergeStinckwich
Use the data-inspector to browse data frames?
Type: Enhancement
#225 opened on 29 Nov 2021 by hernanmd
1

Sponsor our work

https://github.com/sponsors/SergeStinckwich