Tutorial: Bokeh (d3js)

In this tutorial, we will generate a exemplary scatter-plot for introducing the d3js-package Bokeh in Python.

For doing the tutorial, you need to download and import the appliance for a virtual machine (ubuntu). After starting, you can login with:

username: **acm2**
password: **acm2**

To launch the Jupyter Notebook (Python) containing the trainings-material, you just have to open a terminal and type in following command:

```
jupyter notebook
```

A tab in the browser will open automatically. If you navigate to the 'D3_Tutorial' folder in the home directory, you will find a Tutorial.ipynb file to start with. A click on it will open a new tab in the browser.

The tutorial-script is divided in subsections. Each section can be run separately. The first cell contains all used packages that are used. The next cell contains some arbitrary generated data for generating later a scatter-plot followed by a cell where we need to define the tools, we want to provide in our plot. Now we generate a simple scatter-plot without using any tools.

Exercise 1: Include the tools: *HoverTool* and *CrosshairTool.* Generate the plot again and try out the functions.

Exercise 2: Try to modify the style of the output, when you hover with your mouse over the graph. Create a class (*hover*) that contains all properties of the hover-tool by applying the method *select* to the figure (p). As a argument you provide the query dictionary *dict(type=HoverTool).* The method tooltips allows now specifying the output.

```
hover=p.select(dict(type=HoverTool))
hover.tooltips = [
   ("This is index", " $index!"),
   ("x/y", "($x/$y)"),
]
```

As a next plot we want to create a histogram with 20 bars showing the distribution of data-points along the vertical axis. Now we can merge the scatter-plot and the histogram by using subplots.

Exercise 3: Create a horizontal histogram analogue to the vertical one. Keep in mind that you do not need a offset for compensating the toolbar this time. Include this plot in the *layout* (you need to insert a second *hplot*).

Let's make it dynamic now! We want to insert a callback-function enabling the possibility of showing us the fraction of data-points in the histogram, we selected with the lasso-tool in the scatter-plot. The function is already in the notebook, but commented out.

Exercise 4: Uncomment this section now and try to create the plot again, using the tools: *pan,wheel_zoom,box_select,lasso_select,reset.* Now you have to define the additional arrays in the section of each histogram:

```
vzeros = np.zeros(len(vedges)-1)
LINE_ARGS = dict(color="#3A5785", line_color=None)
vh1 = pv.quad(left=0, bottom=vedges[:-1], top=vedges[1:], right=vzeros, alpha=0.9,
        **LINE_ARGS)
vh2 = pv.quad(left=0, bottom=vedges[:-1], top=vedges[1:], right=vzeros, alpha=0.5,
        **LINE_ARGS)

hzeros = np.zeros(len(hedges)-1)
hh1 = ph.quad(bottom=0, left=hedges[:-1], right=hedges[1:], top=hzeros, alpha=0.9,
        **LINE_ARGS)
hh2 = ph.quad(bottom=0, left=hedges[:-1], right=hedges[1:], top=hzeros, alpha=0.5,
        **LINE_ARGS)
```

Unfortunately, we cannot observe the effect in the notebook. We have to use the *bokeh serve* function. To do so, enter in a new terminal tab:

```
bokeh serve
```

Exercise 5: Now we need to specify the output server in (cell four). Just insert the command output_server() instead of output_notebook(). In the second last cell you should create a class "*session*" with the "*push_session(curdoc())*" function. Apply the method "*add_periodic_callback(update_fun, 50)*" to "*curdoc()*" and than create the plot by "*session.show()*". In the end add the command "*session.loop_until_closed()*". Before running the script, you might want to comment out all *show(...)* commands but the last one, to open just one new plot.

Finally, we can also save a static HTML-file by changing the output again.

Exercise 6: Replace the "*output_server*" command by output_file(NAME)

Now I would suggest you to play a bit with example-plots on the Bokeh webpage.
Thanks for your interest and participation.