Python For Data Science *Cheat Sheet*
Bokeh

Plotting With Bokeh

The Python interactive visualization library **Bokeh** enables high-performance visual presentation of large datasets in modern web browsers.

Bokeh's mid-level general purpose `bokeh.plotting` interface is centered around two main components: data and glyphs.

data + glyphs = plot

The basic steps to creating plots with the `bokeh.plotting` interface are:

1. Prepare some data:
   Python lists, NumPy arrays, Pandas DataFrames and other sequences of values
2. Create a new plot
3. Add renderers for your data, with visual customizations
4. Specify where to generate the output
5. Show or save the results

```
>>> from bokeh.plotting import figure
>>> from bokeh.io import output_file, show
>>> x = [1, 2, 3, 4, 5]                    Step 1
>>> y = [6, 7, 2, 4, 5]
>>> p = figure(title="simple line example",   Step 2
           x_axis_label='x',
           y_axis_label='y')
>>> p.line(x, y, legend="Temp.", line_width=2)   Step 3
>>> output_file("lines.html")              Step 4
>>> show(p)                                Step 5
```

1 Data *Also see Lists, NumPy & Pandas*

Under the hood, your data is converted to Column Data Sources. You can also do this manually:

```
>>> import numpy as np
>>> import pandas as pd
>>> df = pd.DataFrame(np.array([[33.9,4,65, 'US'],
                        [32.4,4,66, 'Asia'],
                        [21.4,4,109, 'Europe']]),
                columns=['mpg','cyl', 'hp', 'origin'],
                index=['Toyota', 'Fiat', 'Volvo'])
```

```
>>> from bokeh.models import ColumnDataSource
>>> cds_df = ColumnDataSource(df)
```

2 Plotting

```
>>> from bokeh.plotting import figure
>>> p1 = figure(plot_width=300, tools='pan,box_zoom')
>>> p2 = figure(plot_width=300, plot_height=300,
           x_range=(0, 8), y_range=(0, 8))
>>> p3 = figure()
```

3 Renderers & Visual Customizations

Glyphs

Scatter Markers
```
>>> p1.circle(np.array([1,2,3]), np.array([3,2,1]),
           fill_color='white')
>>> p2.square(np.array([1.5,3.5,5.5]), [1,4,3],
           color='blue', size=1)
```

Line Glyphs
```
>>> p1.line([1,2,3,4], [3,4,5,6], line_width=2)
>>> p2.multi_line(pd.DataFrame([[1,2,3],[5,6,7]]),
              pd.DataFrame([[3,4,5],[3,2,1]]),
              color="blue")
```

Customized Glyphs *Also see Data*

Selection and Non-Selection Glyphs
```
>>> p = figure(tools='box_select')
>>> p.circle('mpg', 'cyl', source=cds_df,
           selection_color='red',
           nonselection_alpha=0.1)
```

Hover Glyphs
```
>>> from bokeh.models import HoverTool
>>> hover = HoverTool(tooltips=None, mode='vline')
>>> p3.add_tools(hover)
```

Colormapping
```
>>> from bokeh.models import CategoricalColorMapper
>>> color_mapper = CategoricalColorMapper(
           factors=['US', 'Asia', 'Europe'],
           palette=['blue', 'red', 'green'])
>>> p3.circle('mpg', 'cyl', source=cds_df,
           color=dict(field='origin',
                   transform=color_mapper),
           legend='Origin')
```

Legend Location

Inside Plot Area
```
>>> p.legend.location = 'bottom_left'
```

Outside Plot Area
```
>>> from bokeh.models import Legend
>>> r1 = p2.asterisk(np.array([1,2,3]), np.array([3,2,1])
>>> r2 = p2.line([1,2,3,4], [3,4,5,6])
>>> legend = Legend(items=[("One" ,[p1, r1]),("Two",[r2])],
              location=(0, -30))
>>> p.add_layout(legend, 'right')
```

Legend Orientation
```
>>> p.legend.orientation = "horizontal"
>>> p.legend.orientation = "vertical"
```

Legend Background & Border
```
>>> p.legend.border_line_color = "navy"
>>> p.legend.background_fill_color = "white"
```

Rows & Columns Layout

Rows
```
>>> from bokeh.layouts import row
>>> layout = row(p1,p2,p3)
```

Columns
```
>>> from bokeh.layouts import columns
>>> layout = column(p1,p2,p3)
```

Nesting Rows & Columns
```
>>>layout = row(column(p1,p2), p3)
```

Grid Layout
```
>>> from bokeh.layouts import gridplot
>>> row1 = [p1,p2]
>>> row2 = [p3]
>>> layout = gridplot([[p1,p2],[p3]])
```

Tabbed Layout
```
>>> from bokeh.models.widgets import Panel, Tabs
>>> tab1 = Panel(child=p1, title="tab1")
>>> tab2 = Panel(child=p2, title="tab2")
>>> layout = Tabs(tabs=[tab1, tab2])
```

Linked Plots

Linked Axes
```
>>> p2.x_range = p1.x_range
>>> p2.y_range = p1.y_range
```

Linked Brushing
```
>>> p4 = figure(plot_width = 100,
           tools='box_select,lasso_select')
>>> p4.circle('mpg', 'cyl', source=cds_df)
>>> p5 = figure(plot_width = 200,
           tools='box_select,lasso_select')
>>> p5.circle('mpg', 'hp', source=cds_df)
>>> layout = row(p4,p5)
```

4 Output & Export

Notebook
```
>>> from bokeh.io import output_notebook, show
>>> output_notebook()
```

HTML

Standalone HTML
```
>>> from bokeh.embed import file_html
>>> from bokeh.resources import CDN
>>> html = file_html(p, CDN, "my_plot")
```

```
>>> from bokeh.io import output_file, show
>>> output_file('my_bar_chart.html', mode='cdn')
```

Components
```
>>> from bokeh.embed import components
>>> script, div = components(p)
```

PNG
```
>>> from bokeh.io import export_png
>>> export_png(p, filename="plot.png")
```

SVG
```
>>> from bokeh.io import export_svgs
>>> p.output_backend = "svg"
>>> export_svgs(p, filename="plot.svg")
```

5 Show or Save Your Plots
```
>>> show(p1)          >>> show(layout)
>>> save(p1)          >>> save(layout)
```