iPyRegulus

Analysis of ensembles of simulations

(Regulus 2.0 in Jupyter Lab)

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Scientific Computing and Imaging Institute
University of Utah

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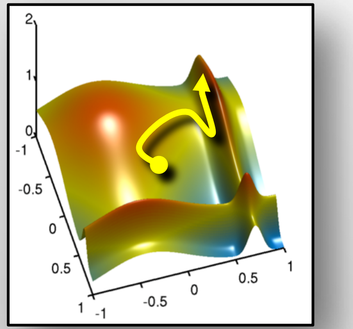
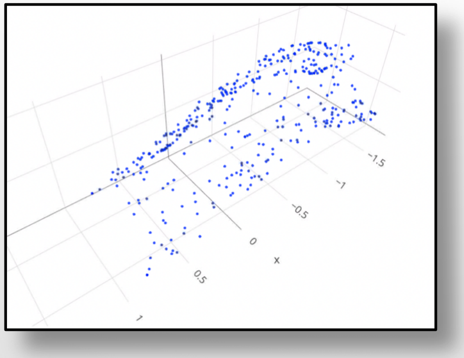
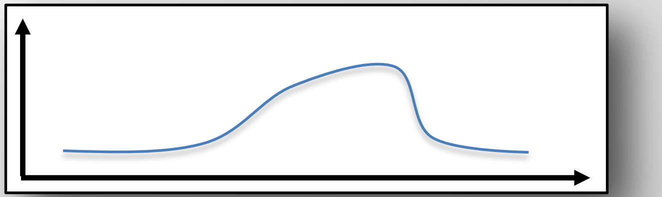
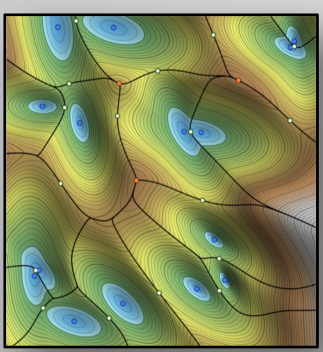
Topological Analysis using Morse-Smale Complexes

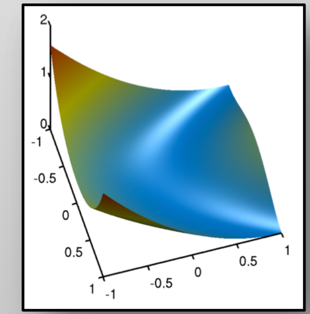




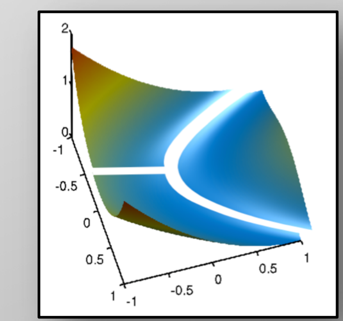


Partition the space into monotonic patches



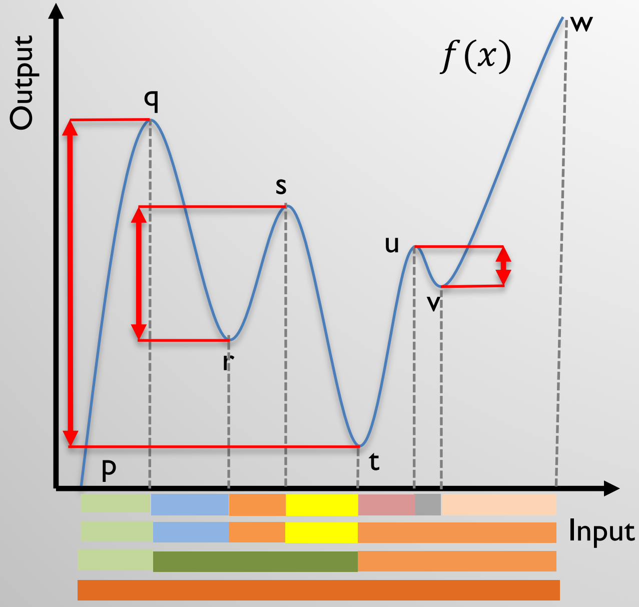


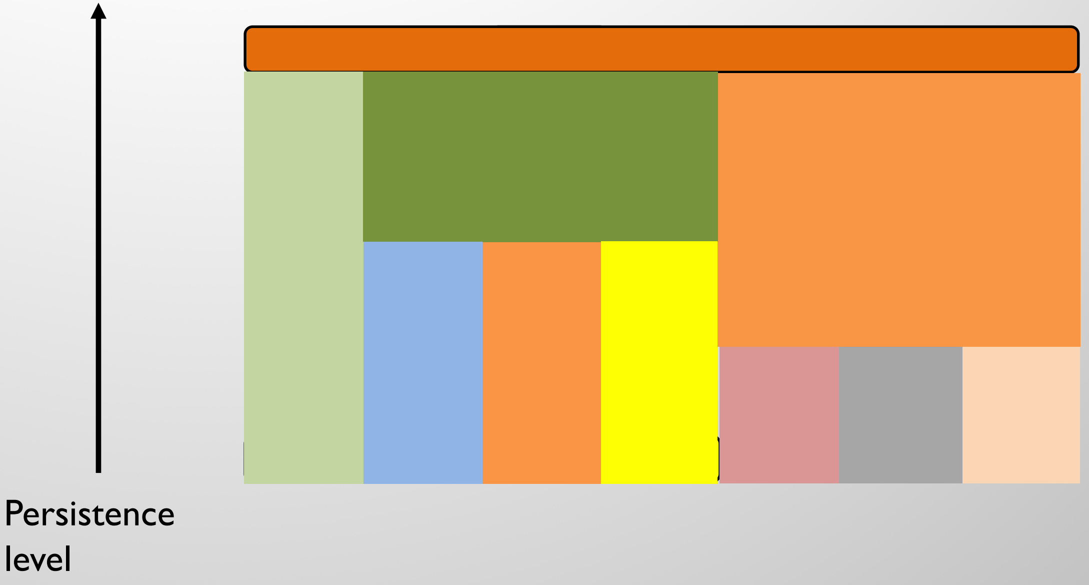
Morse Complex:
Single local minimum

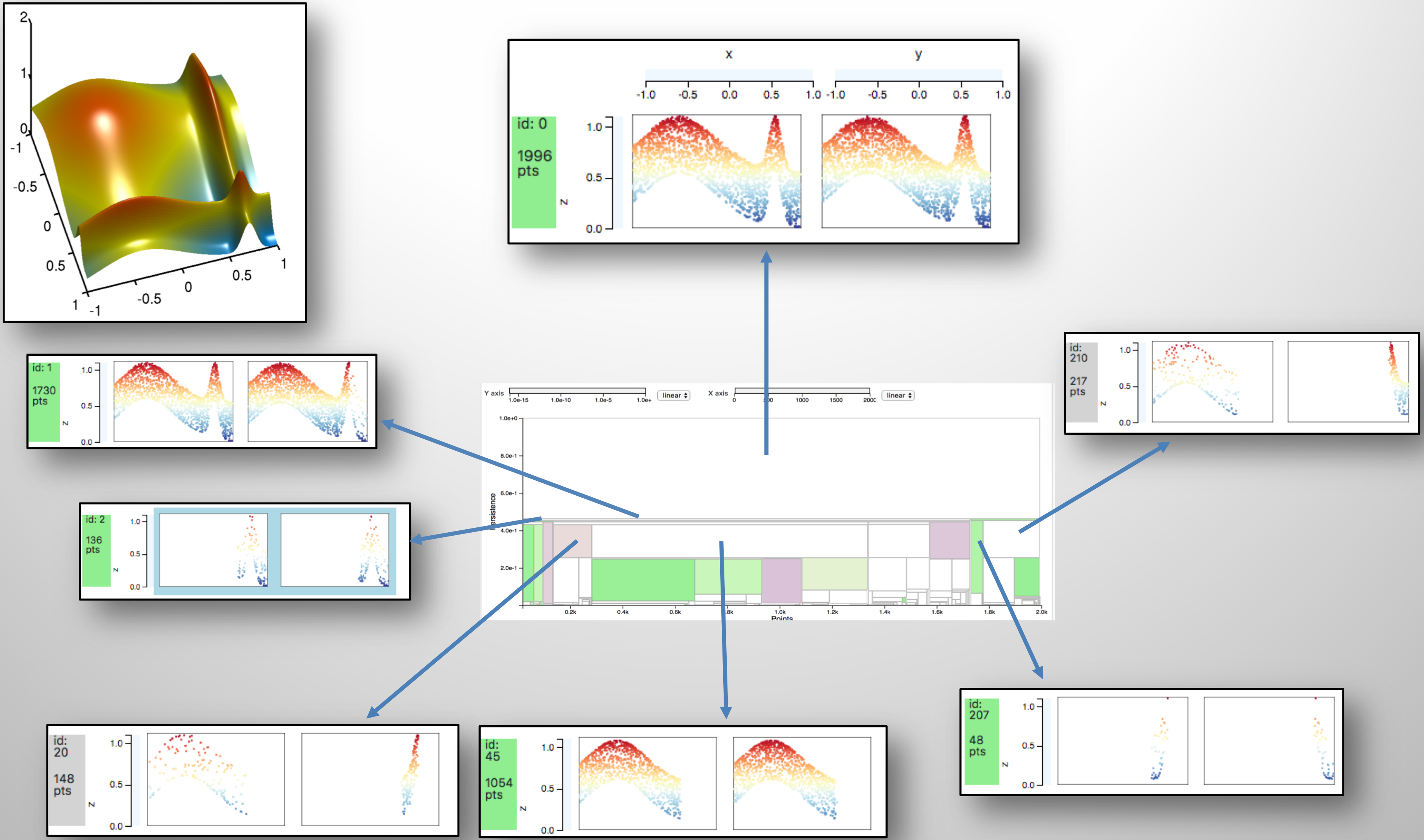


Morse-Smale Complex:
Single local minimum
and a single local maximum

Regulus Hierarchical Partition Tree



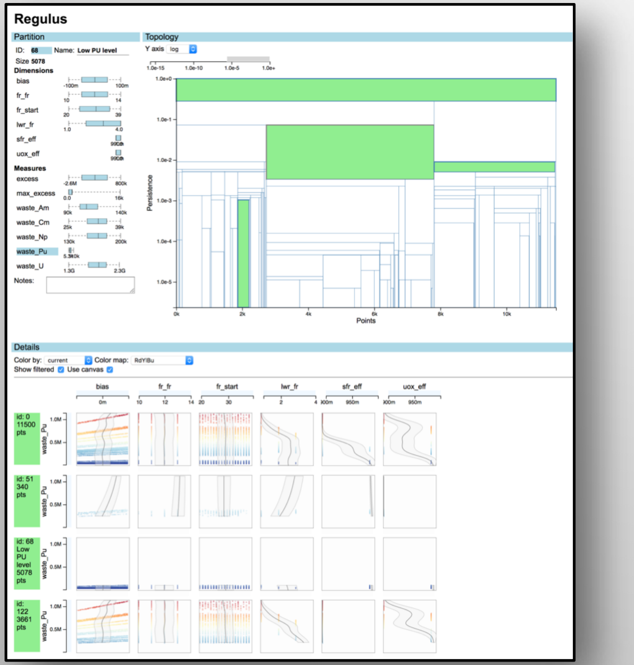




2
1
0
-1
-0.5
0
0.5
1
-1
-0.5
0
0.5
1
x
y
-1.0
-0.5
0.0
0.5
1.0
id: 0
1996 pts
z
Y axis
1.0e-15
1.0e-10
1.0e-5
1.0e+
linear
X axis
0
500
1000
1500
2000
1.0e+0
8.0e-1
6.0e-1
4.0e-1
2.0e-1
Persistence
0.2k
0.4k
0.6k
0.8k
1.0k
1.2k
1.4k
1.6k
1.8k
2.0k
Points
id: 1
1730 pts
id: 2
136 pts
id: 20
148 pts
id: 45
1054 pts
id: 207
48 pts
id: 210
217 pts

Regulus.js

- Hierarchical Partition Tree based on levels of detail
- Web-based with a python backend



Regulus

Partition

ID: 68 Name: Low PU level

Size 5078

Topology

Y axis: log

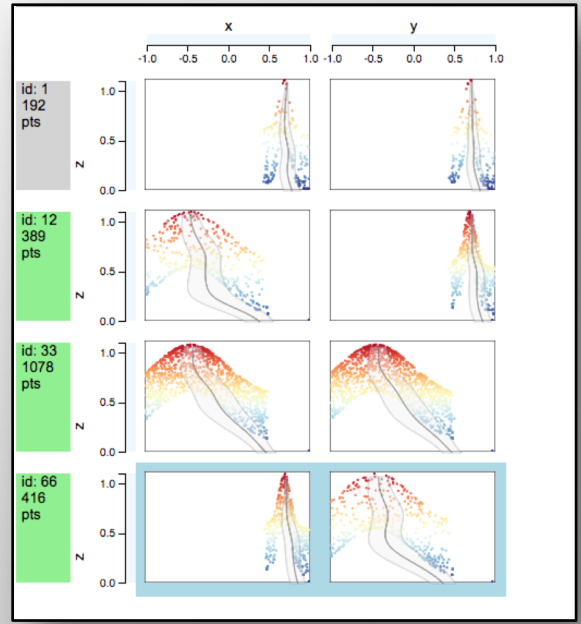
Details

Color by: current Color map: RdYlBu

Show filtered ☑ Use canvas ☑

Notes:

Hierarchical view of a Morse-Smale Complex



Details view

iPyRegulus

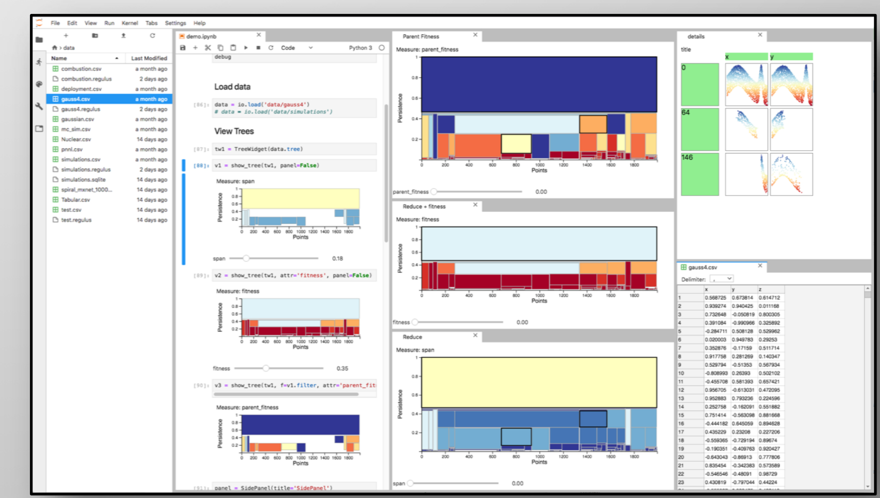
Break away from the typical visualization-first approach

Interactive (and scripted) exploration analysis

Define attributes and measures on the fly

Explore data from multiple views

Coordinate between views on the fly



Name	Last Modified
combustion.csv	a month ago
combustion.regulus	2 days ago
deployment.csv	a month ago
gauss4.csv	a month ago
gauss4.regulus	2 days ago
gaussian.csv	a month ago
mc_sim.csv	a month ago
Nuclear.csv	14 days ago
pnnl.csv	a month ago
simulations.csv	a month ago
simulations.regulus	2 days ago
simulations.sqlite	14 days ago
spiral_mxnet_1000...	14 days ago
Tabular.csv	14 days ago
test.csv	14 days ago
test.regulus	14 days ago

debug

Load data

```
[86]: data = io.load('data/gauss4')
      # data = io.load('data/simulations')
```

View Trees

```
[87]: tw1 = TreeWidget(data.tree)
[88]: v1 = show_tree(tw1, panel=False)
[89]: v2 = show_tree(tw1, attr='fitness', panel=False)
[90]: v3 = show_tree(tw1, f=v1.filter, attr='parent_fit
[91]: panel = SidePanel(title='SidePanel')
```

	x	y	z
1	0.568725	0.673814	0.614712
2	0.939274	0.940425	0.011168
3	0.732648	-0.050819	0.800305
4	0.391084	-0.990966	0.325892
5	-0.284711	0.508128	0.529962
6	0.020003	0.949783	0.29253
7	0.352876	-0.17159	0.511714
8	0.917758	0.281269	0.140347
9	0.529794	-0.51353	0.567934
10	-0.808993	0.26393	0.502102
11	-0.455708	0.581393	0.657421
12	0.956705	-0.613031	0.472095
13	0.952883	0.793236	0.224596
14	0.252758	-0.162091	0.551882
15	0.751414	-0.563098	0.881668
16	-0.444182	0.645059	0.894628
17	0.435229	0.23208	0.227206
18	-0.559365	-0.729194	0.89674
19	-0.190351	-0.409763	0.920427
20	-0.643043	-0.86913	0.777806
21	0.835454	-0.342383	0.573589
22	-0.546546	-0.48091	0.98729
23	0.430819	-0.797044	0.44224

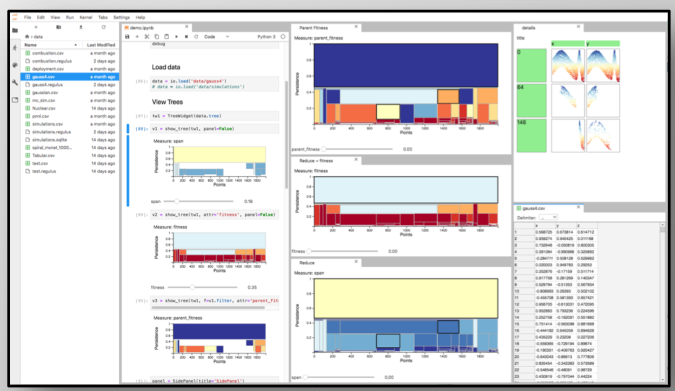
iPyRegulus

Interactive exploration

Break away from the typical visualization-first approach

Jupyter Notebooks driven investigation

- Interactive (and scripted) exploration analysis
- Define attributes and measures on the fly
- Explore data from multiple views
- Coordinate between views on the flu



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[90]: v3 = show_tree(tw1, f=v1.filter, attr='parent_fit
[91]: panel = SidePanel(title='SidePanel')
```

gauss4.csv

	x	y	z
1	0.568725	0.673814	0.614712
2	0.939274	0.940425	0.011168
3	0.732648	-0.050819	0.800305
4	0.391084	-0.990966	0.325892
5	-0.284711	0.508128	0.529962
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7	0.352876	-0.17159	0.511714
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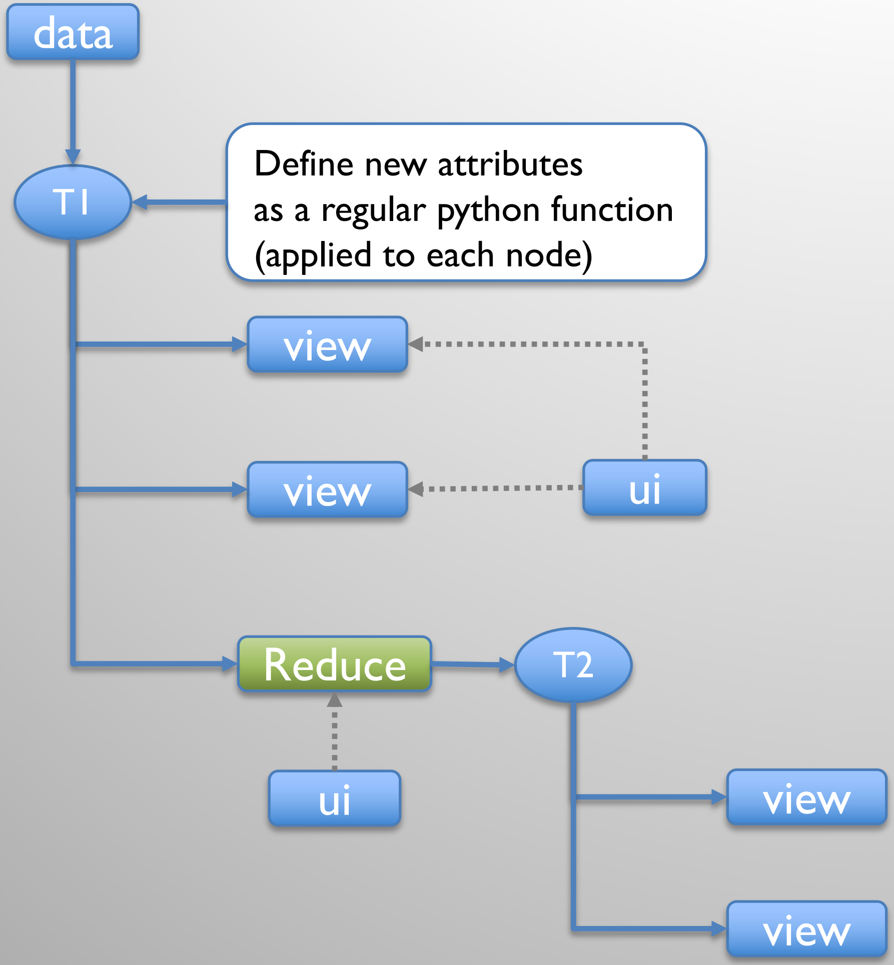
20	-0.643043	-0.86913	0.777806
21	0.835454	-0.342383	0.573589
22	-0.546546	-0.48091	0.98729
23	0.430819	-0.797044	0.44224

iPyRegulus and Sidepanel: extensions for Jupyter Lab

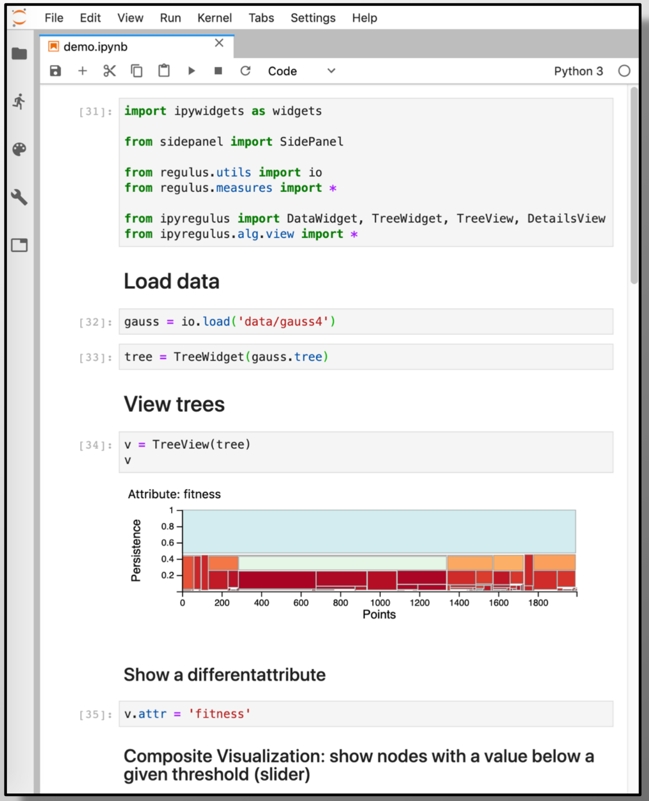
Visual Exploration

Python kernel in Jupyter



Define new attributes as a regular python function (applied to each node)

Browser



[31]:
```
import ipywidgets as widgets

from sidepanel import SidePanel

from regulus.utils import io
from regulus.measures import *

from ipyregulus import DataWidget, TreeWidget, TreeView, DetailsView
from ipyregulus.alg.view import *
```

Load data

[32]:
```
gauss = io.load('data/gauss4')
```

[33]:
```
tree = TreeWidget(gauss.tree)
```

View trees

[34]:
```
v = TreeView(tree)
v
```

Show a differentattribute

[35]:
```
v.attr = 'fitness'
```

Composite Visualization: show nodes with a value below a given threshold (slider)

iPyRegulus in action