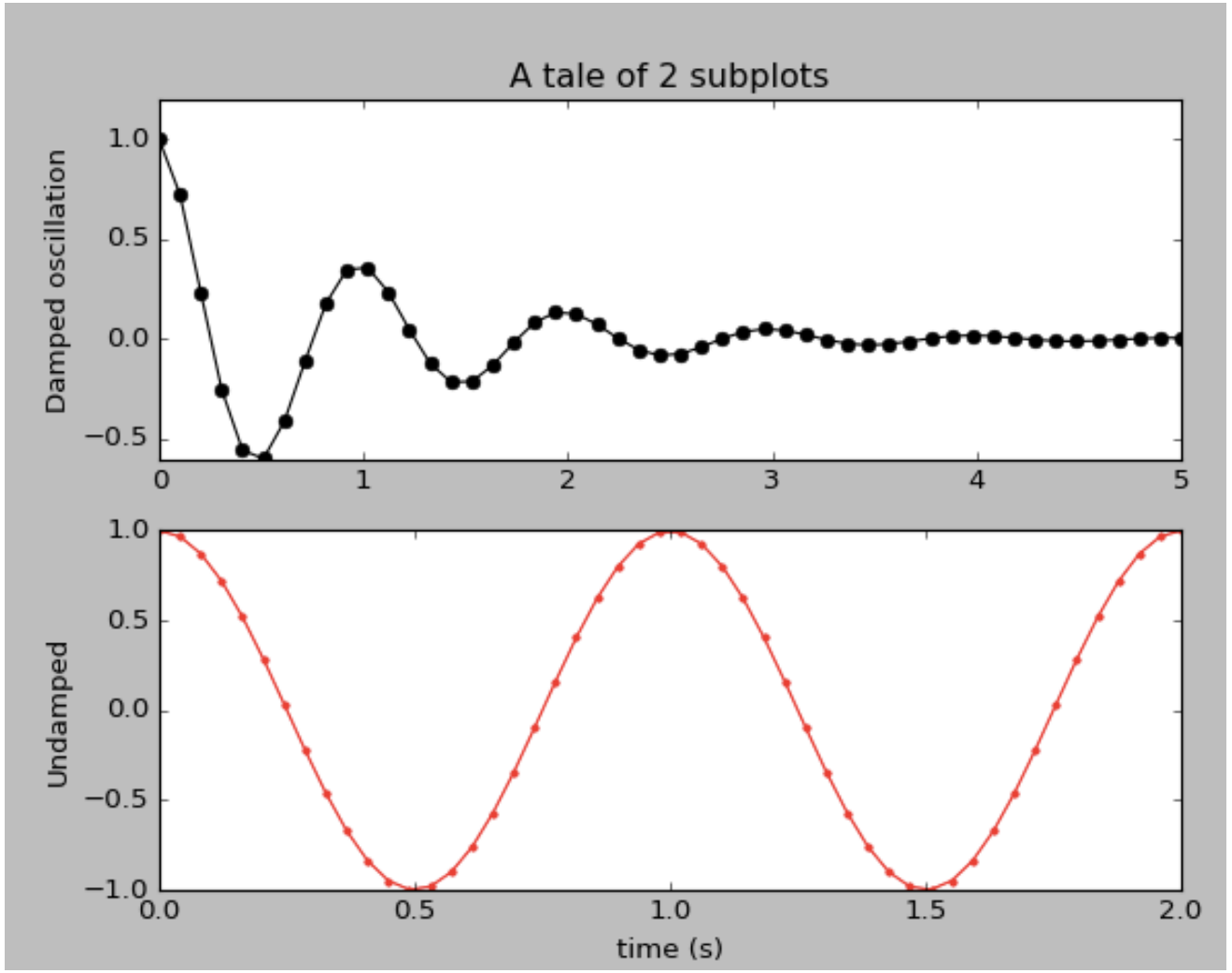
visualizations

Agenda

- **Matplotlib**
- Bokeh
- Tableau
- Final Project

Anatomy of a matplotlib plot



Anatomy of a matplotlib plot

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')
plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Import libraries

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
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plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Define 2 x-axis ranges in linear space

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
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plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Create 2 sinusoidal functions

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')
plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Plot subplot #1

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')
plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

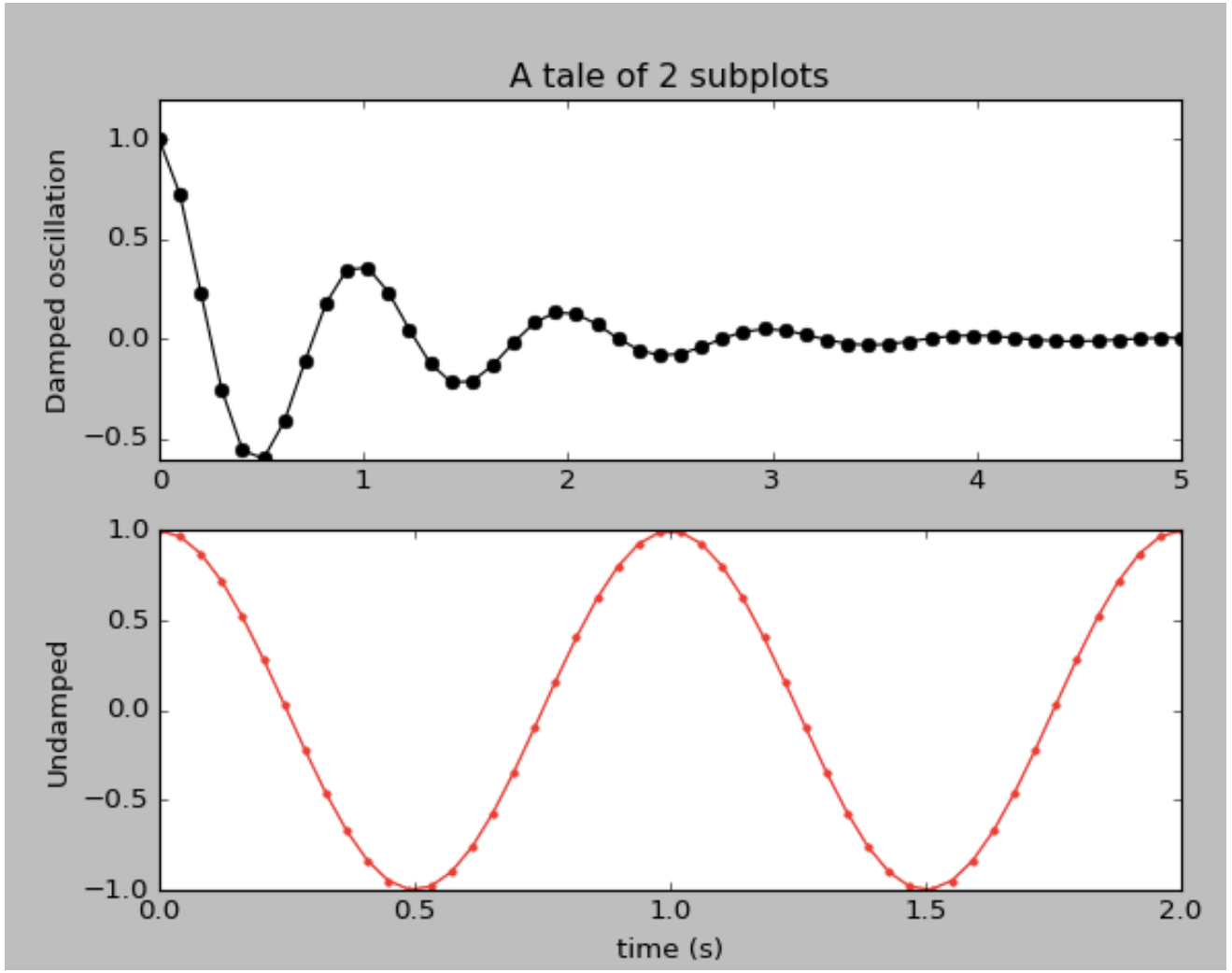
Plot subplot #2

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')
plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Finally: show it!

```
import numpy as np
import matplotlib.pyplot as plt
x1 = np.linspace(0.0, 5.0)
x2 = np.linspace(0.0, 2.0)
y1 = np.cos(2 * np.pi * x1) * np.exp(-x1)
y2 = np.cos(2 * np.pi * x2)
plt.subplot(2, 1, 1)
plt.plot(x1, y1, 'ko-')
plt.title('A tale of 2 subplots')
plt.ylabel('Damped oscillation')
plt.subplot(2, 1, 2)
plt.plot(x2, y2, 'r.-')
plt.xlabel('time (s)')
plt.ylabel('Undamped')
plt.show()
```

Anatomy of a matplotlib plot



Agenda

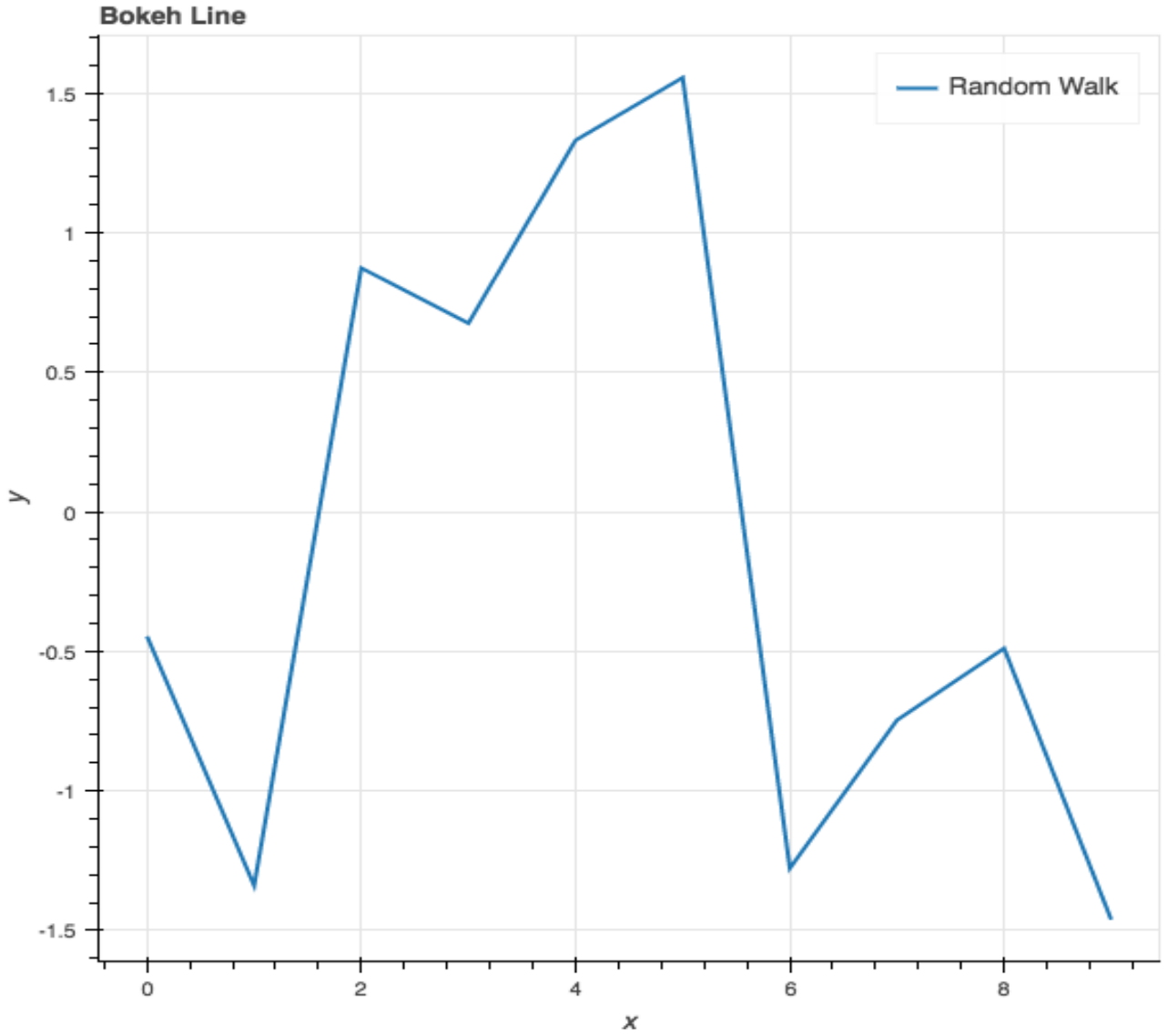
- Matplotlib
- **Bokeh**
- Tableau
- Final Project

Bokeh: web interactive display

Creates interactive visualization for web presentation.

- In the style of D3.js
- High-performance interactivity over very large or streaming datasets
- Quick creation of plots, dashboards, data apps

Anatomy of a Simple Bokeh App



Anatomy of a Simple Bokeh App

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
b = np.random.randn(10)
output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```

Import the libraries

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
b = np.random.randn(10)
output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```

Define the x and y ranges

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
b = np.random.randn(10)
output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```

Define name of the HTML file

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
b = np.random.randn(10)
output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```

Create the actual figure

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
b = np.random.randn(10)
output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```

Finally, show it!

```
import numpy as np
from bokeh.plotting import figure, output_file, show
a = np.arange(10)
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output_file("lines.html")
p = figure(title="Bokeh Line", x_axis_label='x', y_axis_label='y')
p.line(a, b, legend="Random Walk", line_width=2)
show(p)
```
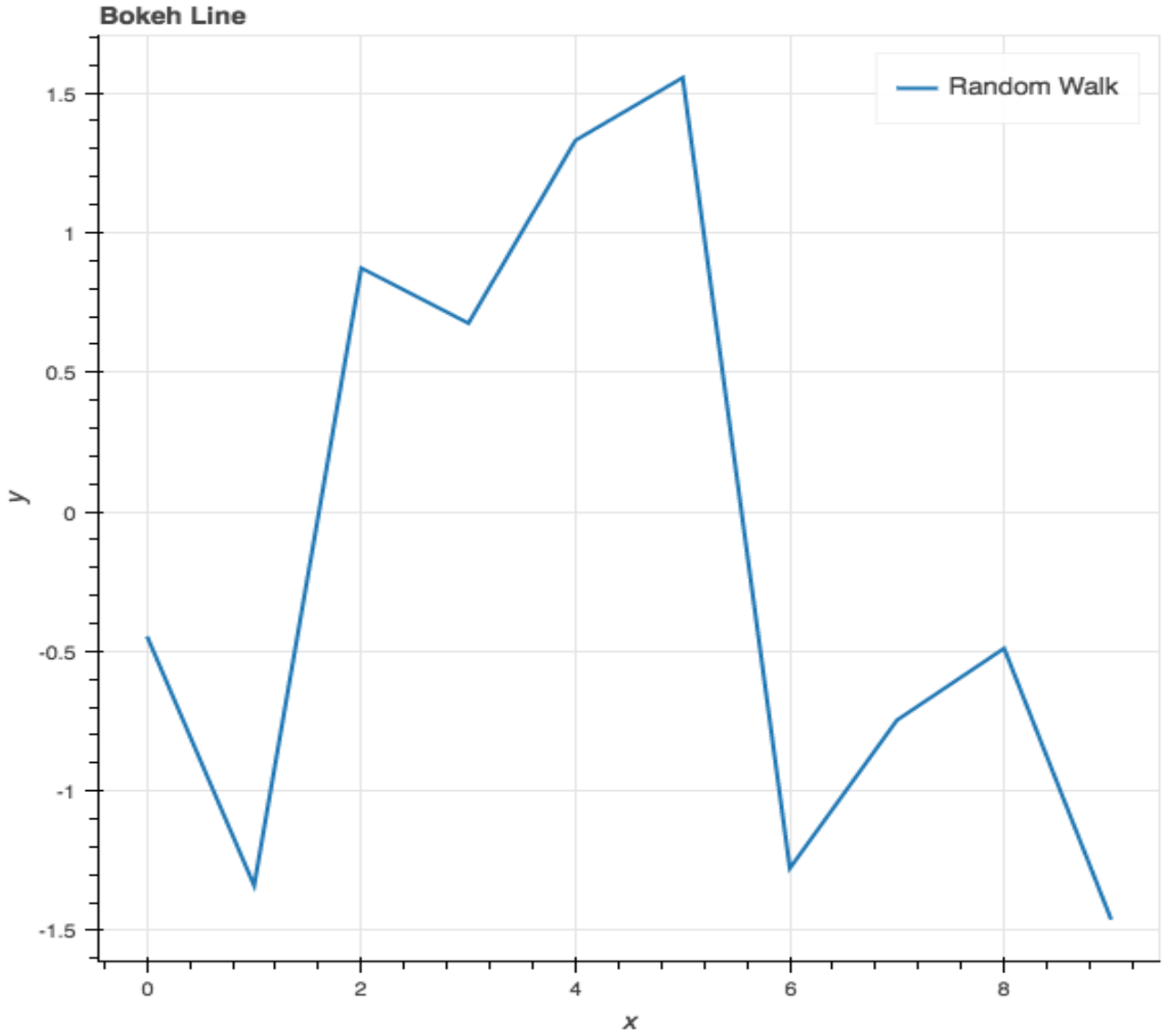
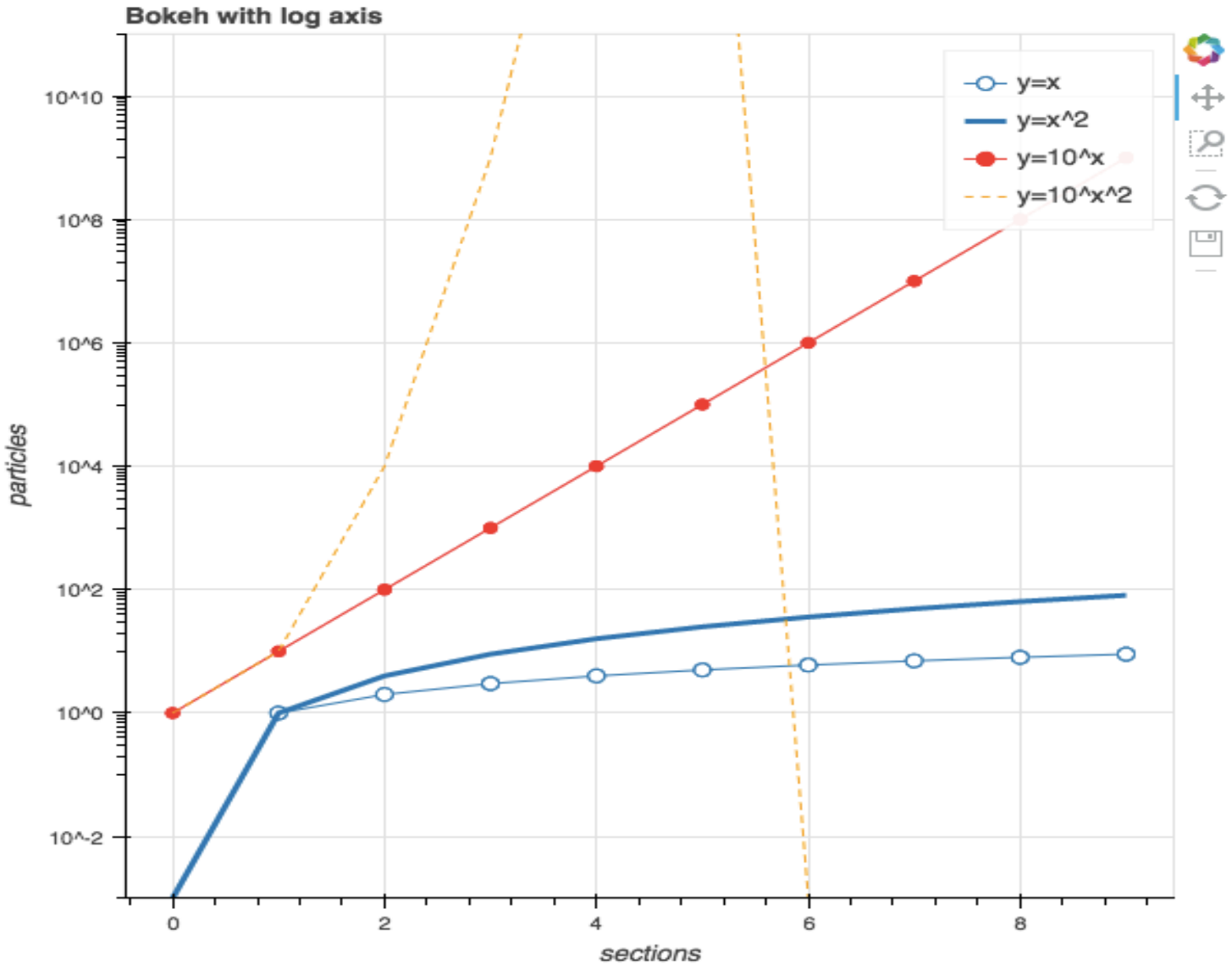

Anatomy of a Simple Bokeh App



Anatomy of an Interactive Bokeh App



Anatomy of an Interactive Bokeh App

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
y2 = [10**(i**2) for i in x]
output_file("loglines.html")
p = figure(tools="pan,box_zoom,reset,save", y_axis_type="log",
           y_range=[0.001, 10**11], title="Bokeh with log axis",
           x_axis_label='sections', y_axis_label='particles')
p.line(x, x, legend="y=x")
p.circle(x, x, legend="y=x", fill_color="white", size=8)
p.line(x, y0, legend="y=x^2", line_width=3)
p.line(x, y1, legend="y=10^x", line_color="red")
p.circle(x, y1, legend="y=10^x",
           fill_color="red", line_color="red", size=6)
p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Define x-range

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
y2 = [10**(i**2) for i in x]
output_file("loglines.html")
p = figure(tools="pan,box_zoom,reset,save", y_axis_type="log",
           y_range=[0.001, 10**11], title="Bokeh with log axis",
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p.line(x, x, legend="y=x")
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p.line(x, y1, legend="y=10^x", line_color="red")
p.circle(x, y1, legend="y=10^x",
           fill_color="red", line_color="red", size=6)
p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Define 3 separate functions in terms of x

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
y2 = [10**(i**2) for i in x]
output_file("loglines.html")
p = figure(tools="pan,box_zoom,reset,save", y_axis_type="log",
           y_range=[0.001, 10**11], title="Bokeh with log axis",
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p.line(x, x, legend="y=x")
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p.line(x, y0, legend="y=x^2", line_width=3)
p.line(x, y1, legend="y=10^x", line_color="red")
p.circle(x, y1, legend="y=10^x",
           fill_color="red", line_color="red", size=6)
p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Specify name of output HTML file

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
y2 = [10**(i**2) for i in x]
output_file("loglines.html")
p = figure(tools="pan,box_zoom,reset,save", y_axis_type="log",
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p.circle(x, y1, legend="y=10^x",
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p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Specify the exact set of “tools” on graph

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
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output_file("loglines.html")
p = figure(tools="pan,box_zoom,reset,save", y_axis_type="log",
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p.circle(x, y1, legend="y=10^x",
           fill_color="red", line_color="red", size=6)
p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Actually creating the 3 separate graphs

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
y2 = [10**(i**2) for i in x]
output_file("loglines.html")
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p.circle(x, y1, legend="y=10^x",
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p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```

Finally, show it!

```
x = np.arange(10)
y0 = [i**2 for i in x]
y1 = [10**i for i in x]
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p.line(x, y1, legend="y=10^x", line_color="red")
p.circle(x, y1, legend="y=10^x",
           fill_color="red", line_color="red", size=6)
p.line(x, y2, legend="y=10^x^2",
           line_color="orange", line_dash="4 4")
show(p)
```
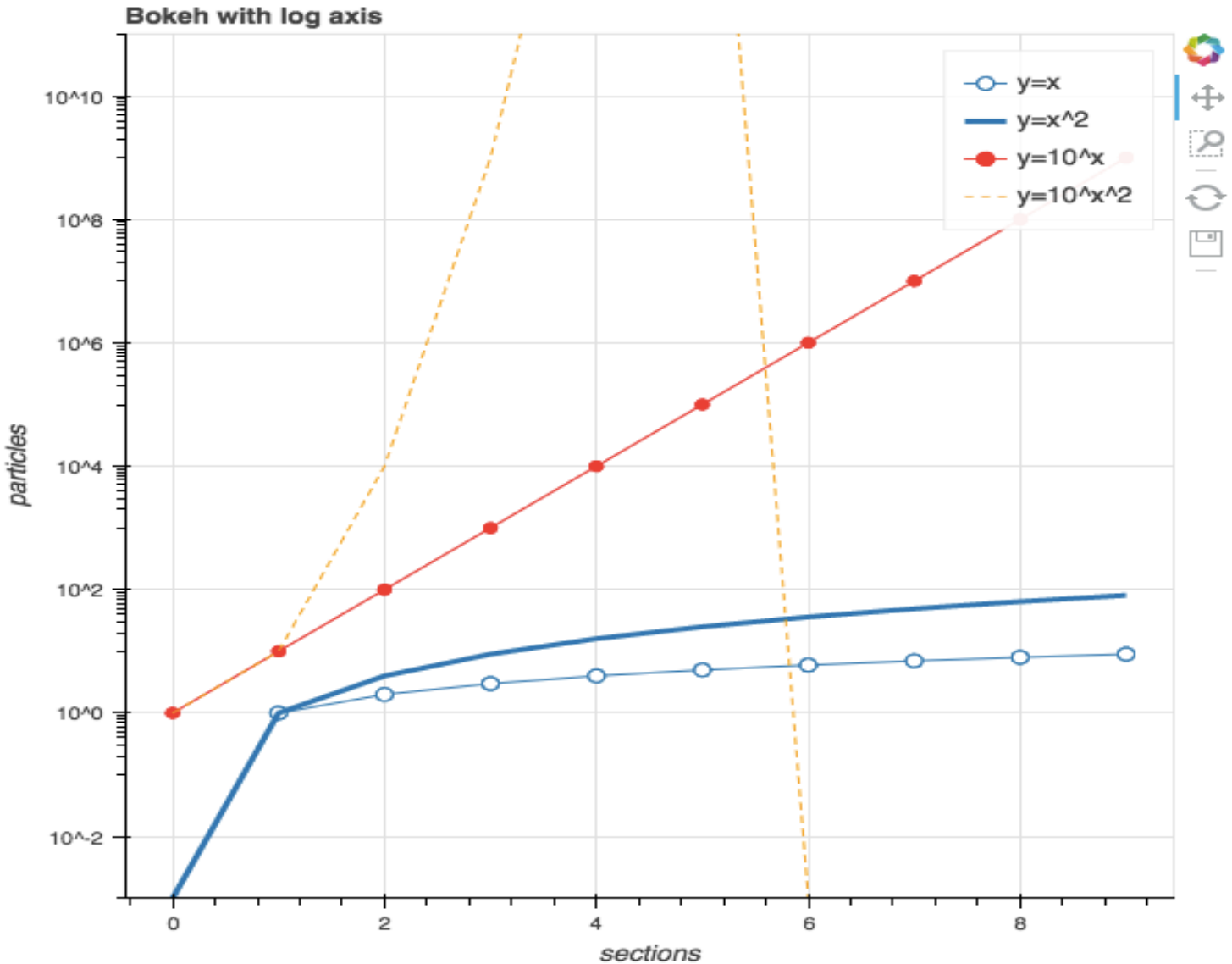

Anatomy of an Interactive Bokeh App



Agenda

- Matplotlib
- Bokeh
- **Tableau**
- Final Project

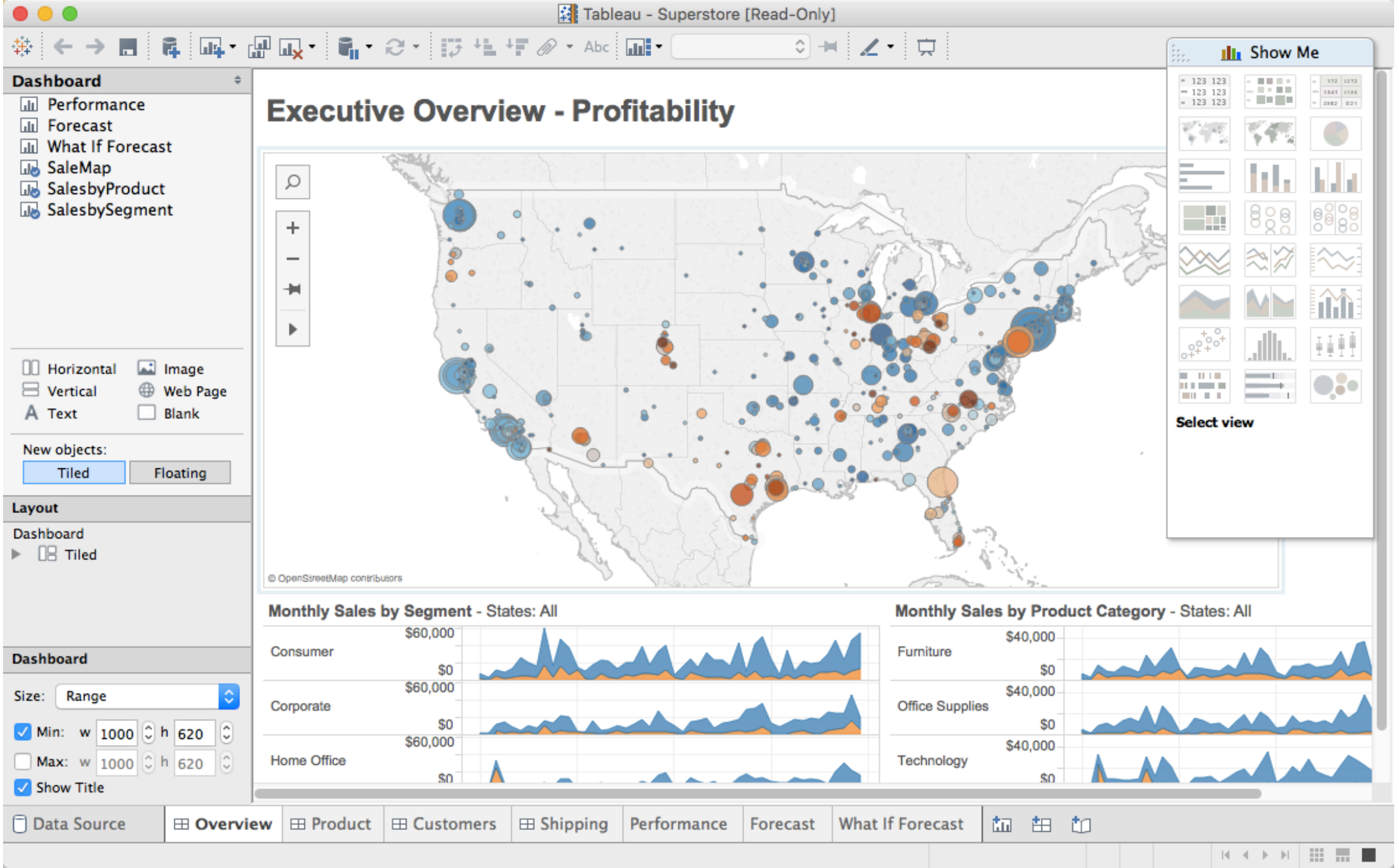


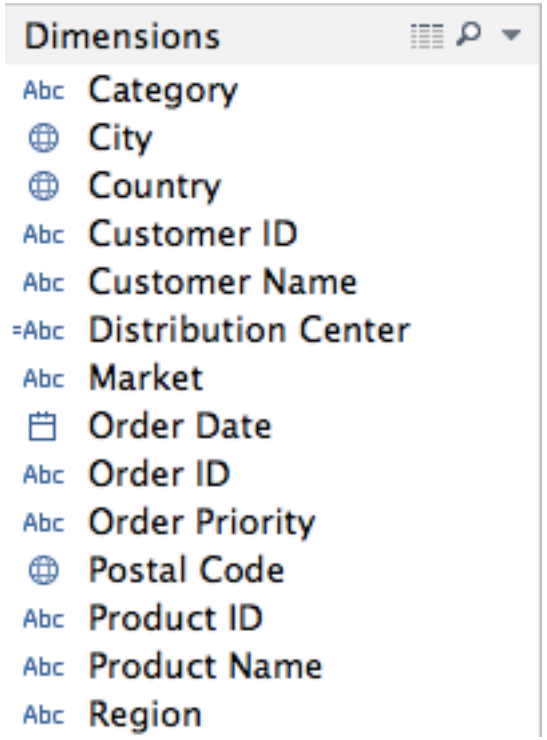
Tableau - Superstore [Read-Only]
Dashboard
Performance
Forecast
What If Forecast
SaleMap
SalesbyProduct
SalesbySegment
Horizontal
Vertical
Text
Image
Web Page
Blank
New objects:
Tiled
Floating
Layout
Dashboard
Tiled
Dashboard
Size:
Range
Min: w 1000 h 620
Max: w 1000 h 620
Show Title
Executive Overview - Profitability
© OpenStreetMap contributors
Show Me
Select view
Monthly Sales by Segment - States: All
Consumer
Corporate
Home Office
$60,000
$0
Monthly Sales by Product Category - States: All
Furniture
Office Supplies
Technology
$40,000
$0
Data Source
Overview
Product
Customers
Shipping
Performance
Forecast
What If Forecast

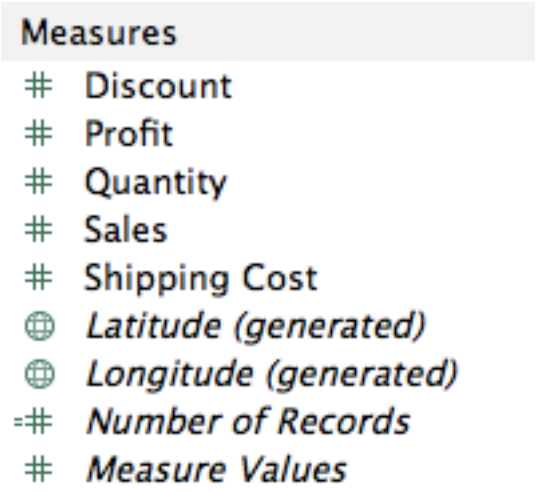
Data Ingestion

- Joins: inner, left, right, full
- Extract – Transform – Load (ETL)
- Field Transformation
- Live / Extract
- Filtering
- Large dataset & role of Tableau

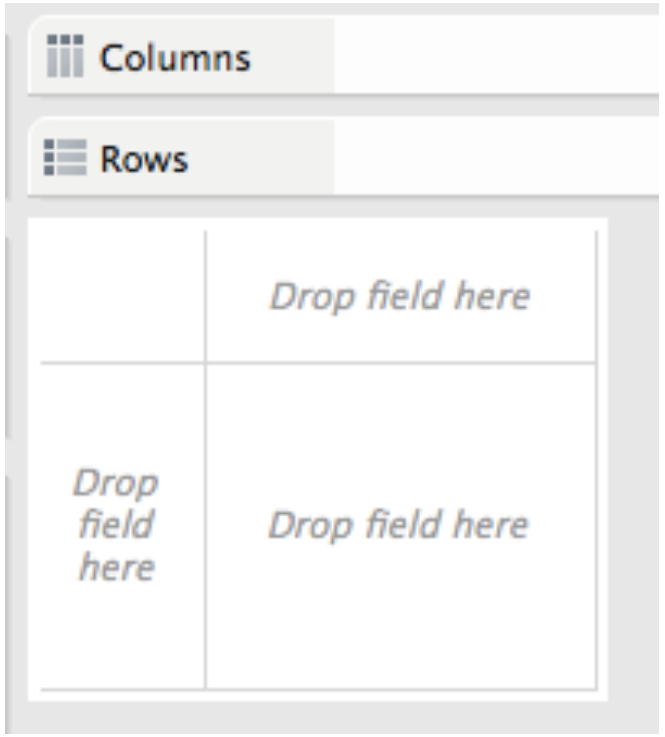
Dimensions & Measures

- Dimensions : categorical
- Measures : numerical

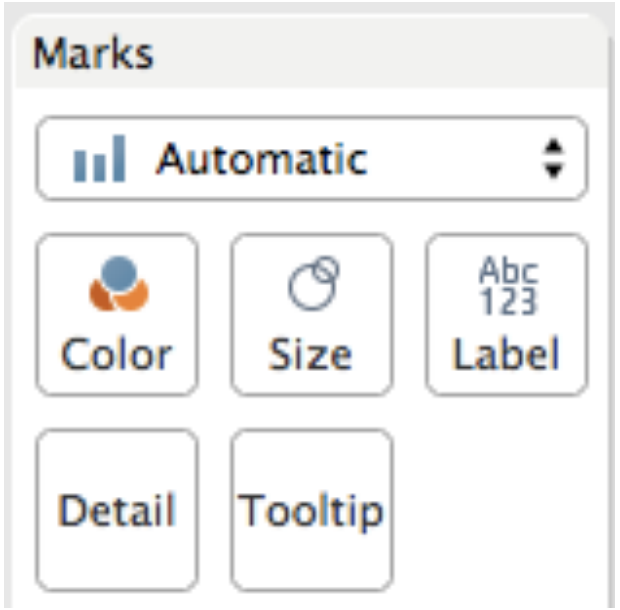




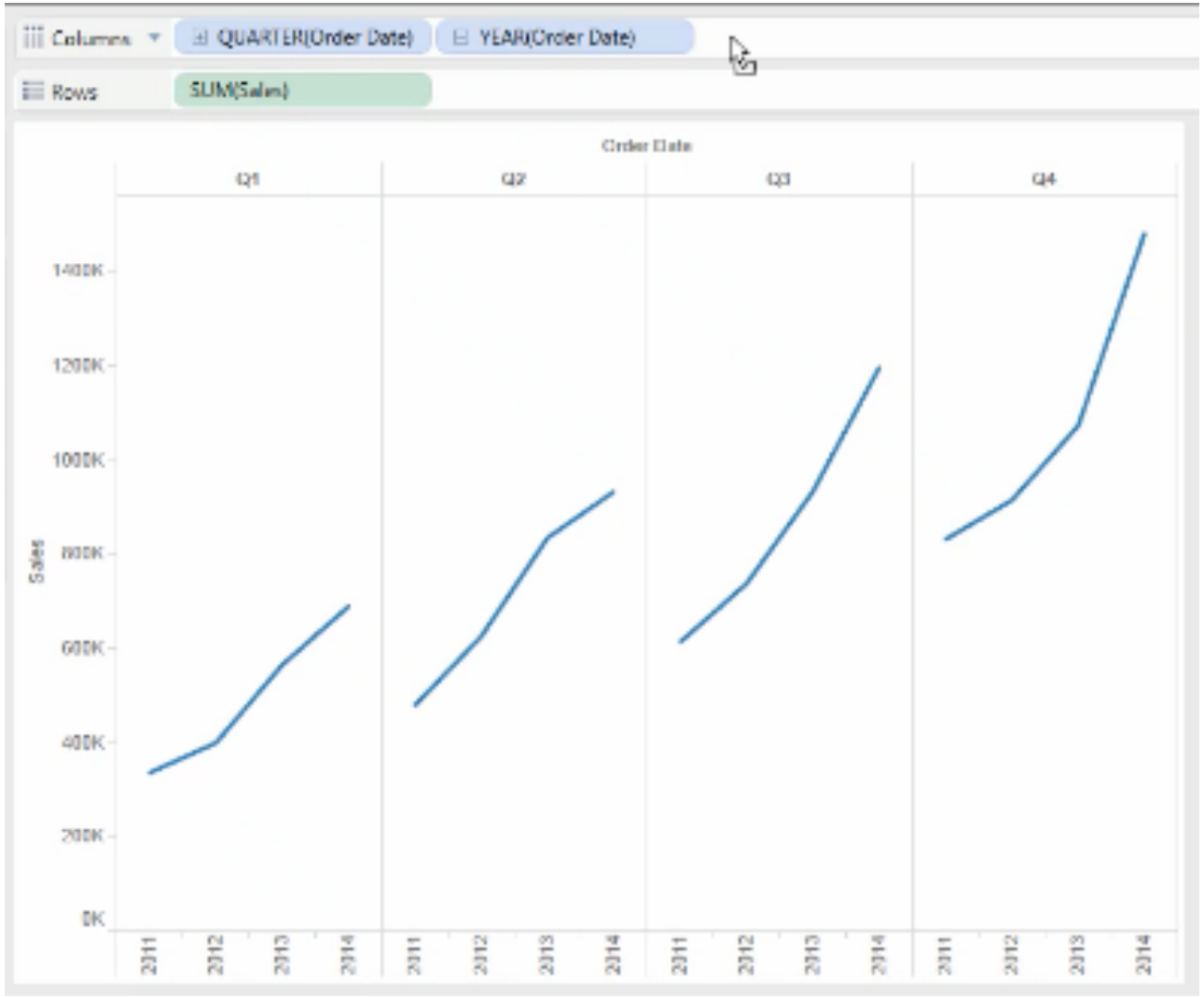
Rows & Columns



Marks



Multi-level Analysis



Group Exercise

- Load the “global_superstore.xls” dataset into Tableau
- Answer the following questions:
  1. Which region has the highest sales?
  2. For (1), which product segment for that region has the highest sales?
  3. Regardless of region, which product segment in a given region has the highest sales?
- Take 15 min in your group to decide on extracting an interesting insight from this dataset to present to the class.

Agenda

- Matplotlib
- Bokeh
- Tableau
- **Final Project**

Your final project : guidelines

- Goal: **apply** what you have learned in this class to a realistic data science challenge + exercise your creativity + have fun!
- This is meant to be a significant **individual effort** to learn by practicing what you are learning to a real-world data science problem.
- The **writeup** of your final project is in the form of a Jupyter notebook and associated data – to be uploaded to the final project assignment in Camino.
- You are to submit your final notebook by September 3 @ 11:59pm.

Your final project : topic selection

- Goal: **apply** what you have learned in this class to a realistic data science challenge + exercise your creativity + have fun!
- You can choose any ”significant” data set via downloadable sites, APIs, or use any of the datasets from the class.
- You need to propose an interesting data insight investigation that you would like to explore, analyze the data, visualize the data, and finally write up your conclusion on what insights you have reached.
- Grading of your final project will be based on the following rubric.

Your final project : grading rubric

Area	Details	Grading %
Topic Selection	Did you create a reasonably interesting data insight hypothesis for your investigation?	10%
Packaging	Did you create a Jupyter project packaging that looks professional and understandable?	10%
Analysis Competence	Does your notebook show competence in using the data science tools we learned in class?	40%
Insight	Does your project show useful or interesting insights from the data analysis you have done?	40%