



**UiO : Department of Physics**  
University of Oslo

**Gain insight**

**Creating interactive dashboards with  
bokeh to process your data**

**Sigbjørn Grini and Christian Zimmermann**



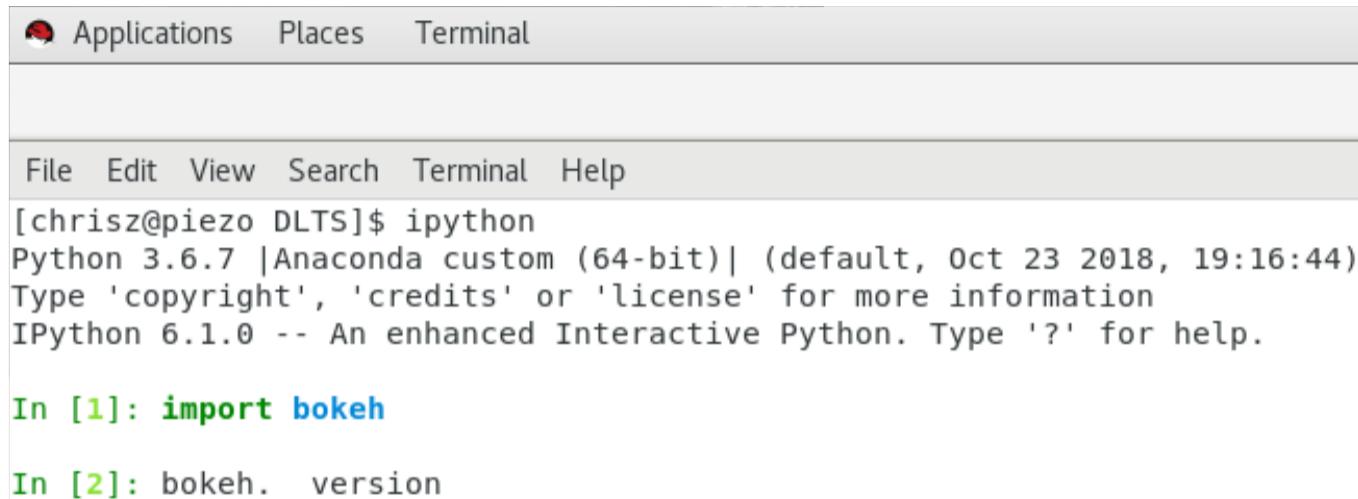
# Agenda

- Introduction to bokeh
- Some examples on what you can do with bokeh
- Make your own interactive dashboard using bokeh

# Getting started



# Getting started



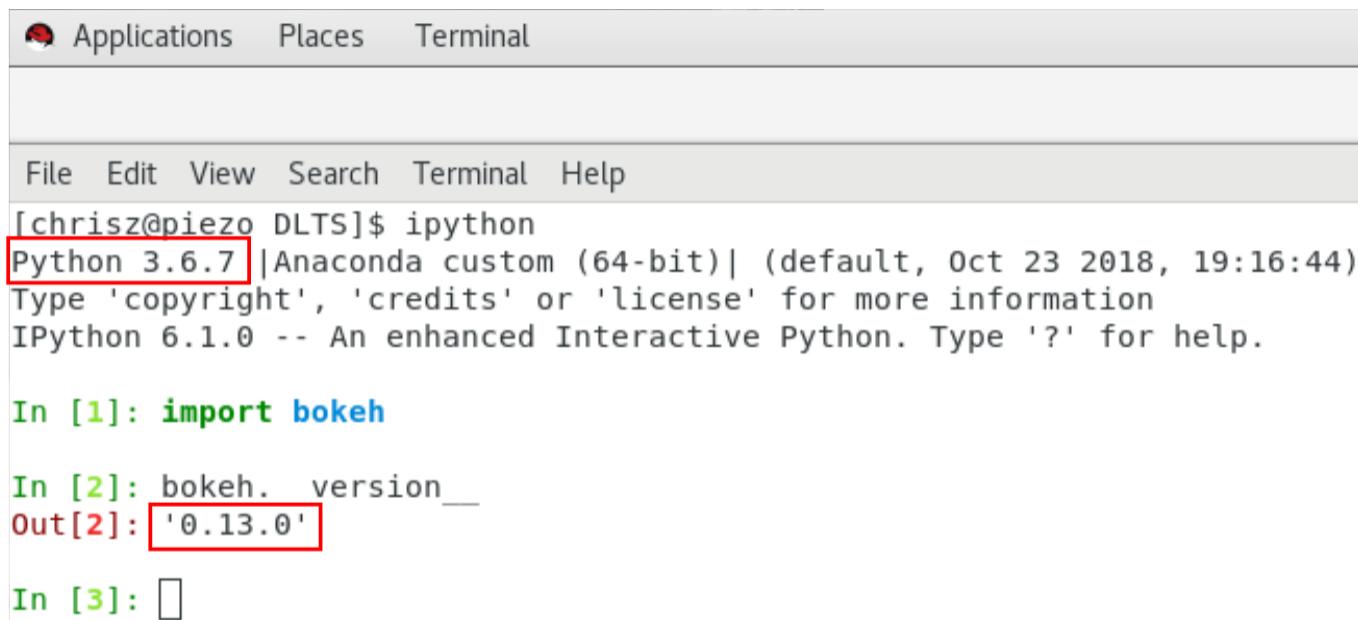
A screenshot of a Linux desktop environment. At the top, there is a horizontal menu bar with icons for Applications, Places, and Terminal. Below the menu bar is a terminal window. The terminal window has a title bar with the text "File Edit View Search Terminal Help". The main area of the terminal shows the following text:

```
[chrisz@piezo DLTS]$ ipython
Python 3.6.7 |Anaconda custom (64-bit)| (default, Oct 23 2018, 19:16:44)
Type 'copyright', 'credits' or 'license' for more information
IPython 6.1.0 -- An enhanced Interactive Python. Type '?' for help.

In [1]: import bokeh

In [2]: bokeh.__version__
```

# Getting started



The screenshot shows a Linux desktop interface with a terminal window open. The terminal window has a title bar with 'Applications', 'Places', and 'Terminal'. Below the title bar is a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'. The main area of the terminal window displays the following text:

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In [1]: import bokeh

In [2]: bokeh.__version__
Out[2]: '0.13.0'

In [3]: 
```

Two specific lines of text are highlighted with red boxes: 'Python 3.6.7 |Anaconda custom (64-bit)| (default, Oct 23 2018, 19:16:44)' and 'Out[2]: '0.13.0''. The 'In' and 'Out' labels are colored green, while the rest of the text is black.

# Agenda

- Introduction to bokeh

# Car dashboards are interactive dashboards



from: [en.wikipedia.org/wiki/Dashboard#/media/File:Lancia\\_beta\\_interior.jpg](https://en.wikipedia.org/wiki/Dashboard#/media/File:Lancia_beta_interior.jpg)  
accessed on 18-12-24  
modified for illustration purposes  
CC BY 3.0

# Car dashboards are interactive dashboards



Visualization of data

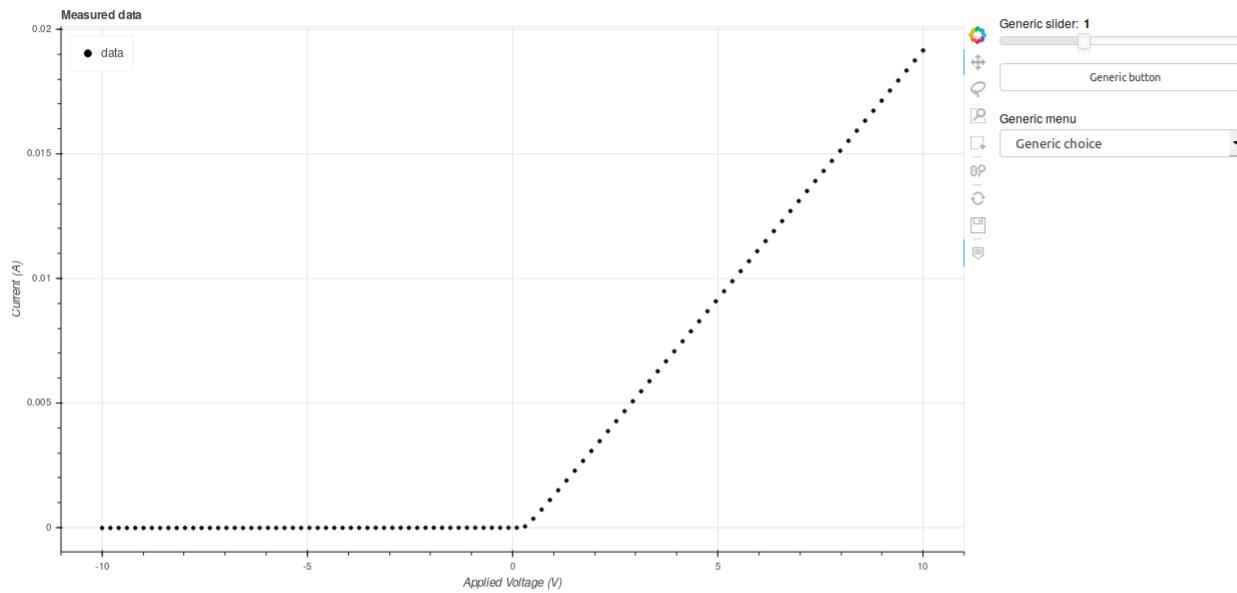
# Car dashboards are interactive dashboards



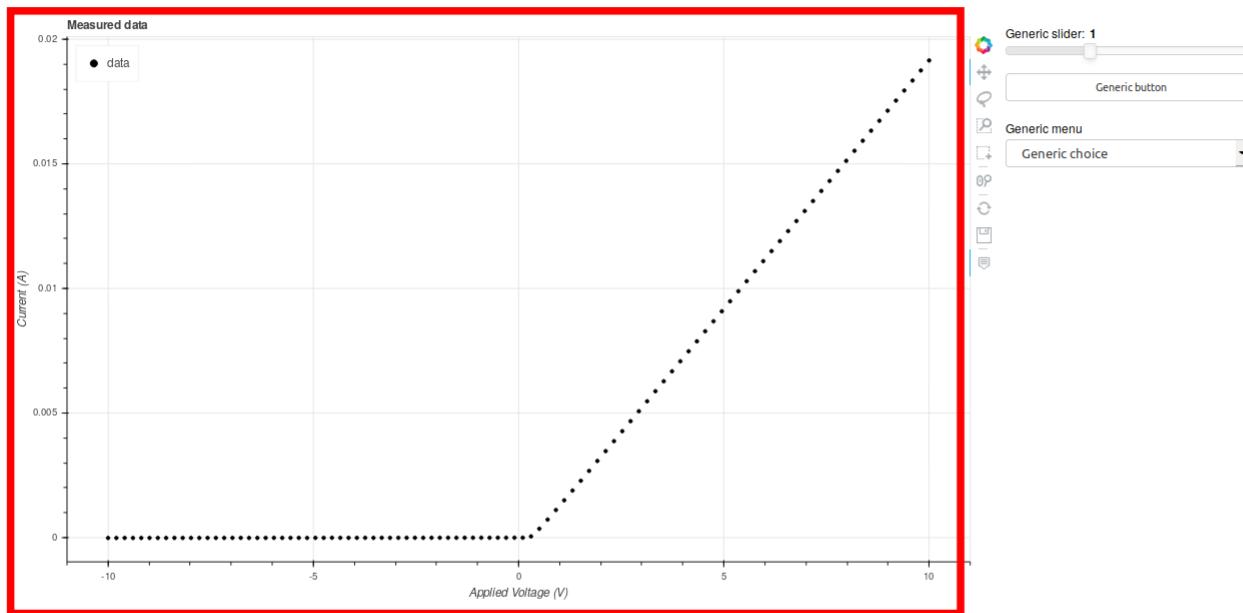
Visualization of data

Widgets to interact with data

# Interactive dashboards in science

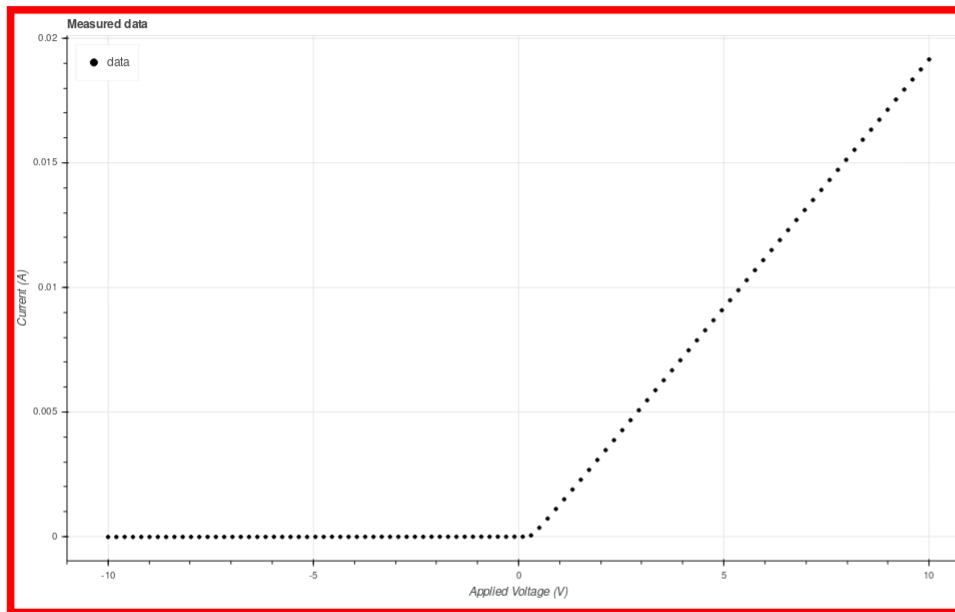


# Interactive dashboards in science

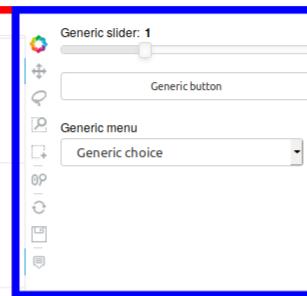


Visualization of data

# Interactive dashboards in science



Visualization of data



Widgets to interact with data

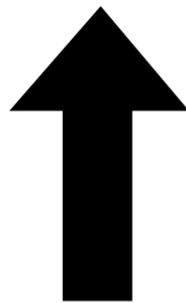
# How to generate interactive dashboards?

Visualization of data

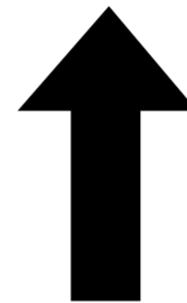
Widgets to interact with data

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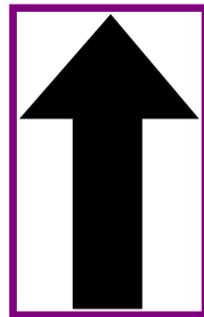
Widgets to interact with data



Programming language, e.g. Python

# How to generate interactive dashboards?

Visualization of data



Widgets to interact with data

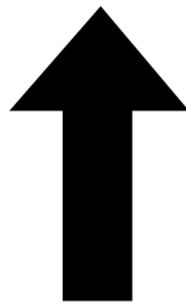


Programming language, e.g. Python

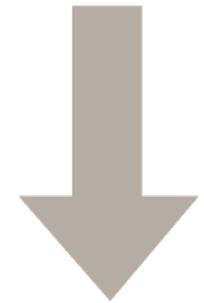
Generate plots with axes, data points, axis labels etc.

# How to generate interactive dashboards?

Visualization of data



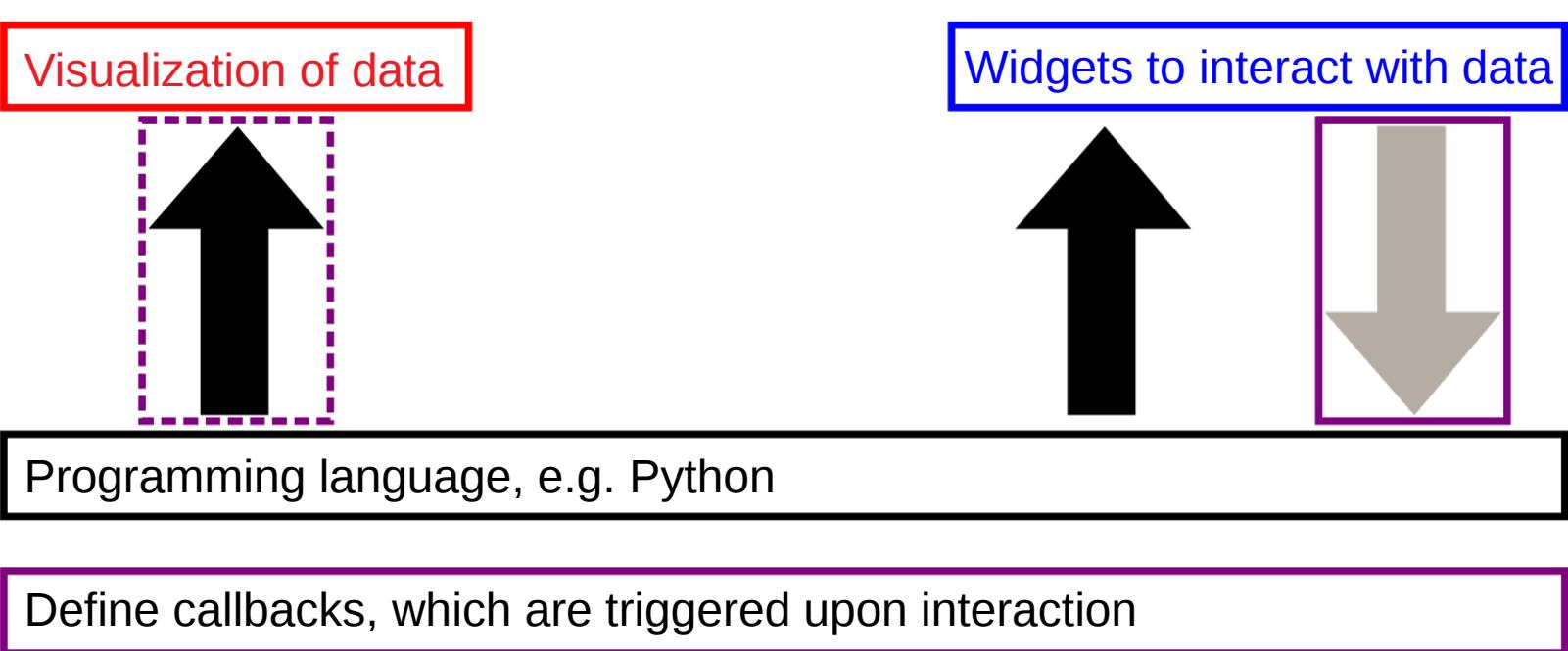
Widgets to interact with data



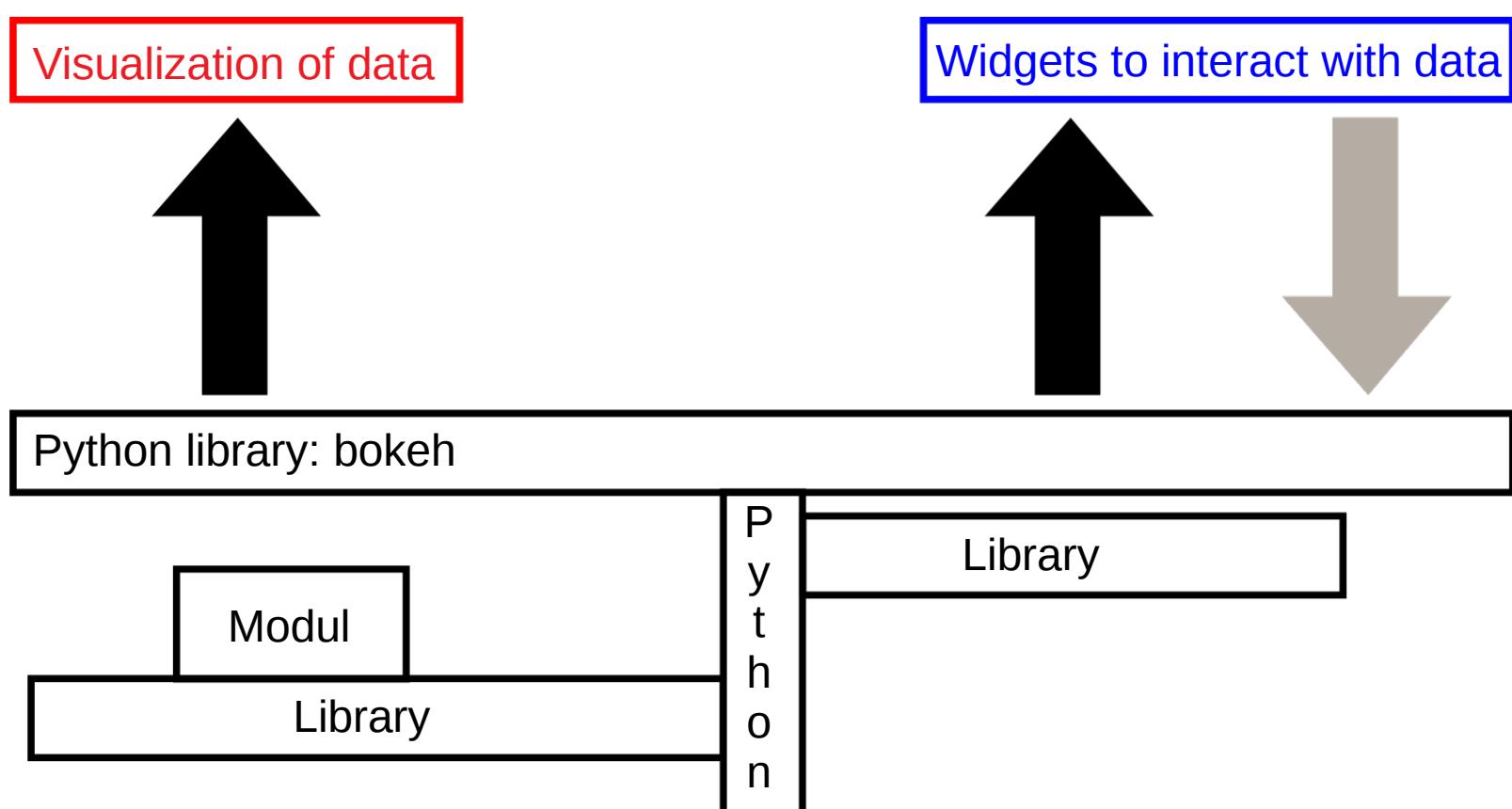
Programming language, e.g. Python

Generate widgets like sliders or buttons

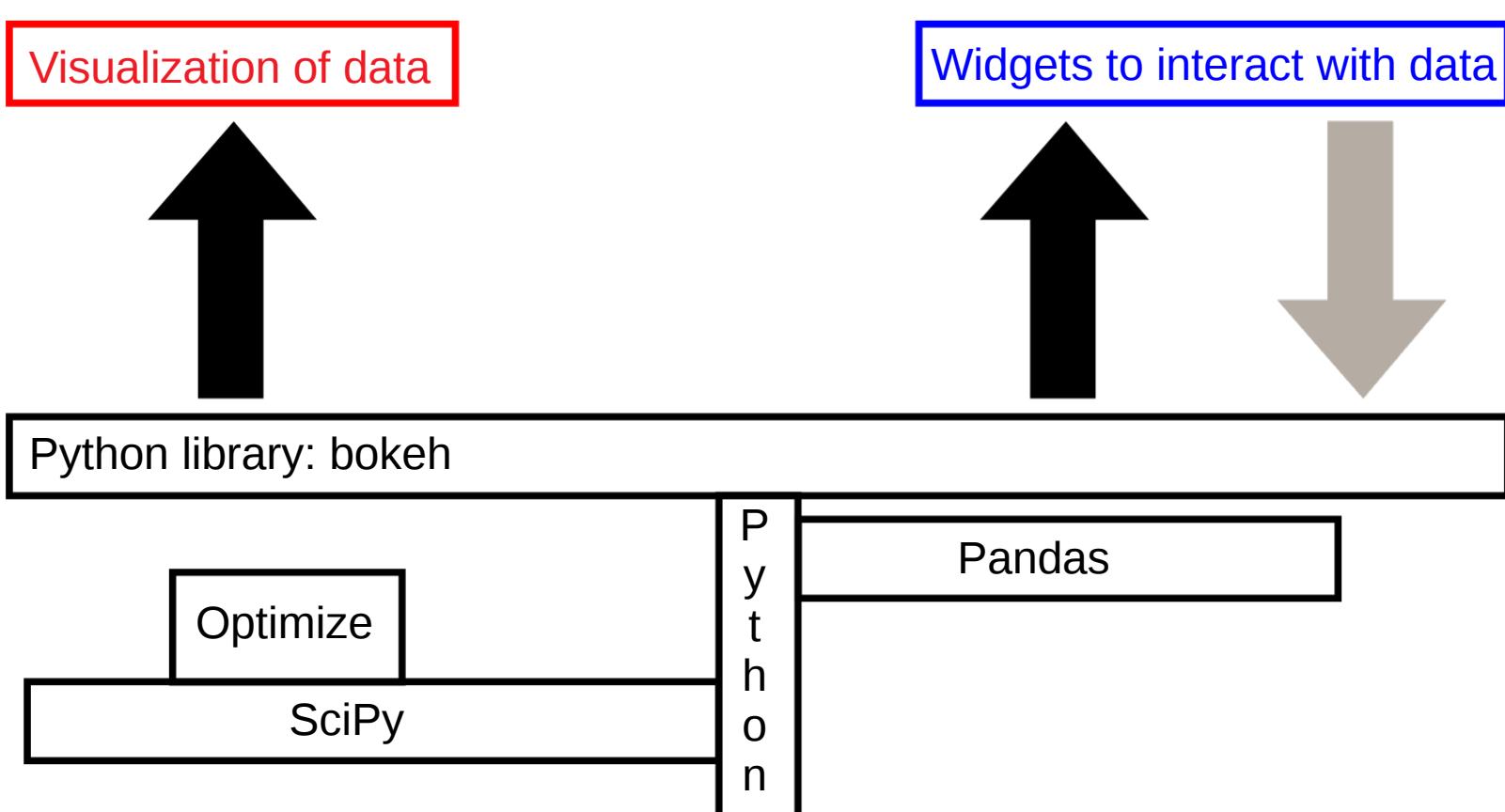
# How to generate interactive dashboards?



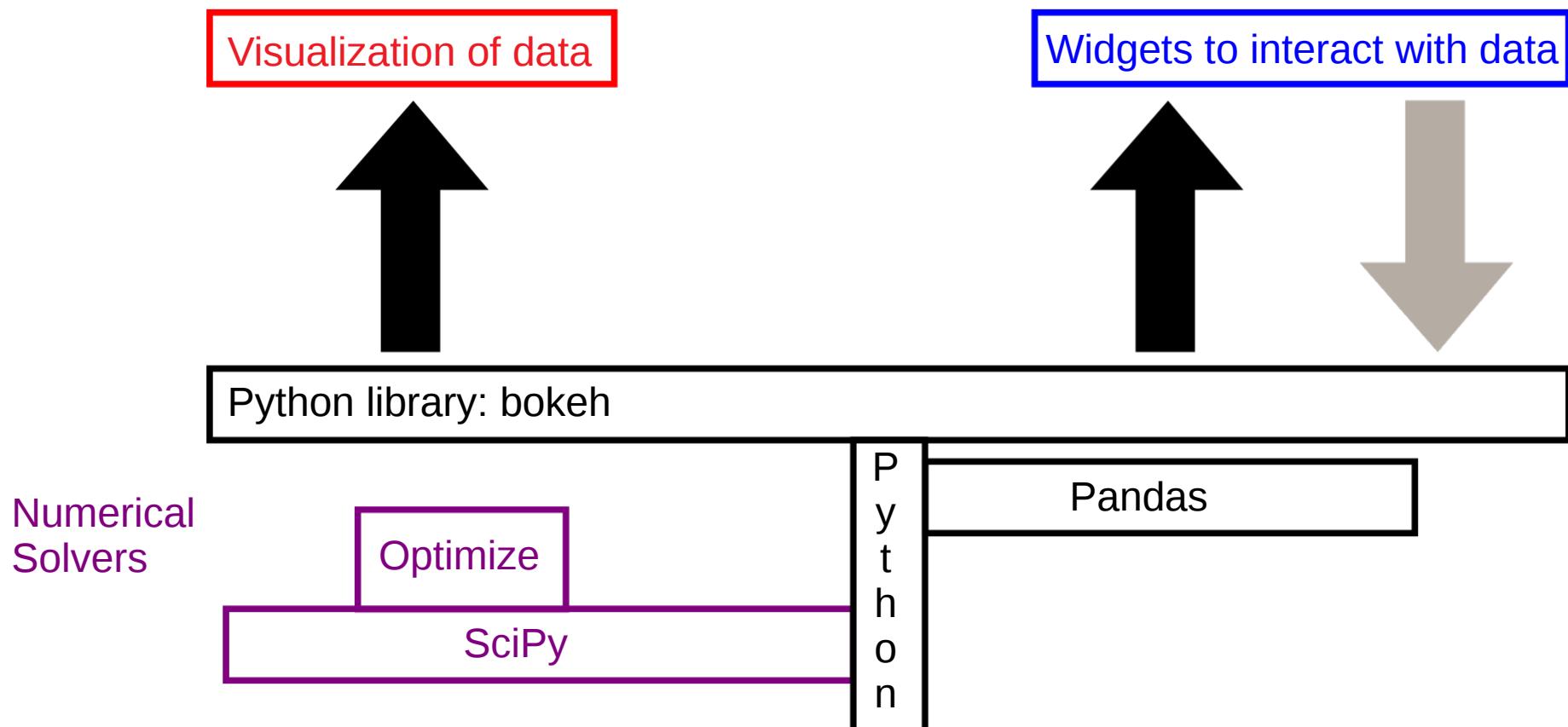
# How to generate interactive dashboards with python and bokeh



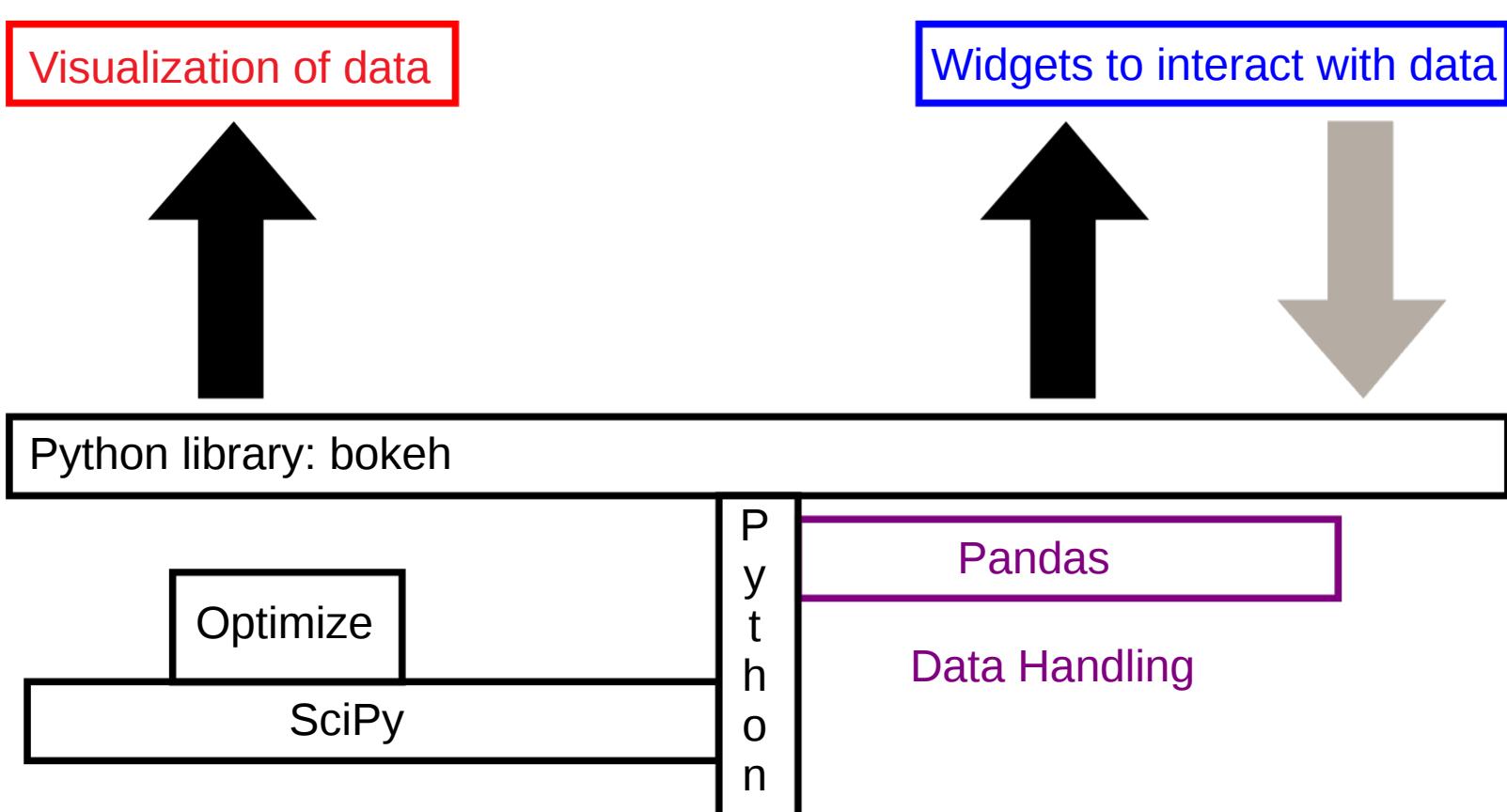
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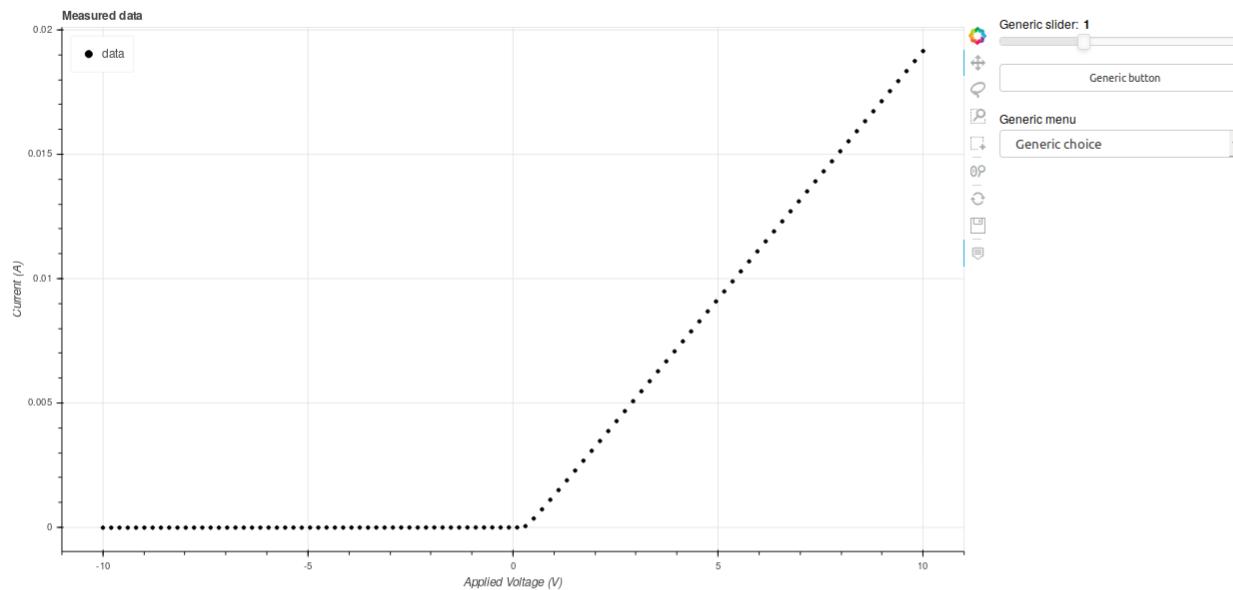
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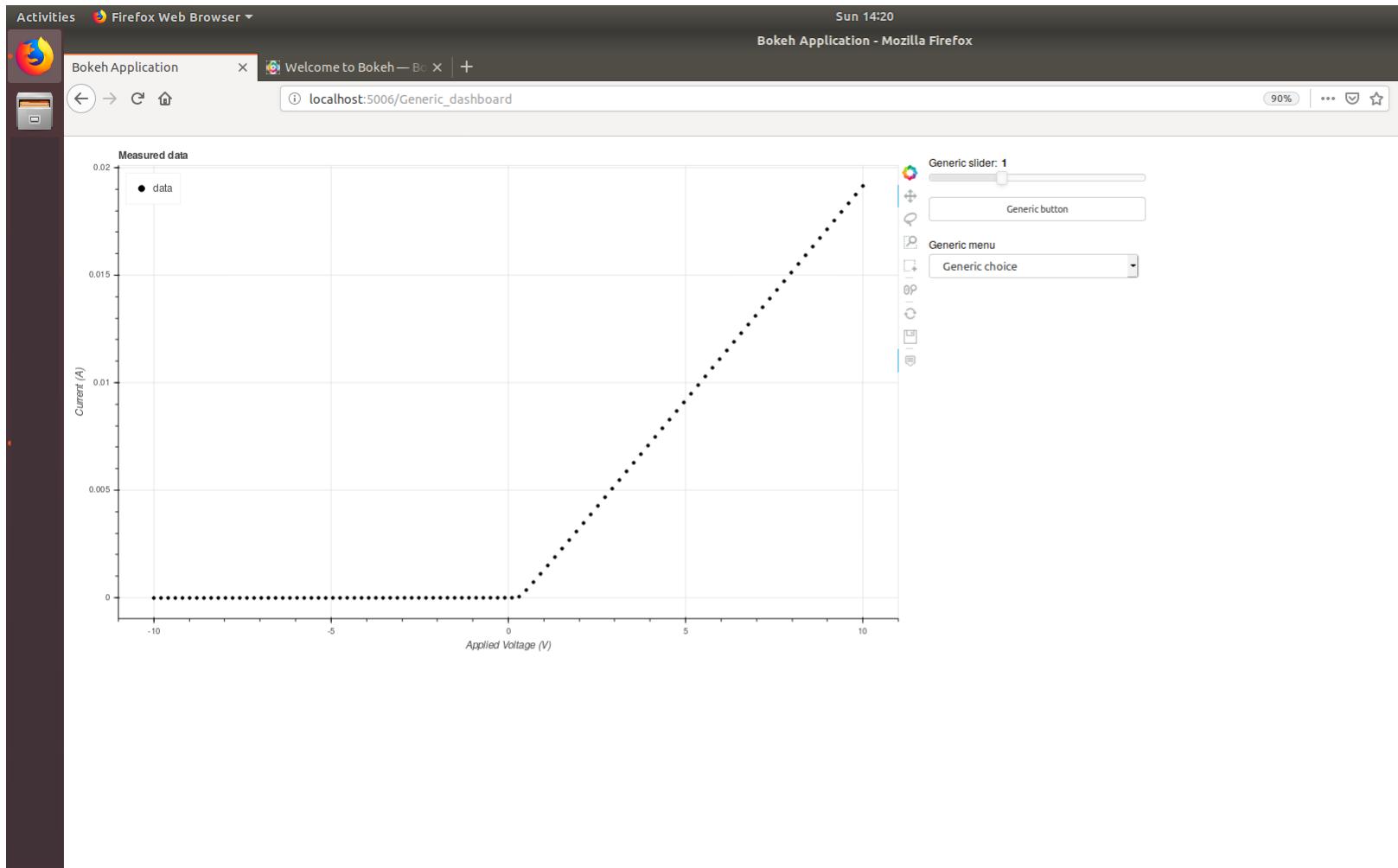
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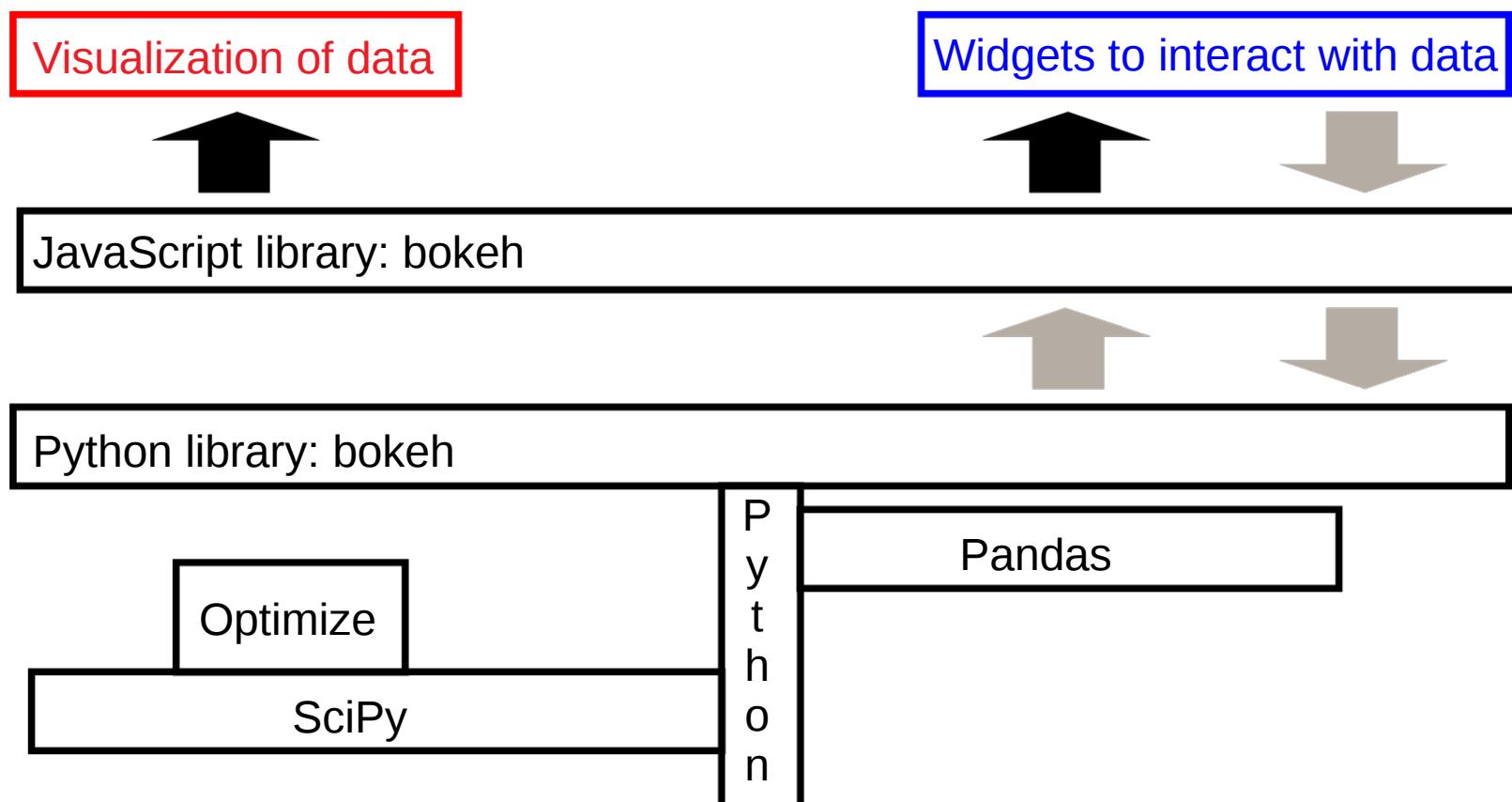
# Why should you use bokeh?



# Interactive dashboards can be run on a server!

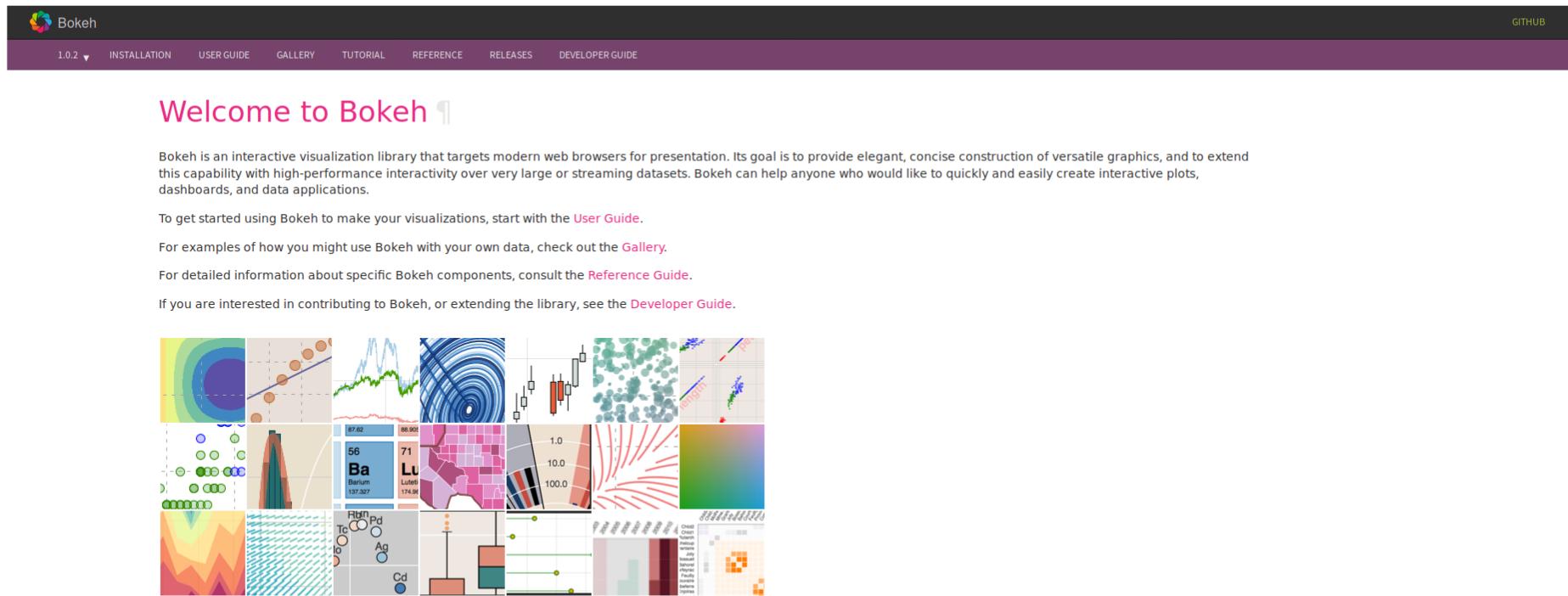


# Interactive dashboards are run on a server using JavaScript



# More about bokeh

Visit [bokeh.pydata.org/en/1.0.2/](https://bokeh.pydata.org/en/1.0.2/)



The screenshot shows the Bokeh website's main page. At the top, there's a navigation bar with links for "INSTALLATION", "USER GUIDE", "GALLERY", "TUTORIAL", "REFERENCE", "RELEASES", and "DEVELOPER GUIDE". Below the navigation bar, the title "Welcome to Bokeh" is displayed in pink. A brief introduction follows, stating that Bokeh is an interactive visualization library targeting modern web browsers for presentation. It highlights the library's goal of providing elegant, concise construction of versatile graphics, and its capability for high-performance interactivity over very large or streaming datasets. The text mentions that Bokeh can help anyone create interactive plots, dashboards, and data applications. Below the introduction, several links are provided: "User Guide", "Gallery", "Reference Guide", and "Developer Guide". The main content area features a grid of nine different Bokeh-generated plots, including a contour plot, a scatter plot with a regression line, a line plot with a moving average, a heatmap, a candlestick chart, a bubble plot, a scatter plot with a logarithmic scale, a radial plot, and a 3D surface plot.

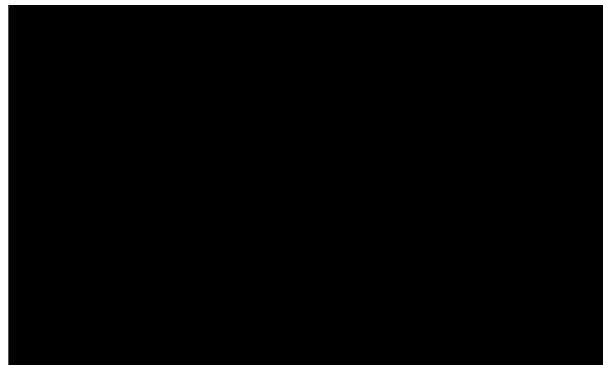
# Agenda

- Some examples on what you can do with bokeh

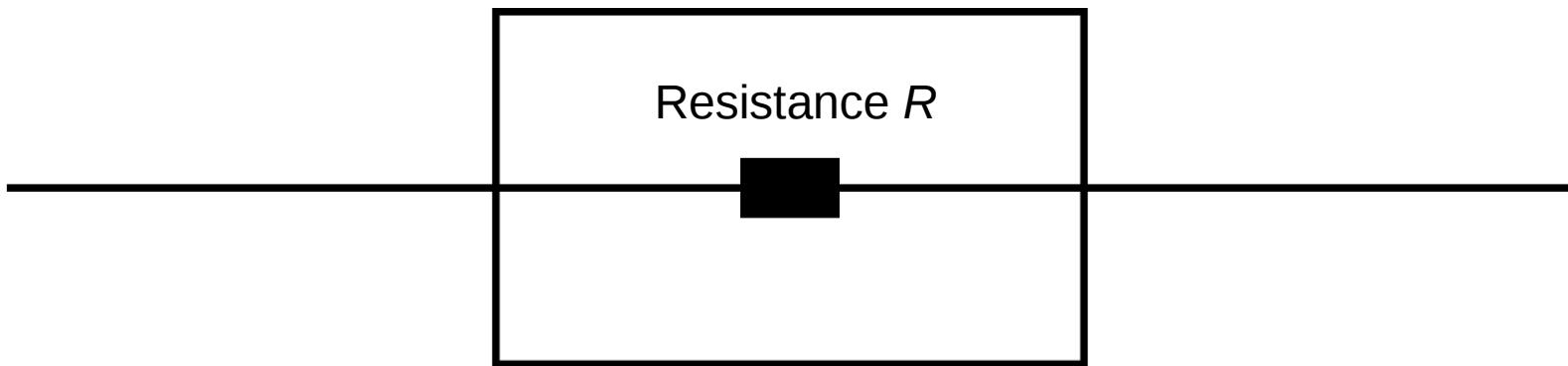
# The quest for model parameters



# The quest for model parameters



# The quest for model parameters: 'What value does $R$ have?'

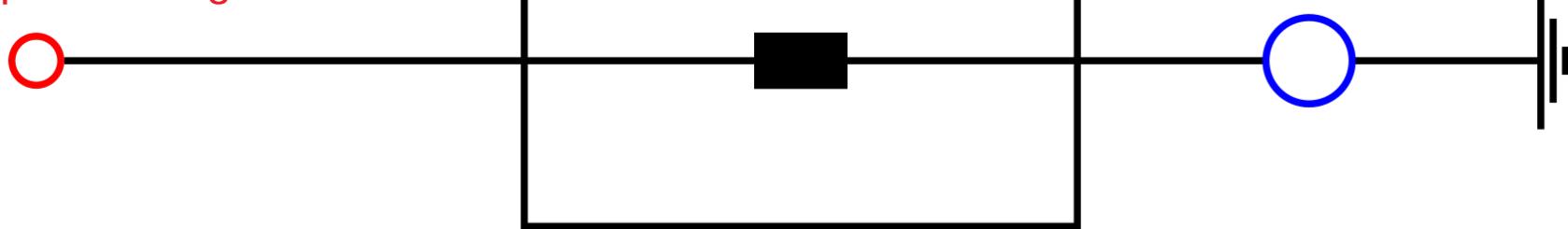


# The quest for model parameters: 'What value does $R$ have?'

Applied Voltage  $V$

Resistance  $R$

Current  $I$



# The quest for model parameters: 'What value does $R$ have?'

Applied Voltage  $V$



$$I = 1/R * V$$

# The quest for model parameters: 'What value does $R$ have?'

Applied Voltage  $V$



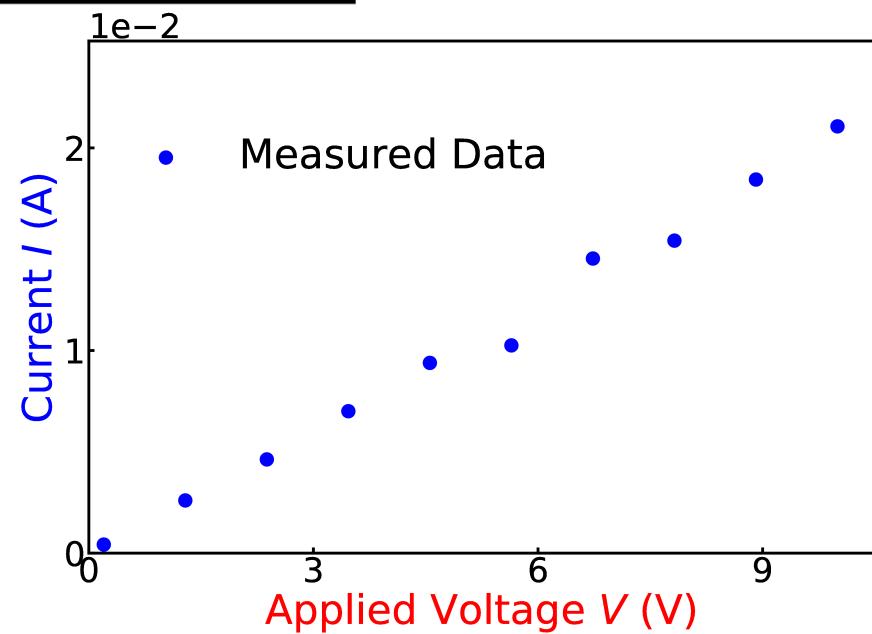
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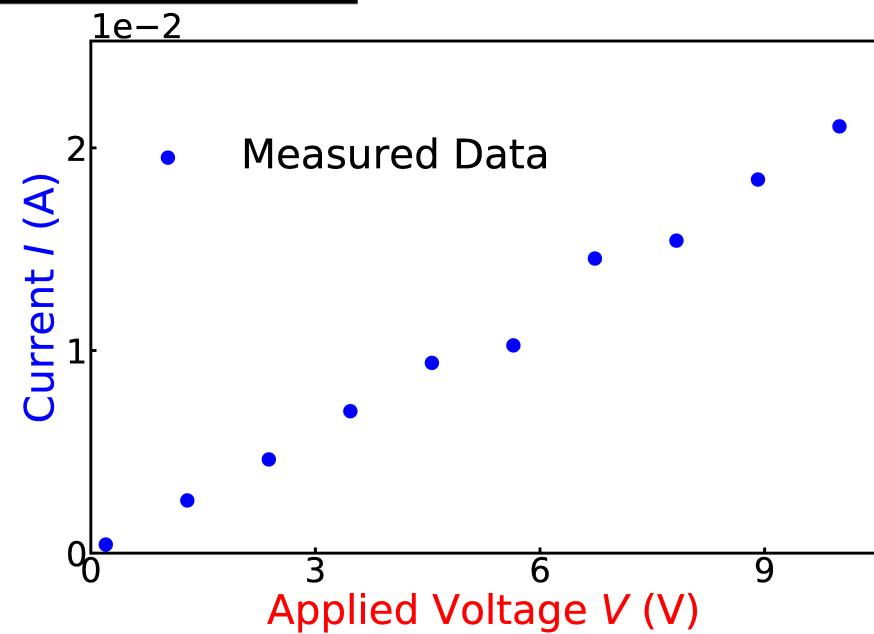
Resistance  $R$



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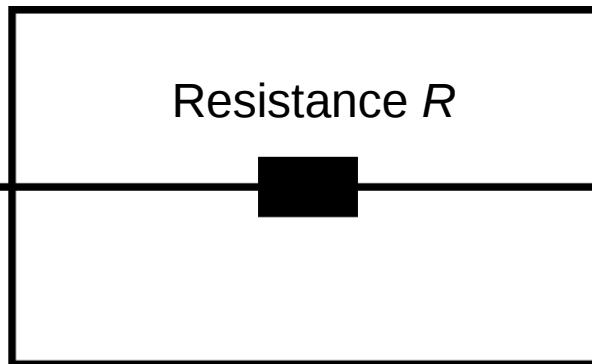


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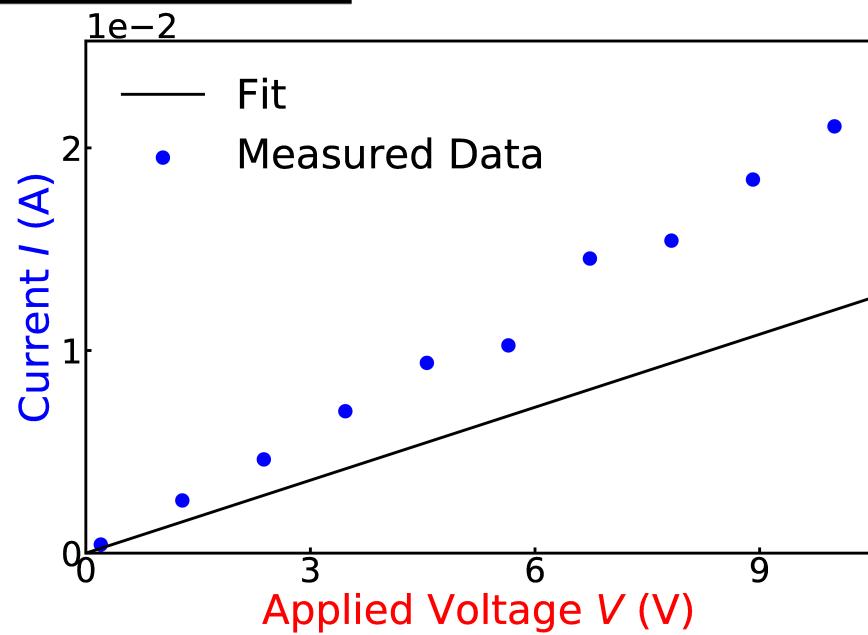


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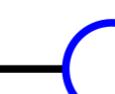
Applied Voltage  $V$



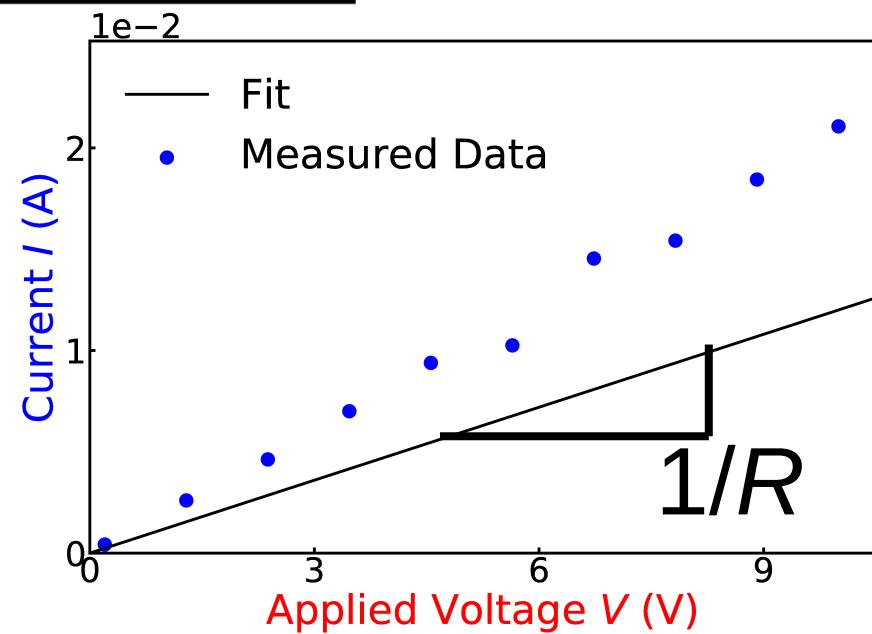
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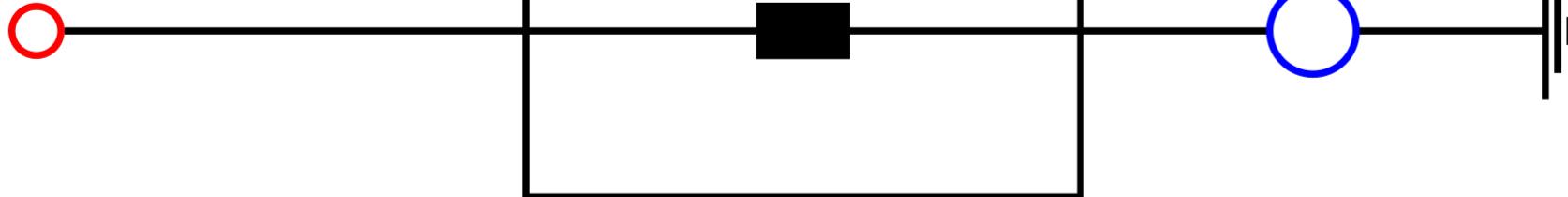


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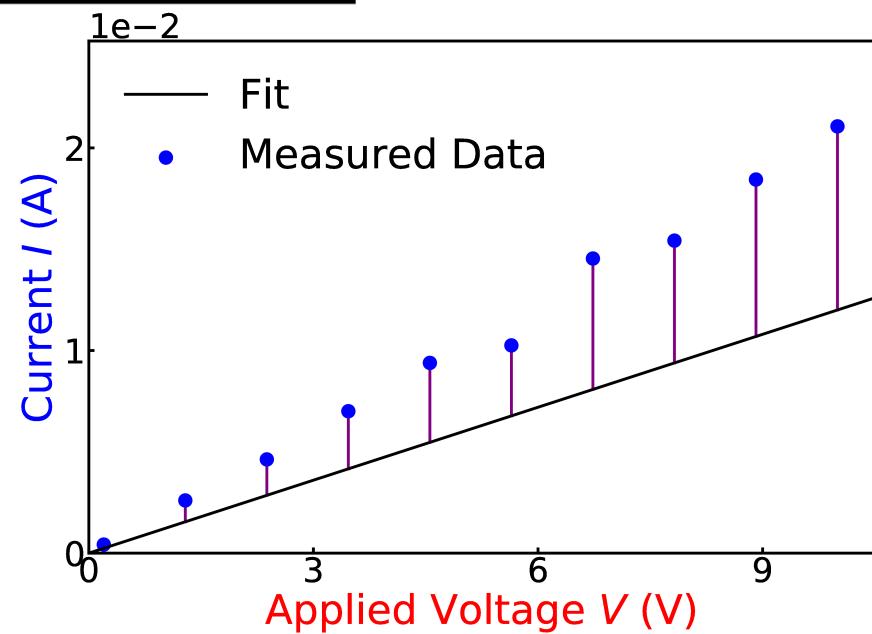
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Applied Voltage  $V$



$$I = 1/R * V$$

$$\epsilon = I_{\text{measured}} - I_{\text{fit}}$$



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Applied Voltage  $V$



Resistance  $R$



Current  $I$

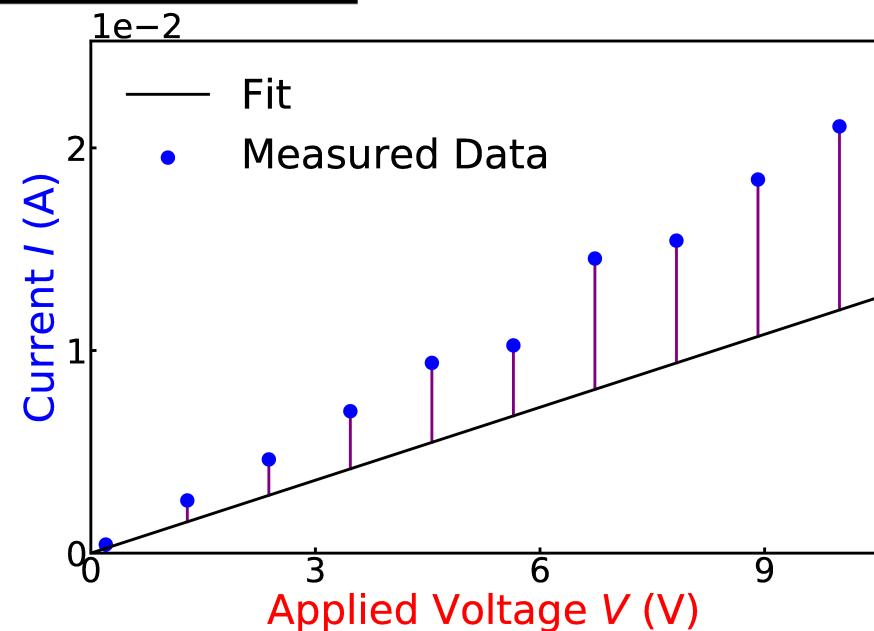


$$I = 1/R * V$$

Minimize:

$$\sum | * |$$

$$| = I_{\text{measured}} - I_{\text{fit}}$$

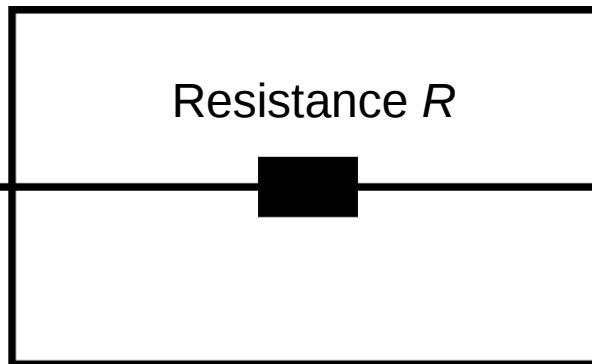


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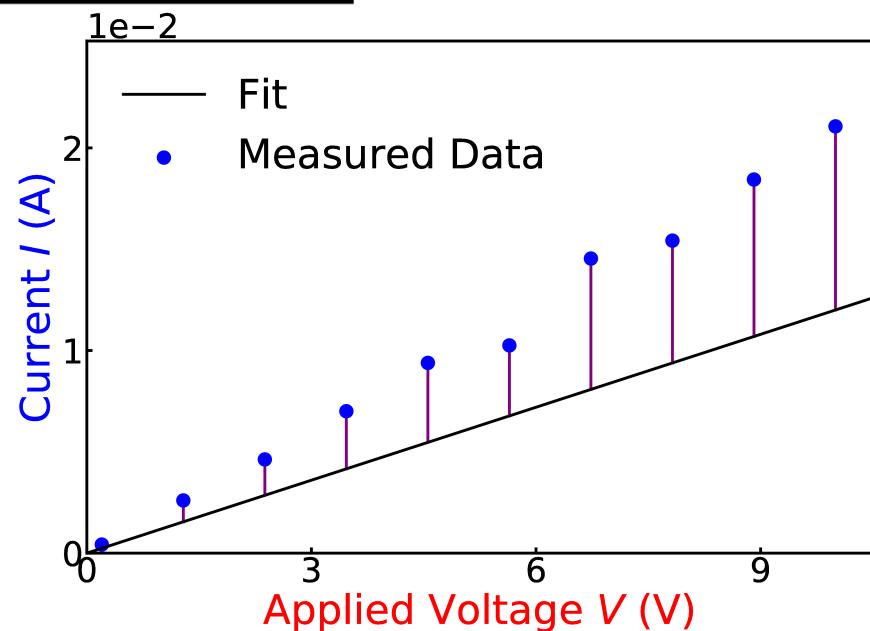
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Minimize:

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Least  
Squares

$$| = I_{\text{measured}} - I_{\text{fit}}$$

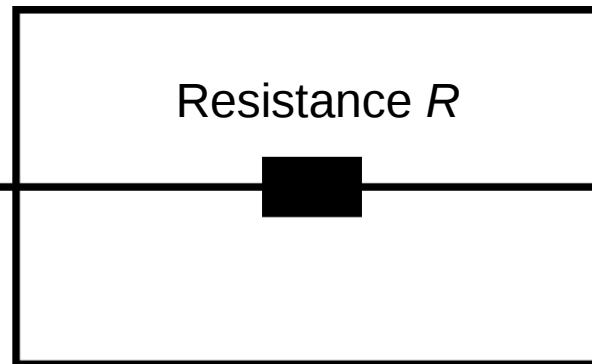


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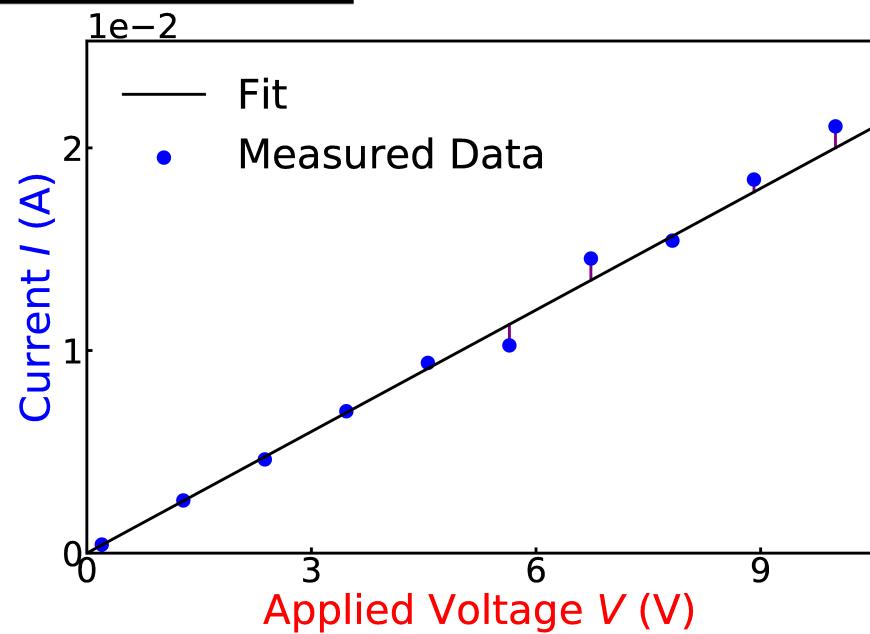
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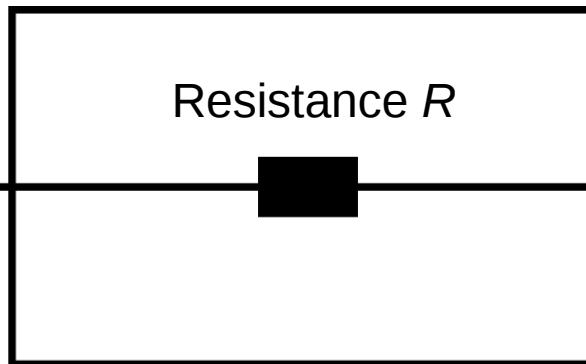


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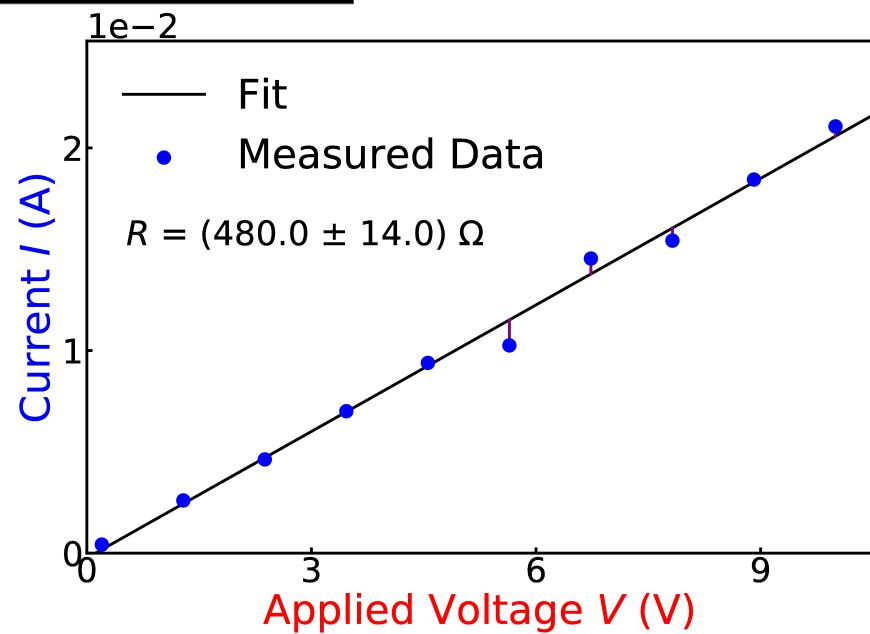
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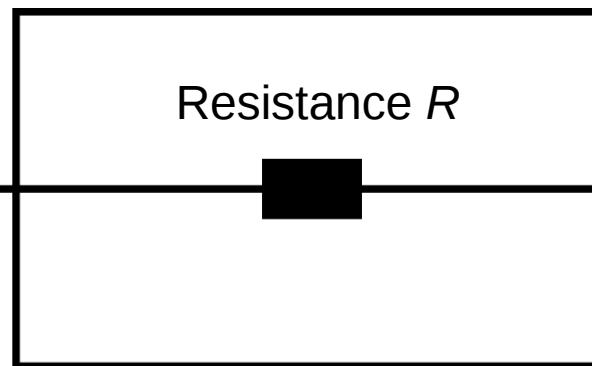


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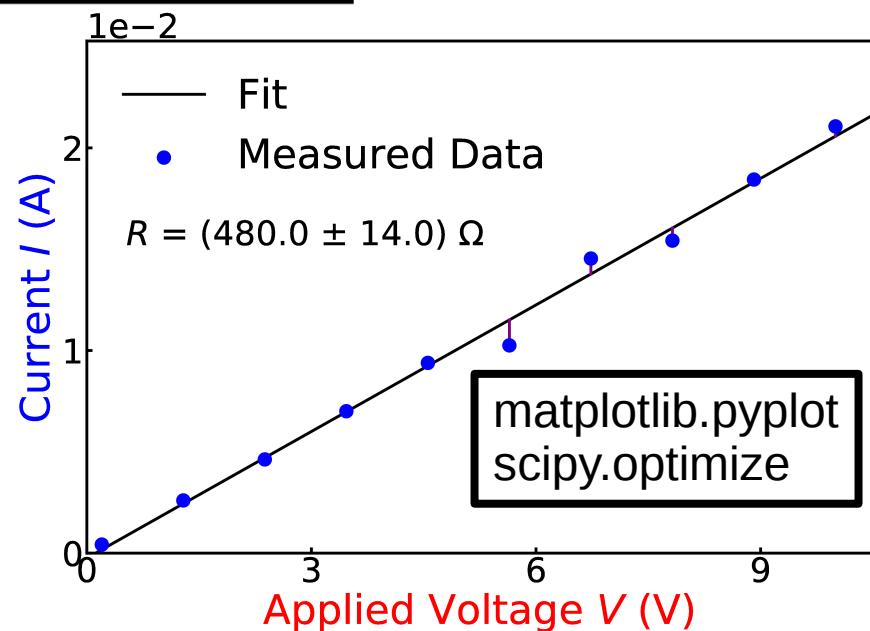
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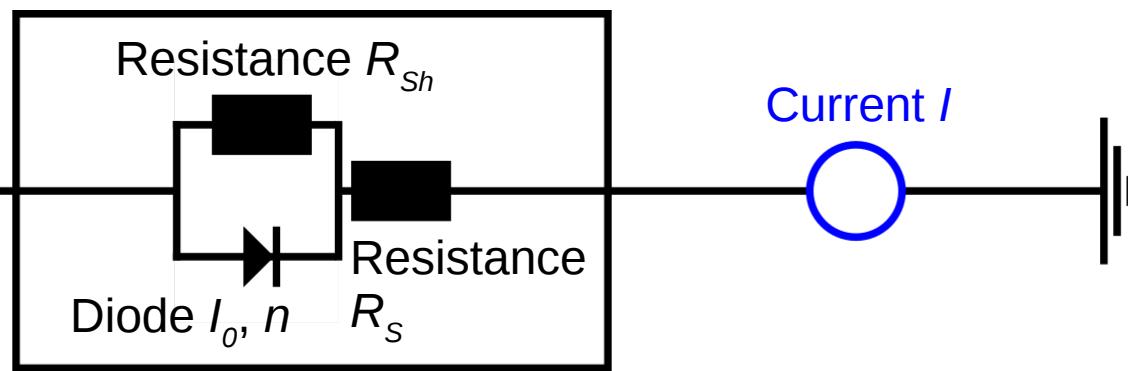
Least  
Squares

$$| = I_{\text{measured}} - I_{\text{fit}}$$



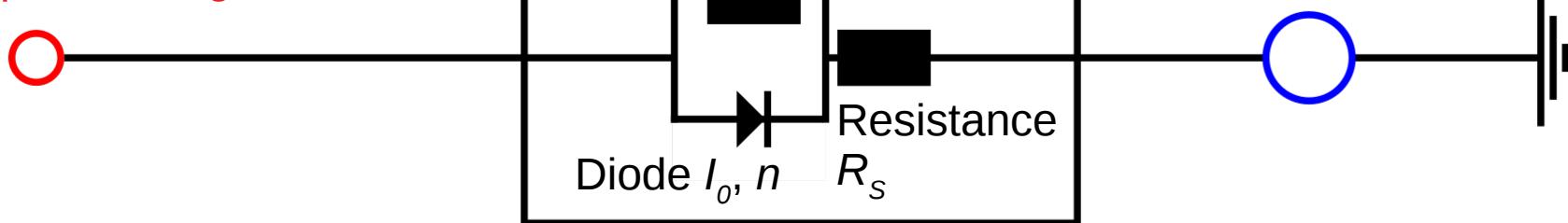
# The quest for model parameters: 'What values do $R_{sh}$ , $R_s$ , $I_0$ and $n$ have?'

Applied Voltage  $V$



# The quest for model parameters: 'What values do $R_{sh}$ , $R_s$ , $I_0$ and $n$ have?'

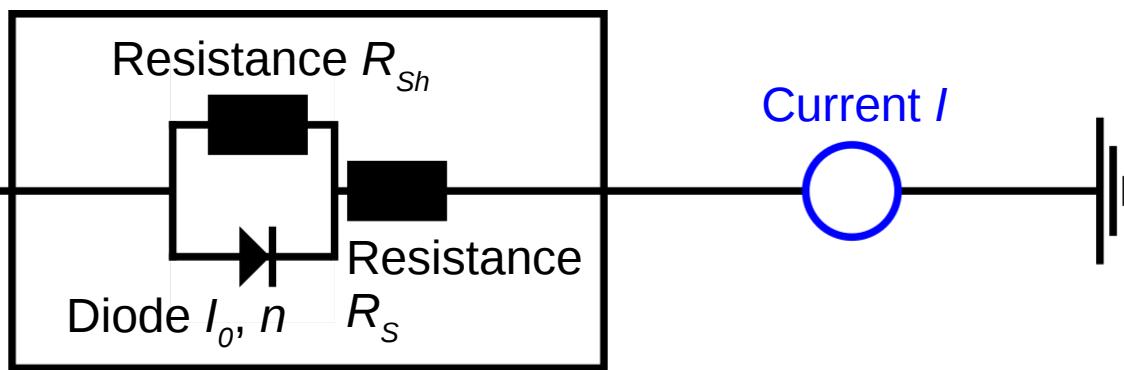
Applied Voltage  $V$



$$I = I_0 * \left( e^{\frac{e(V - IR_s)}{nkT}} - 1 \right) + \frac{V - IR_s}{R_{sh}}$$

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Applied Voltage  $V$



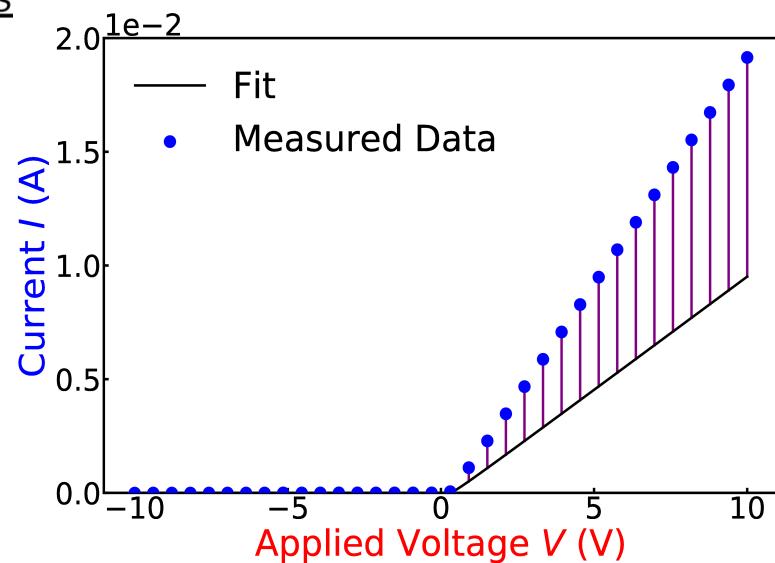
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Minimize:

$$\sum | * |$$

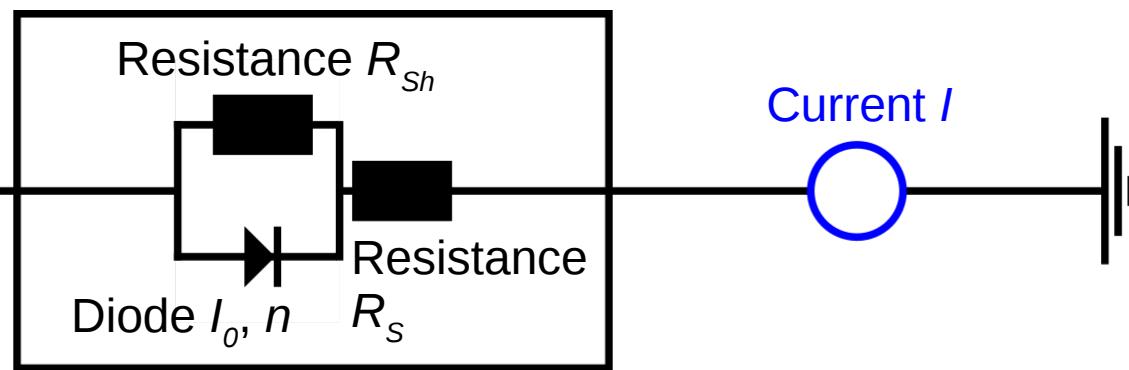
Least  
Squares

$$| = I_{\text{measured}} - I_{\text{fit}}$$



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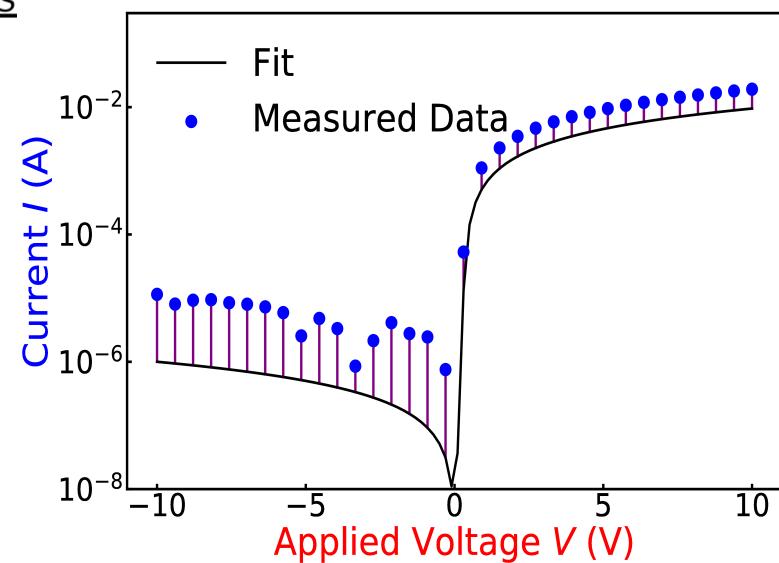
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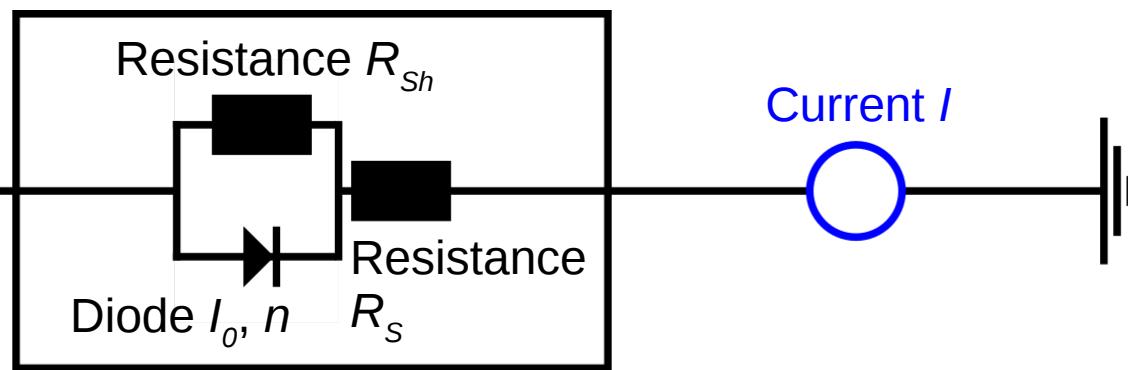
Least  
Squares

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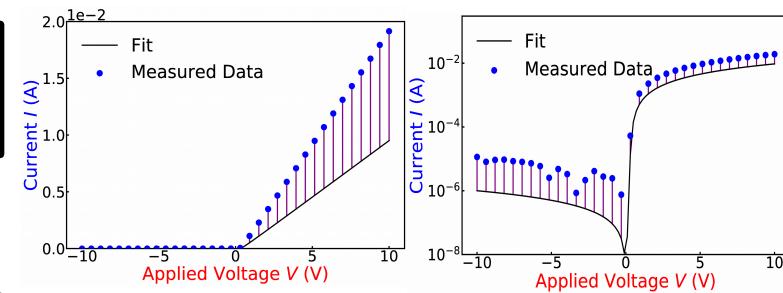


$$I = I_0 * \left( e^{\frac{e(V - IR_s)}{nkT}} - 1 \right) + \frac{V - IR_s}{R_{sh}}$$

Equation must  
be solved  
numerically



scipy.optimize



Minimization  
complex,  
requires good  
initial guess



bokeh

Minimize:  $\sum | *$