



# Data Visualization with matplotlib and seaborn

Bruno Gonçalves

*www.data4sci.com/newsletter*

<https://github.com/DataForScience/DataViz>

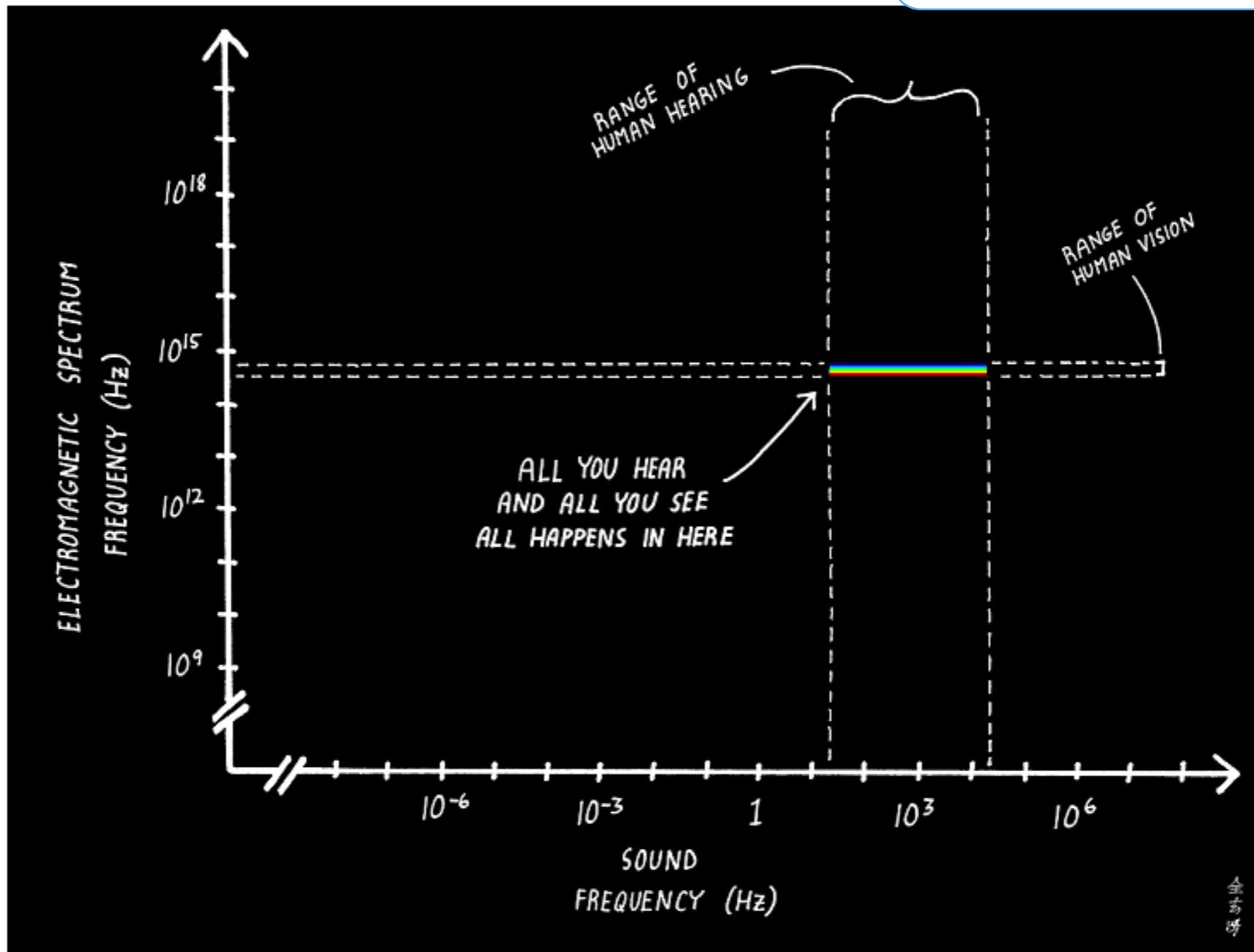




Human Perception

# Human Perception

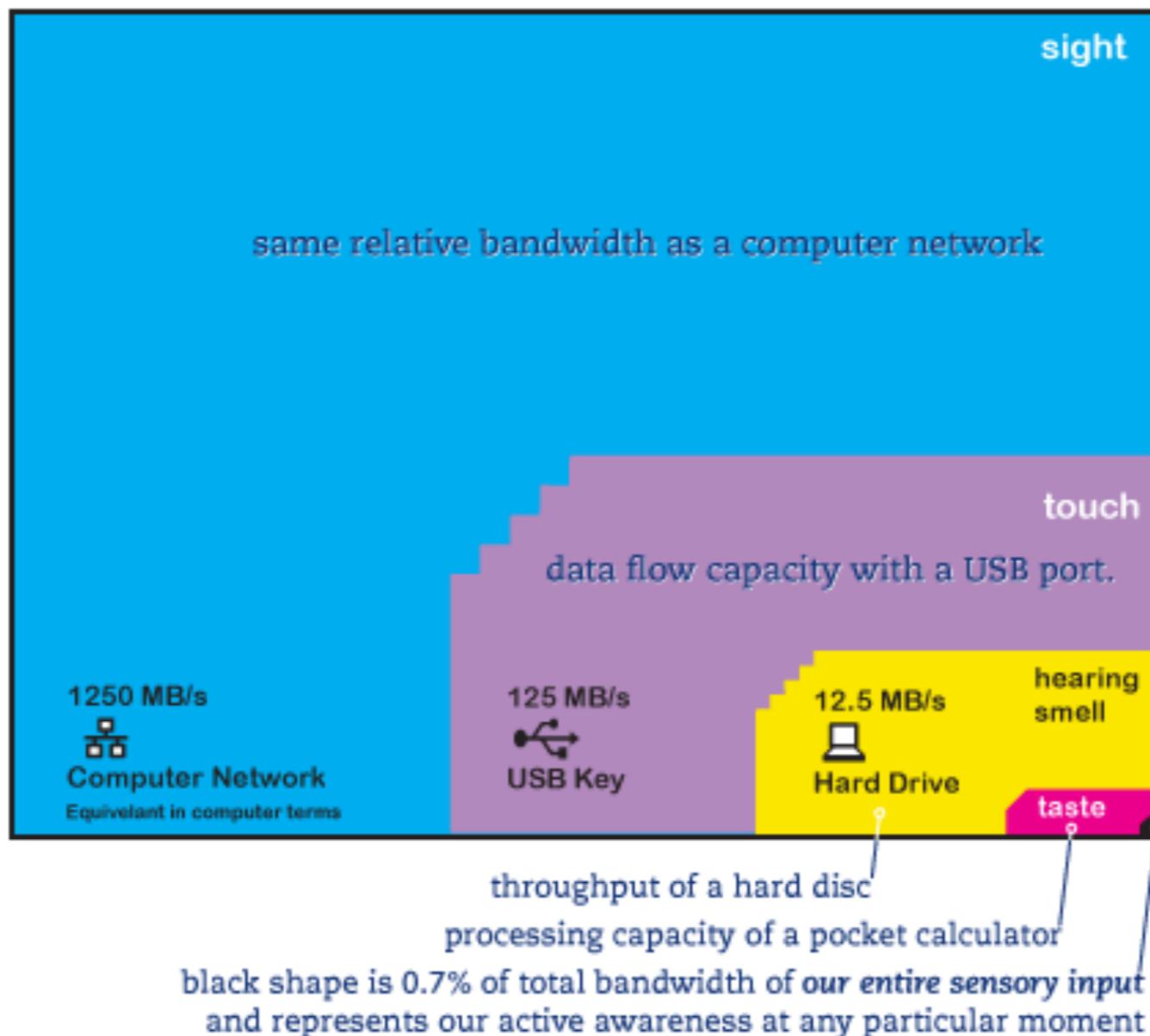
[abstrusegoose.com/421](http://abstrusegoose.com/421)



In the grand scheme of things,  
we're all pretty much blind and deaf.

# Human Senses

## NØRRETRANDERS BANDWIDTH OF THE SENSES



# Perception

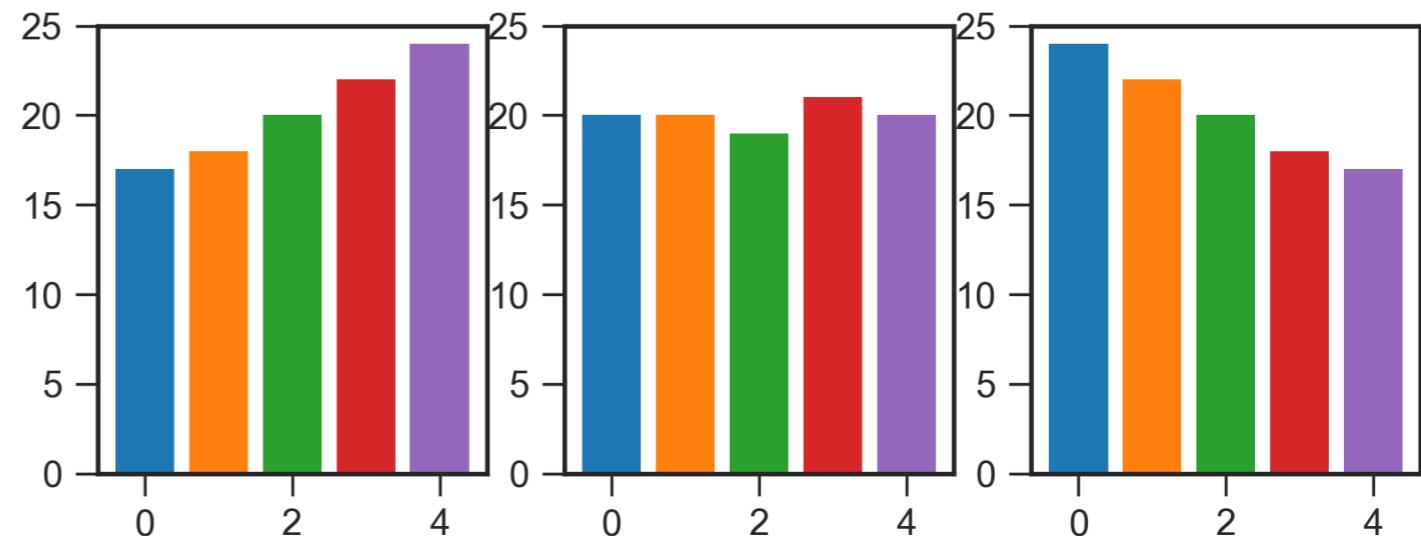
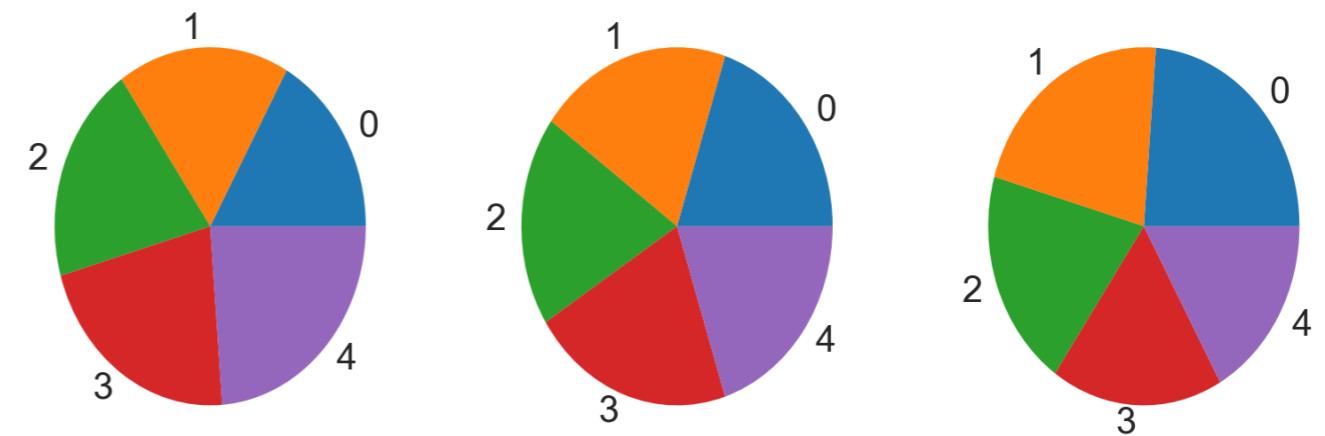
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- Some cognitive tasks are significantly easier than others. In order, we are good at distinguishing:
  - Position, length
  - Direction, Angle, Area
  - Volume, Curvature, Shade
  - Color Saturation.

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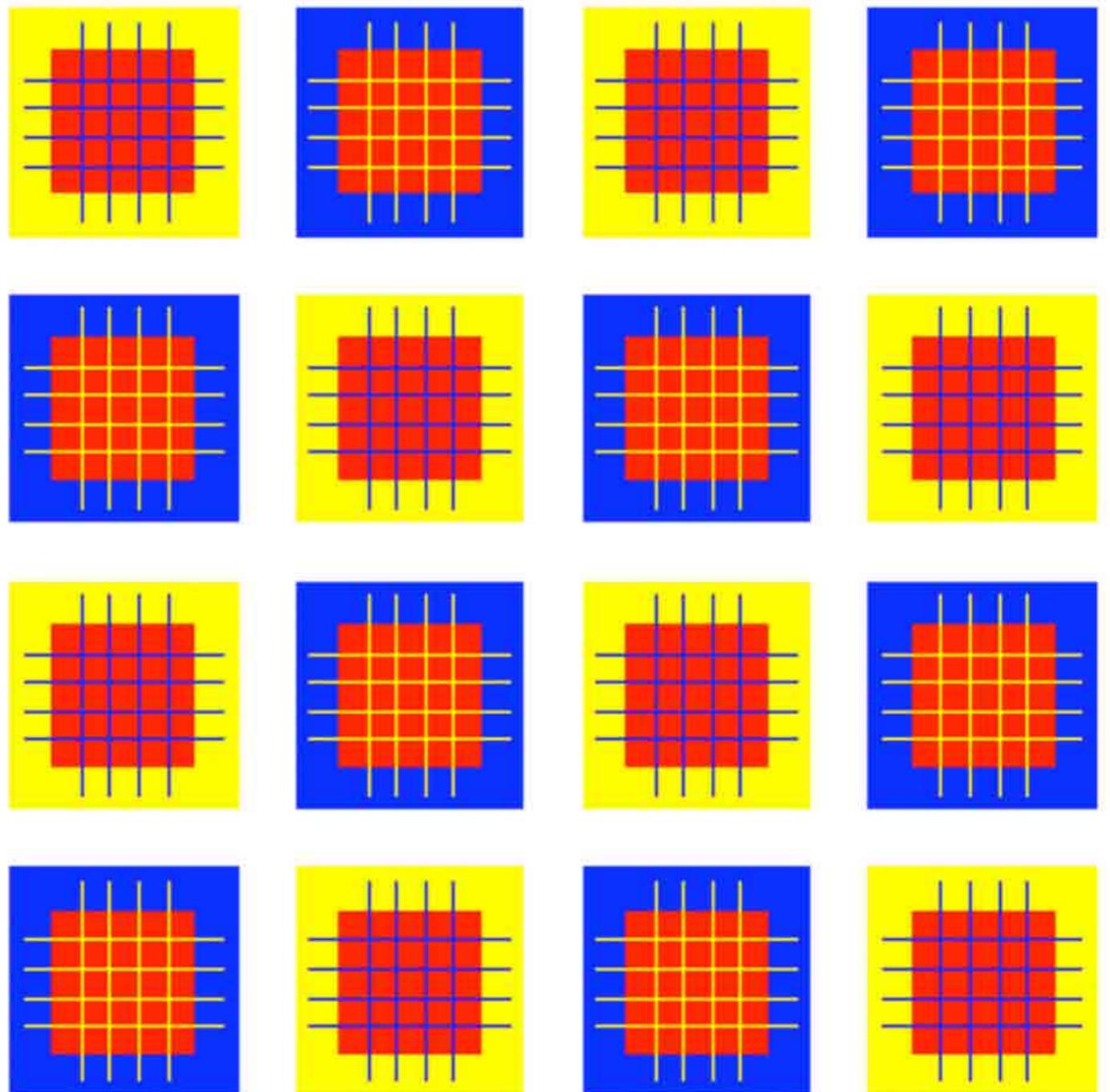
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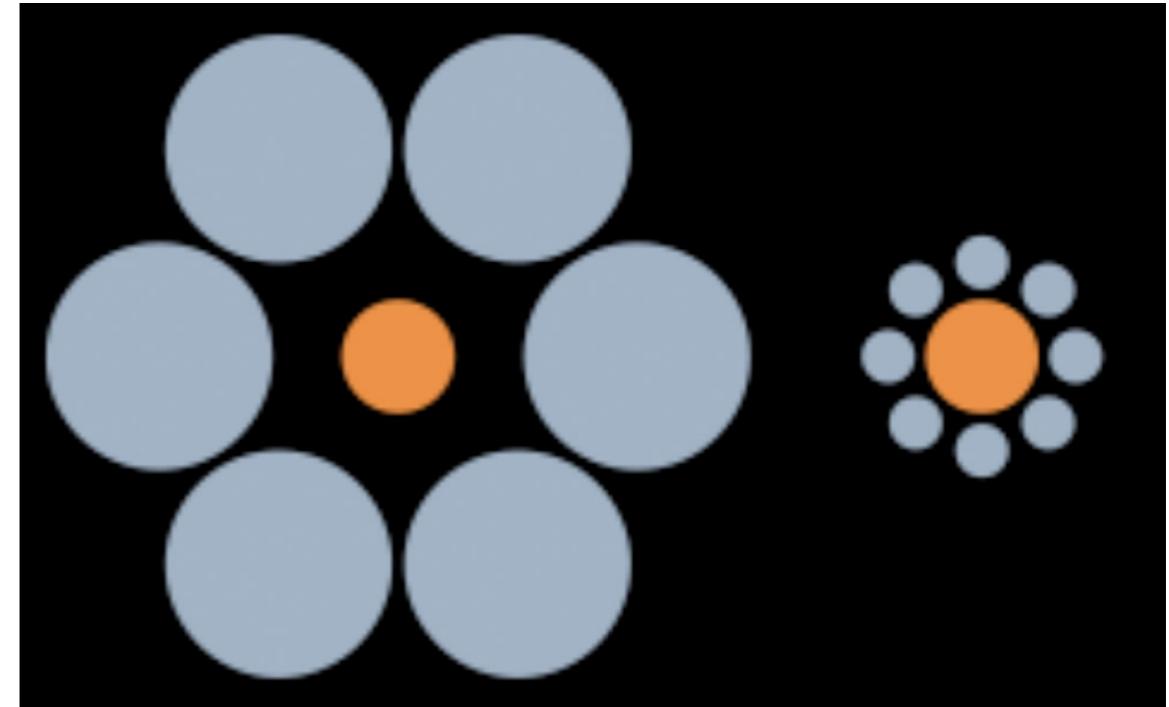
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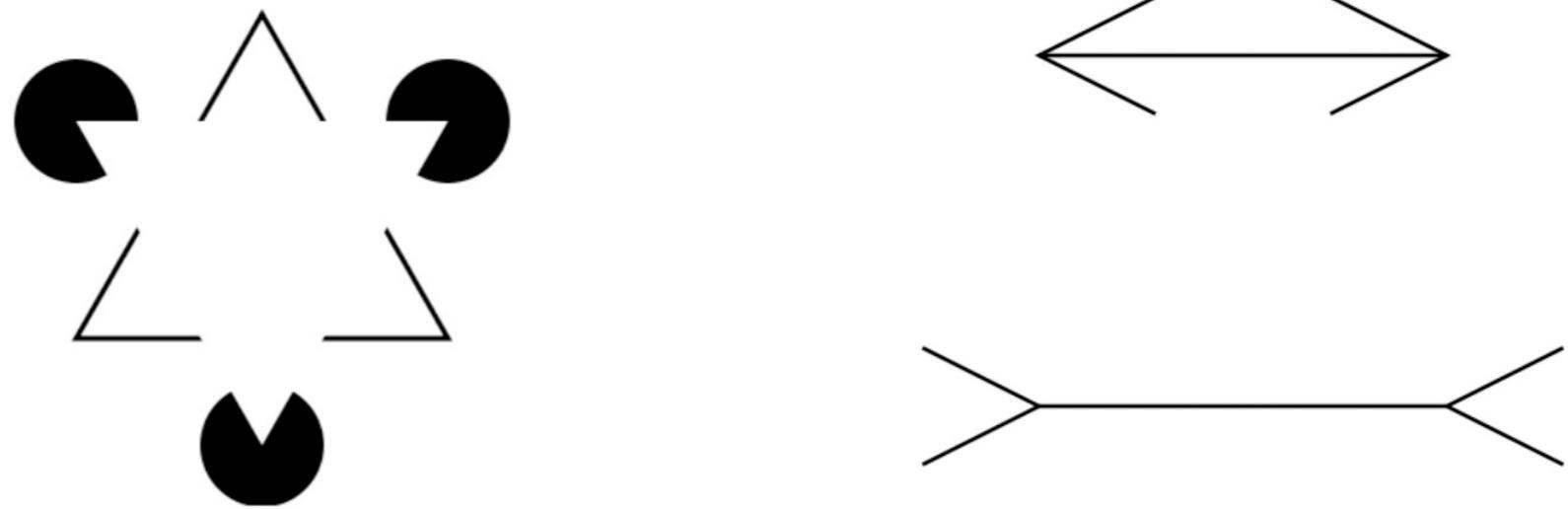
- Context also matters!

- An object seen in the context of larger objects will appear smaller, while in the context of smaller objects it will appear larger.
- And we "fill in the gaps"



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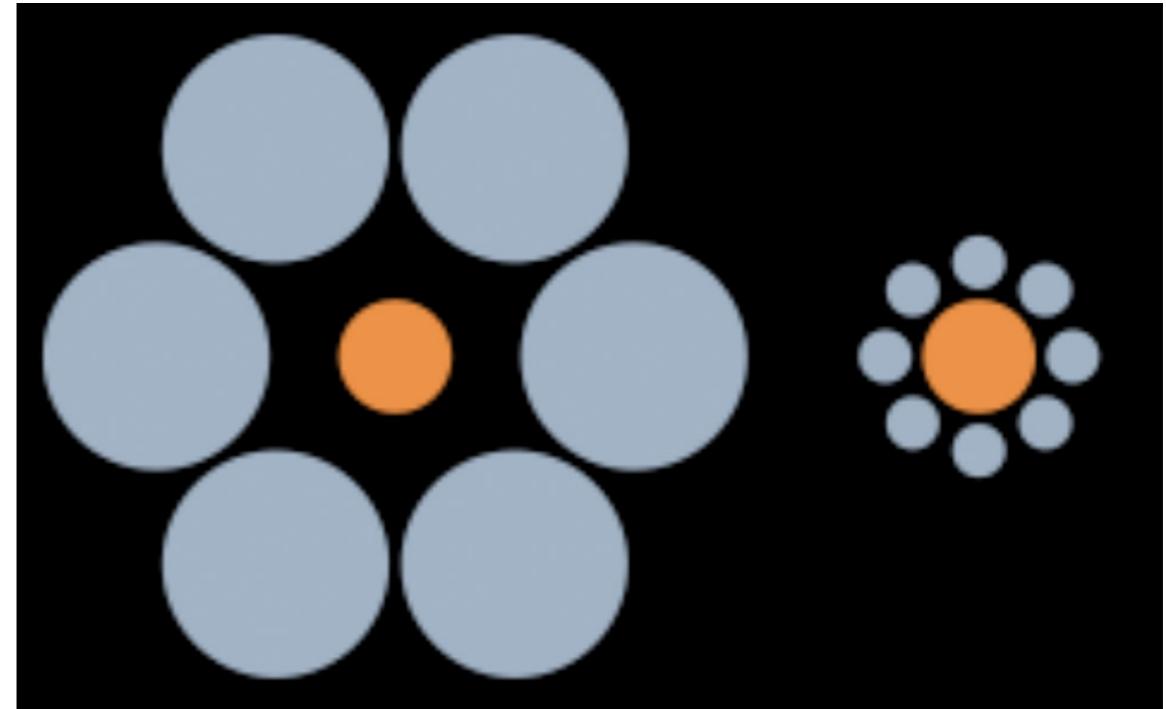
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# Perception

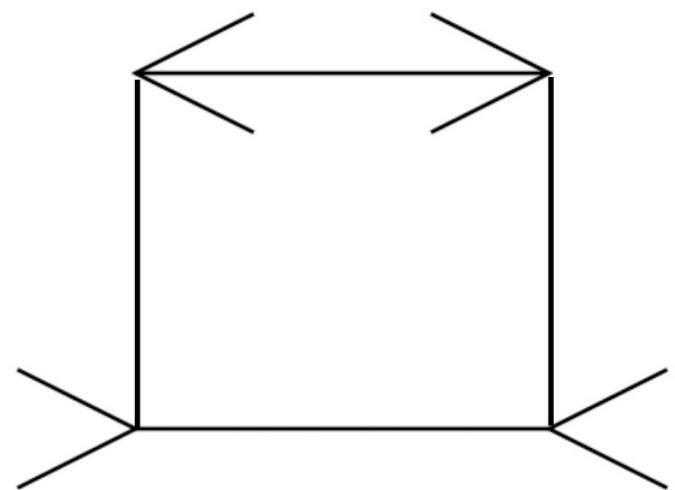
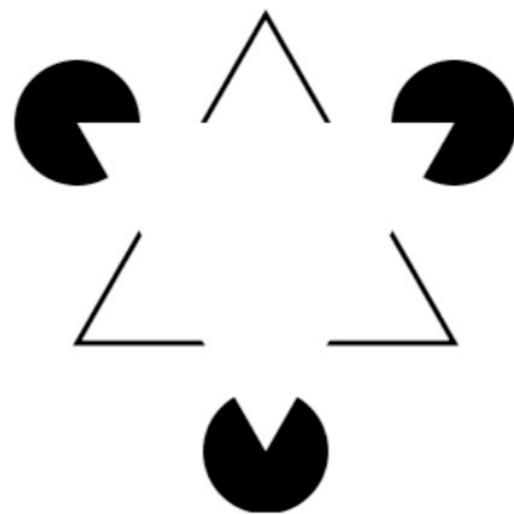
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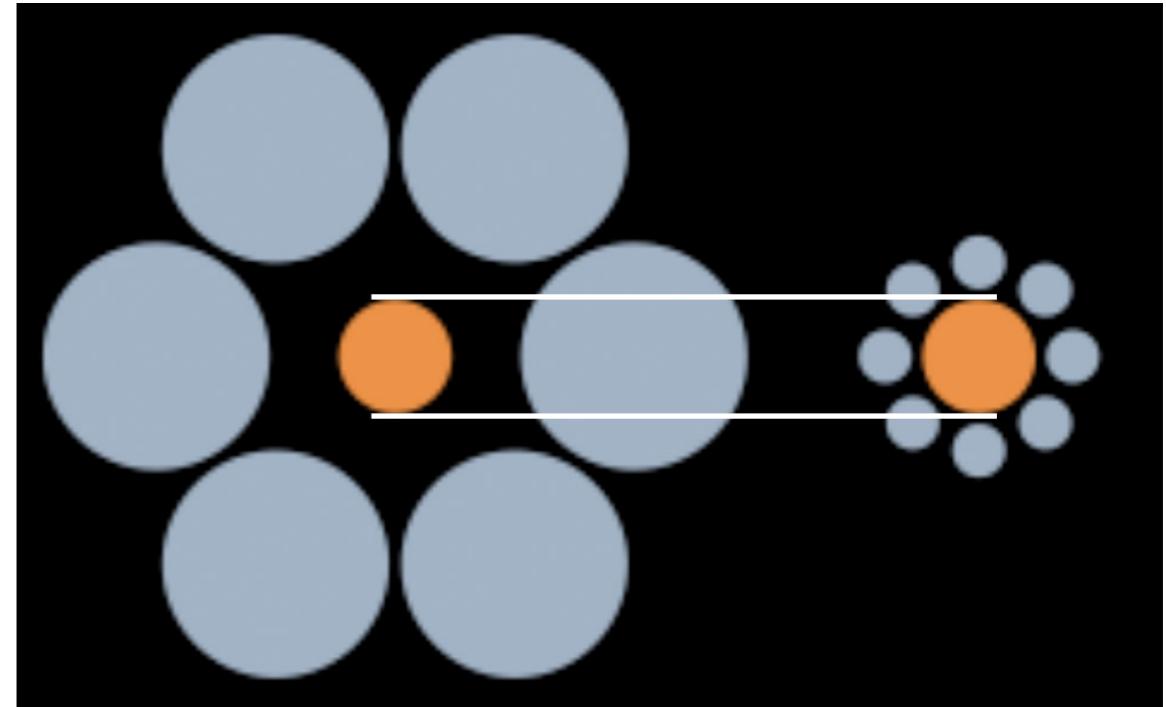
- Position, length
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# Perception

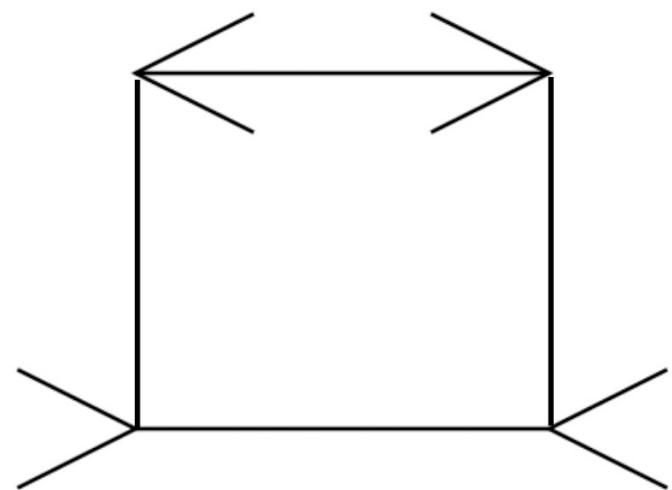
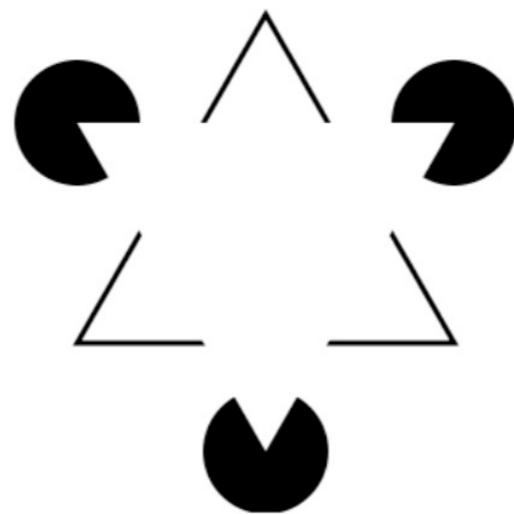
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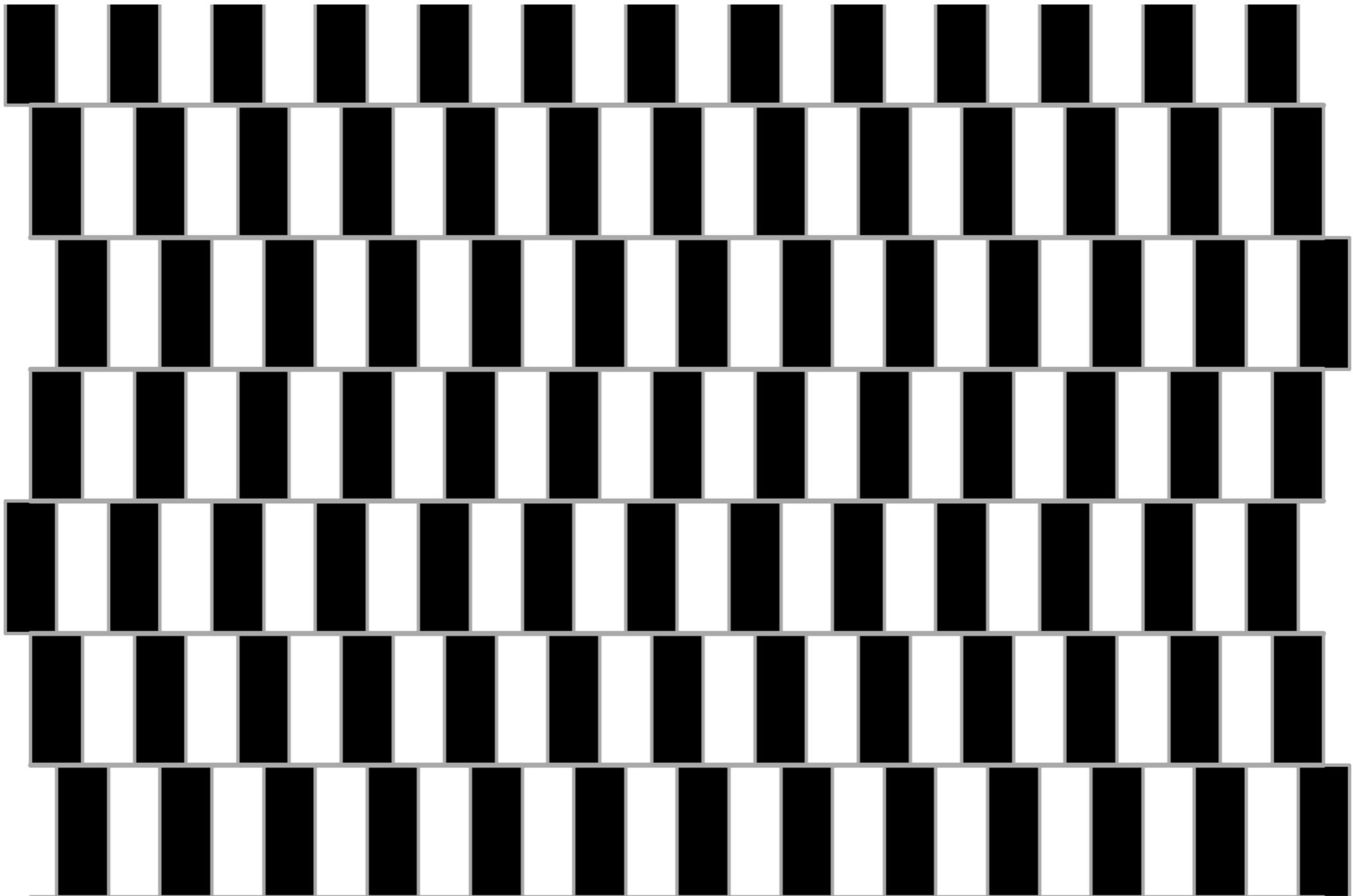


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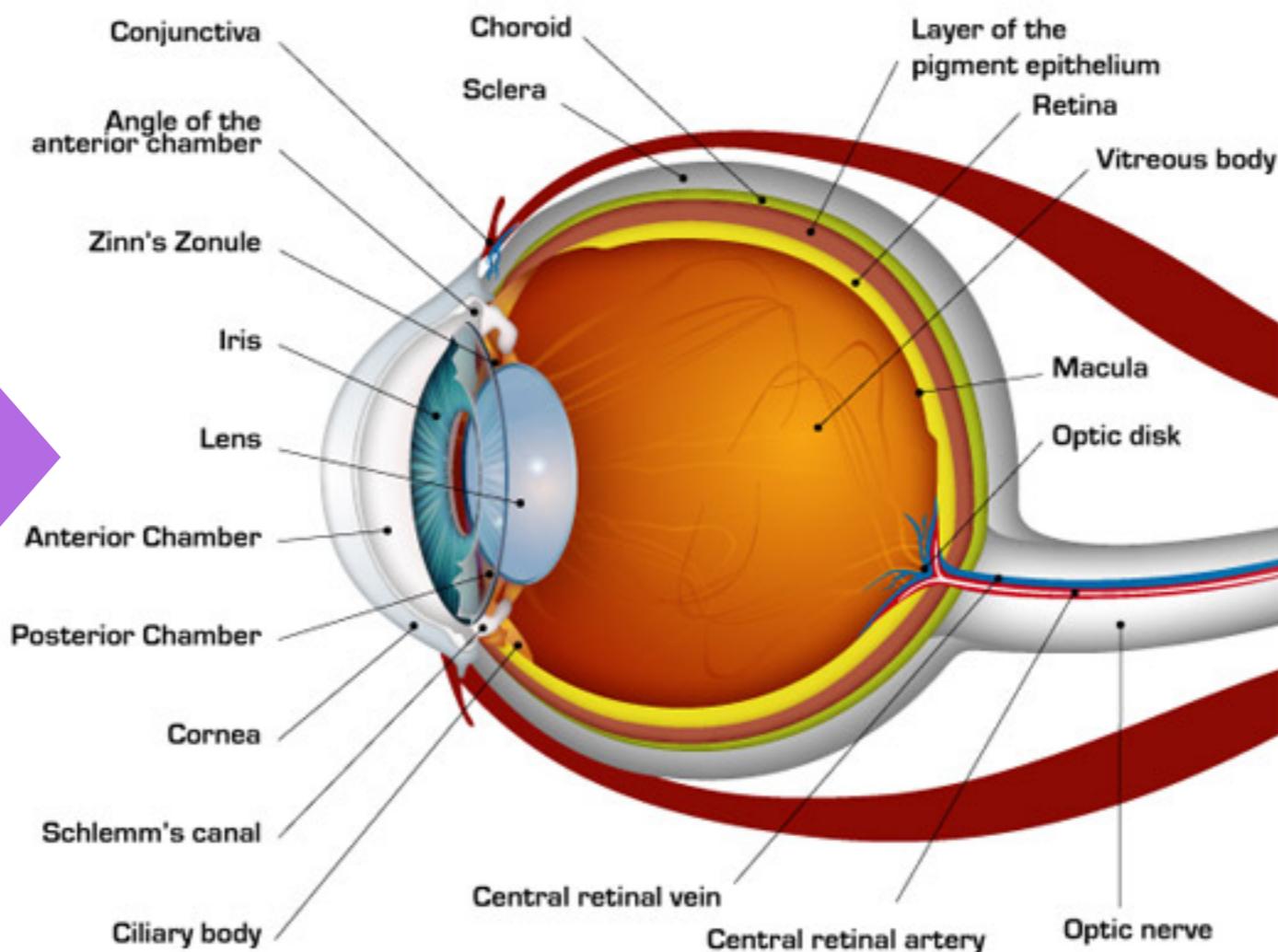
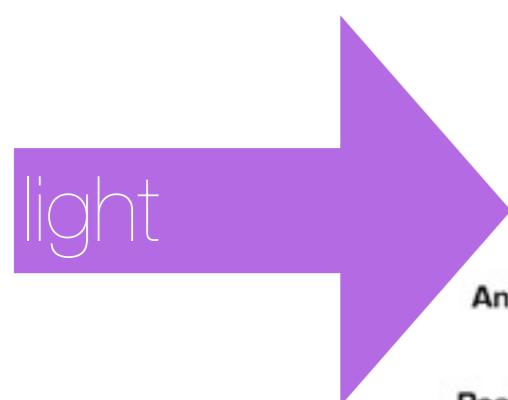


# Perception Biases



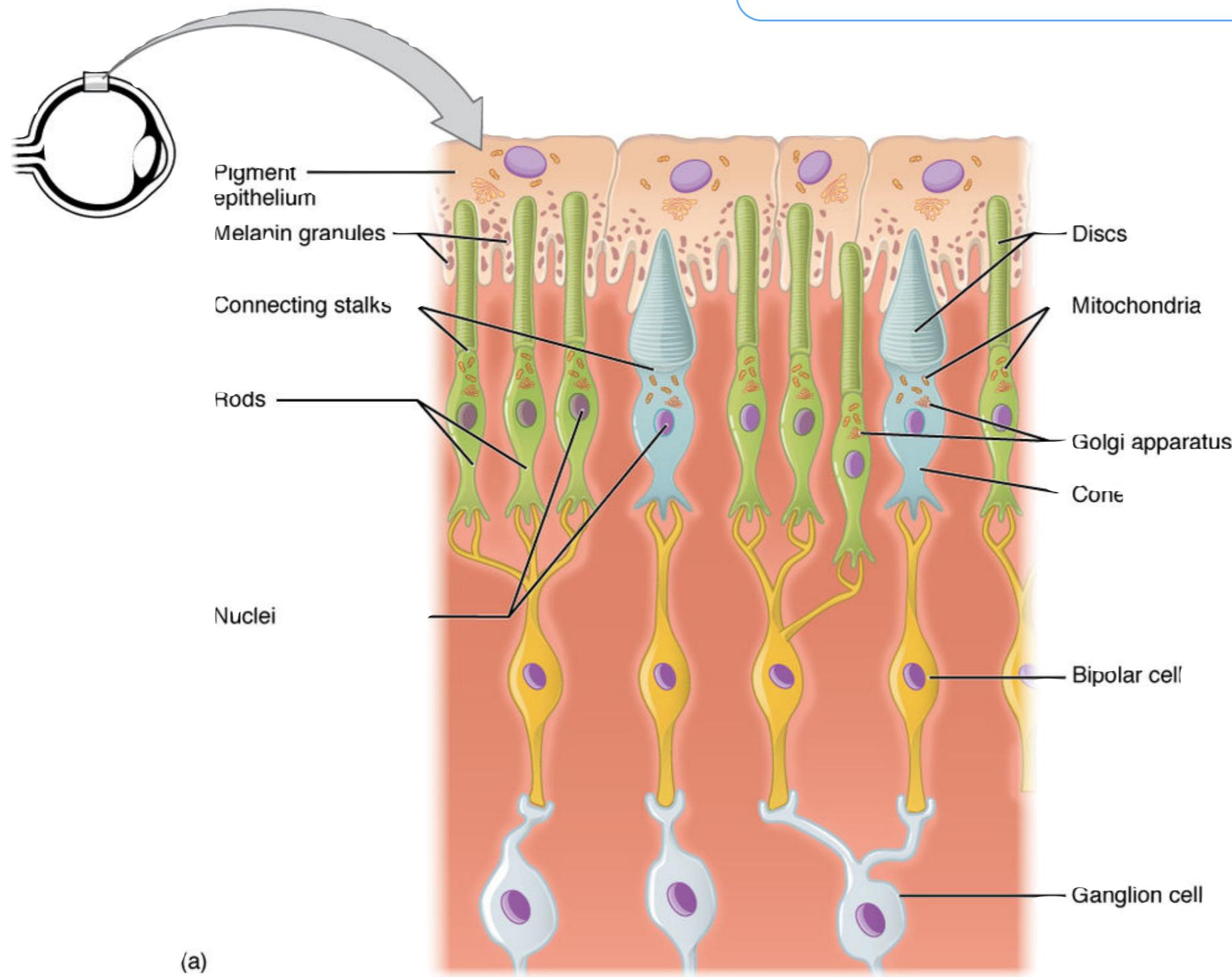
# Human Vision

[en.wikipedia.org/wiki/Photoreceptor\\_cell](https://en.wikipedia.org/wiki/Photoreceptor_cell)



# Human Vision

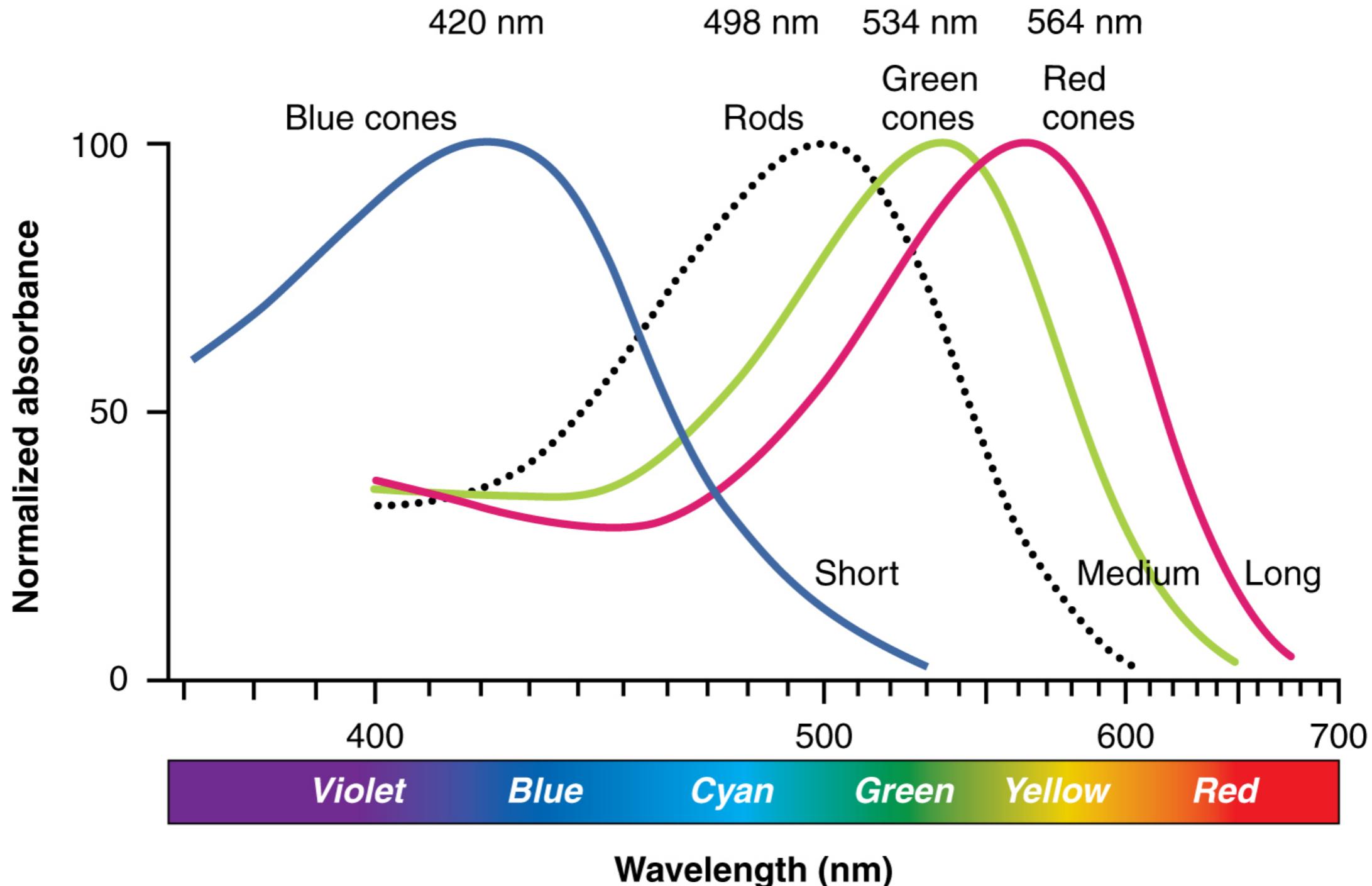
[en.wikipedia.org/wiki/Photoreceptor\\_cell](https://en.wikipedia.org/wiki/Photoreceptor_cell)

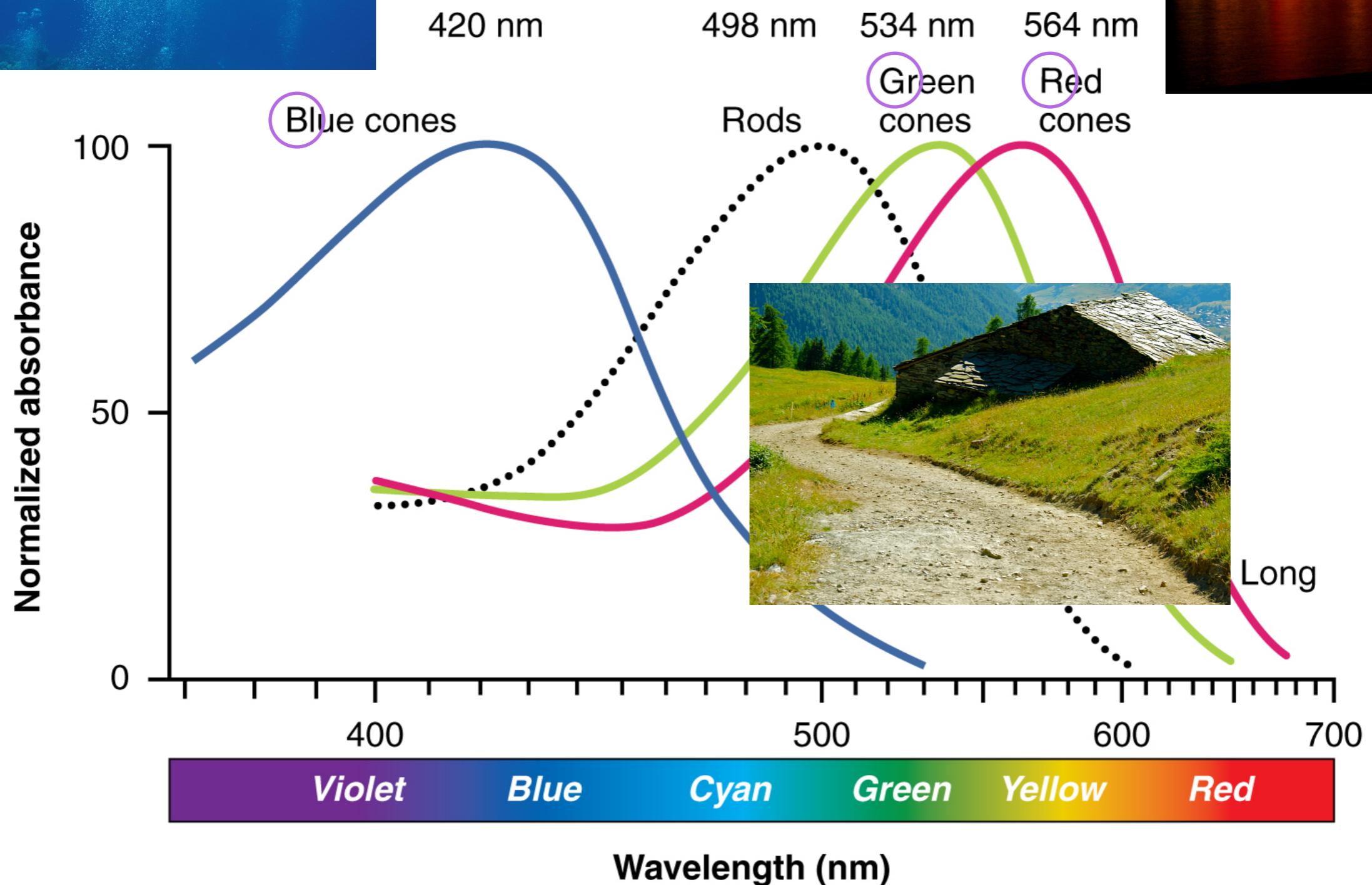


(a)

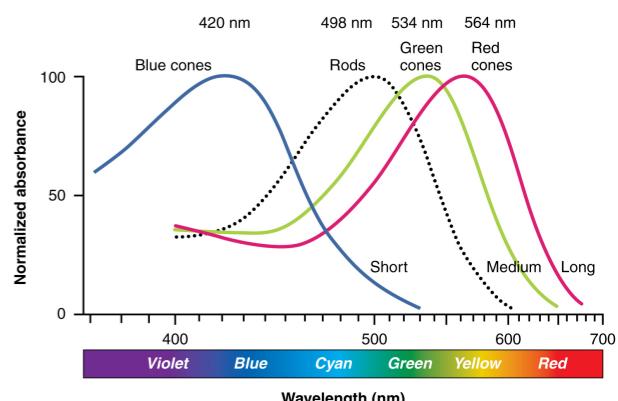
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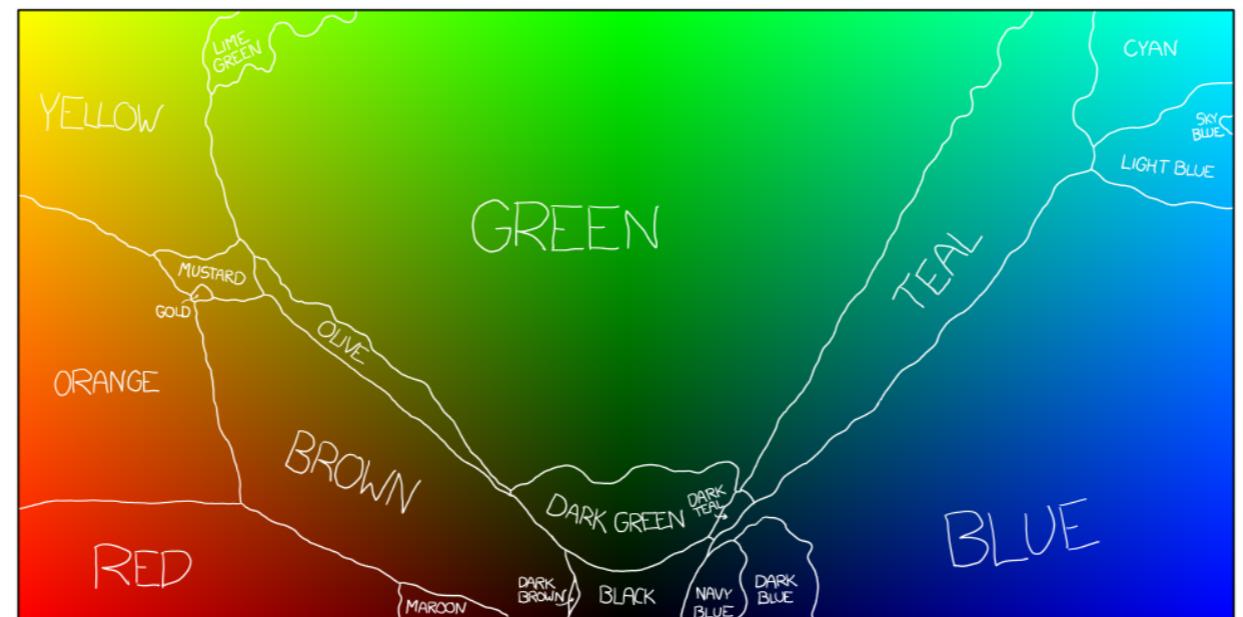
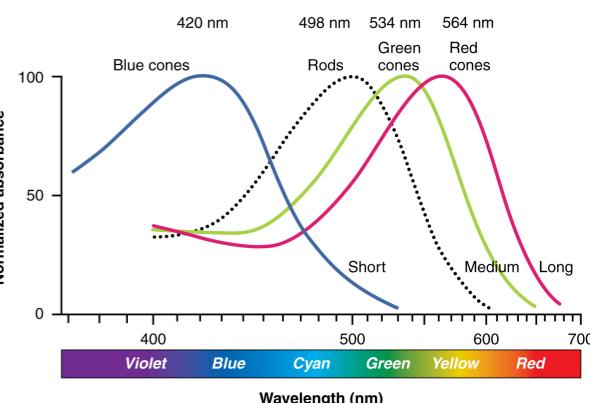




# Colors galore!

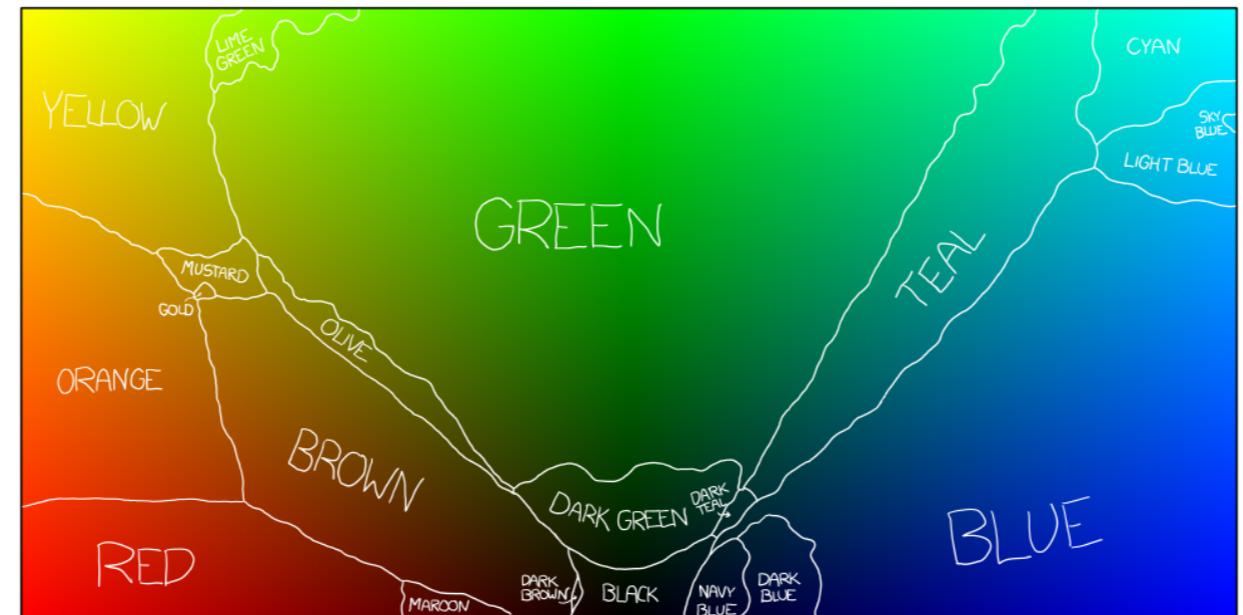
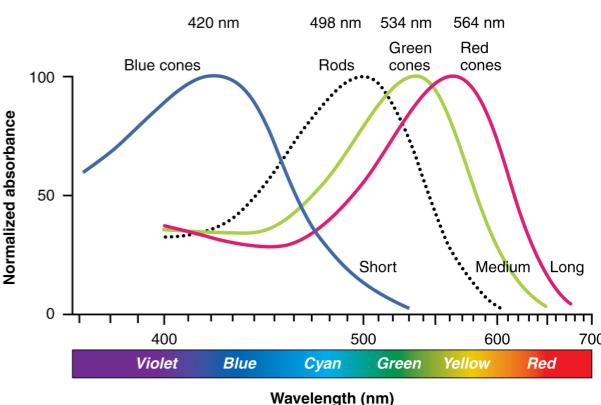


# Color Perception



THIS CHART SHOWS THE DOMINANT COLOR NAMES OVER THE THREE FULLY-SATURATED FACES OF THE RGB CUBE (COLORS WHERE ONE OF THE RGB VALUES IS ZERO)

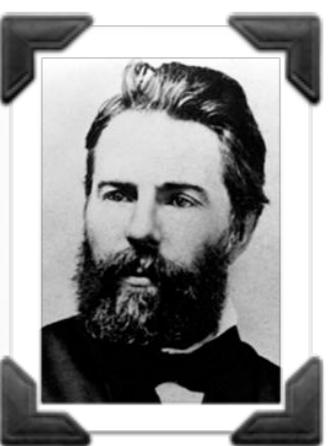
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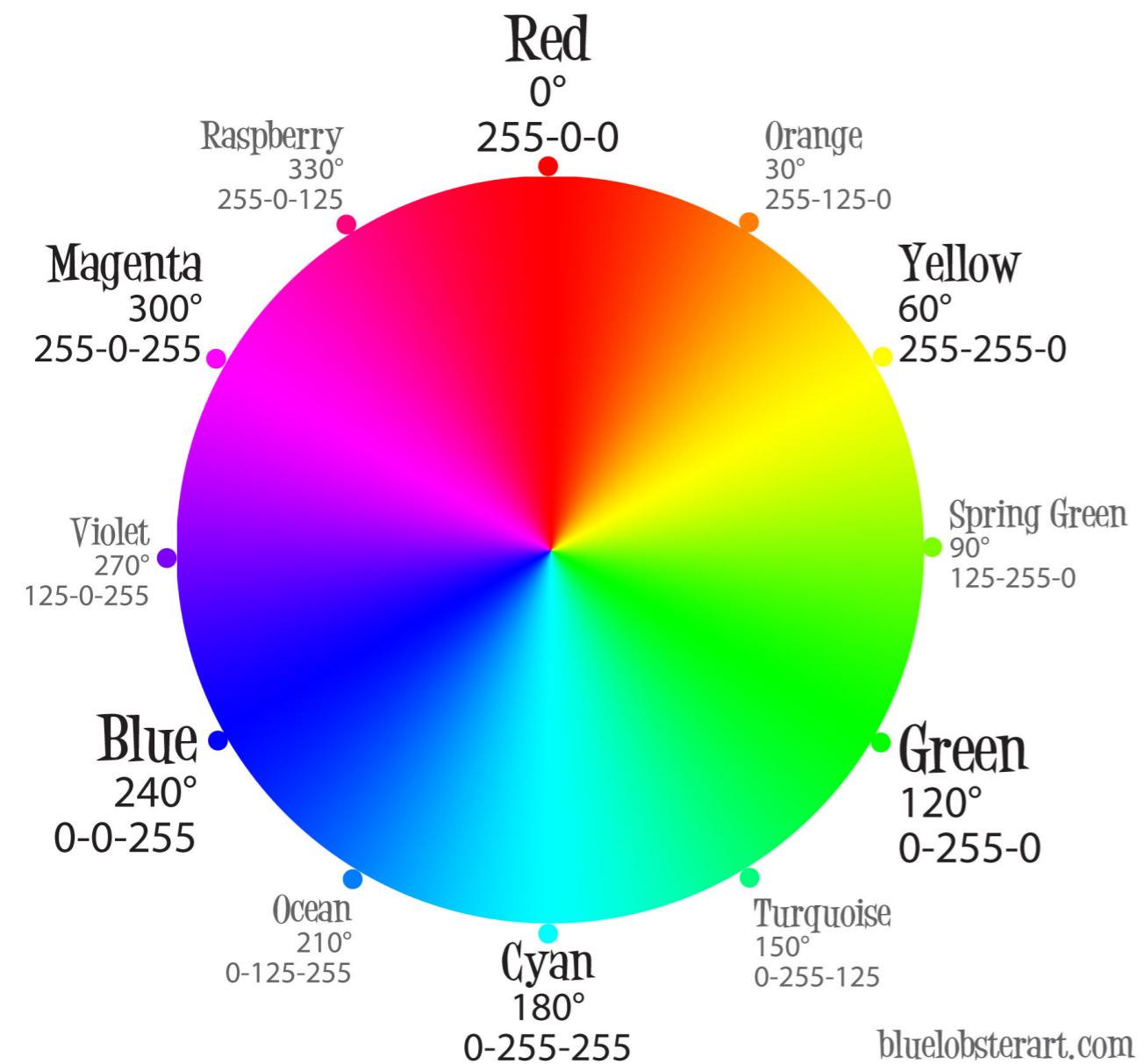
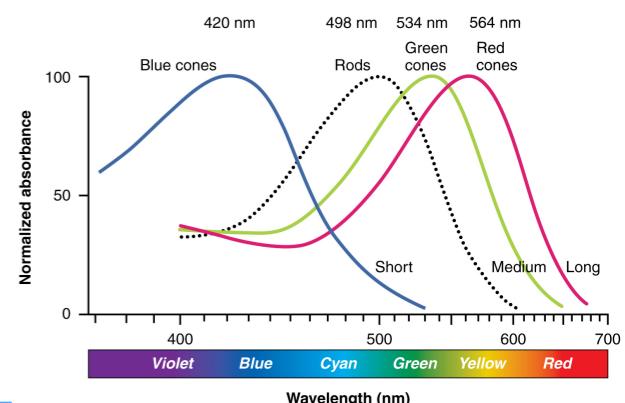
THIS CHART SHOWS THE DOMINANT COLOR NAMES OVER THE THREE FULLY-SATURATED FACES OF THE RGB CUBE (COLORS WHERE ONE OF THE RGB VALUES IS ZERO)

"Who in the rainbow can draw the line where the violet tint ends and the orange tint begins? Distinctly we see the difference of the colors, but where exactly does the one first blendingly enter into the other? So with sanity and insanity."  
(H. Melville)

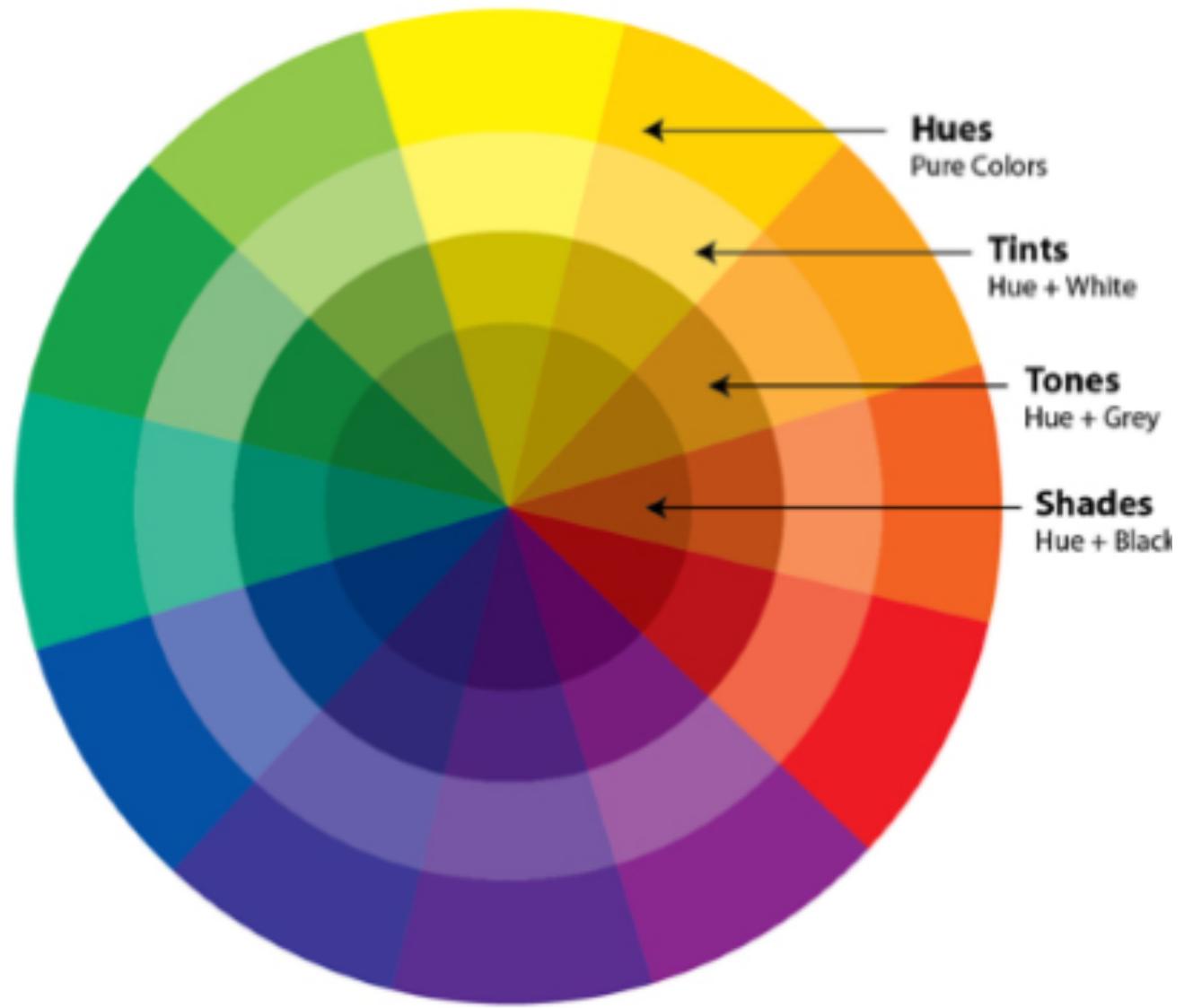
@bgoncalves



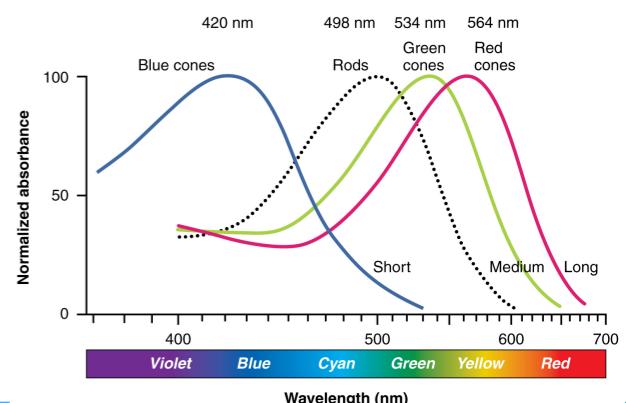
# Color Wheel



[bluelobsterart.com](http://bluelobsterart.com)



# Color Schemes

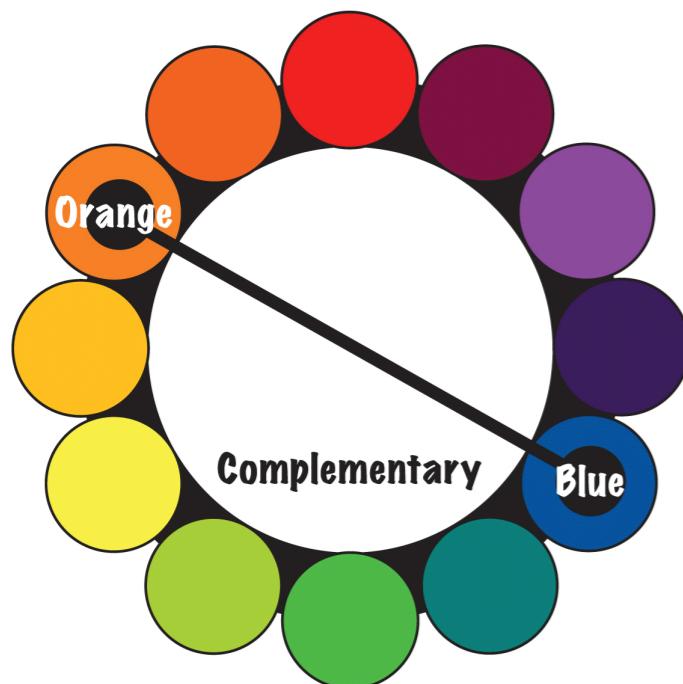
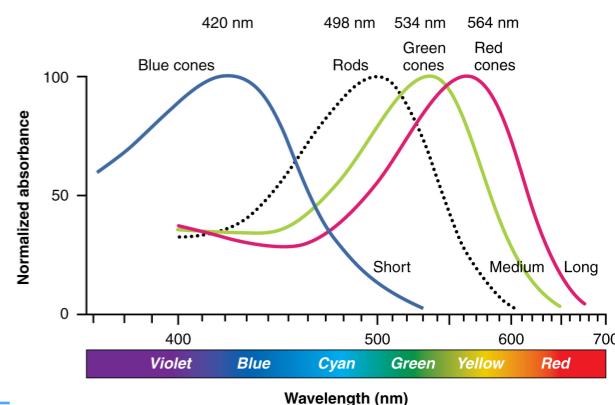


Warm Colors



Cold Colors

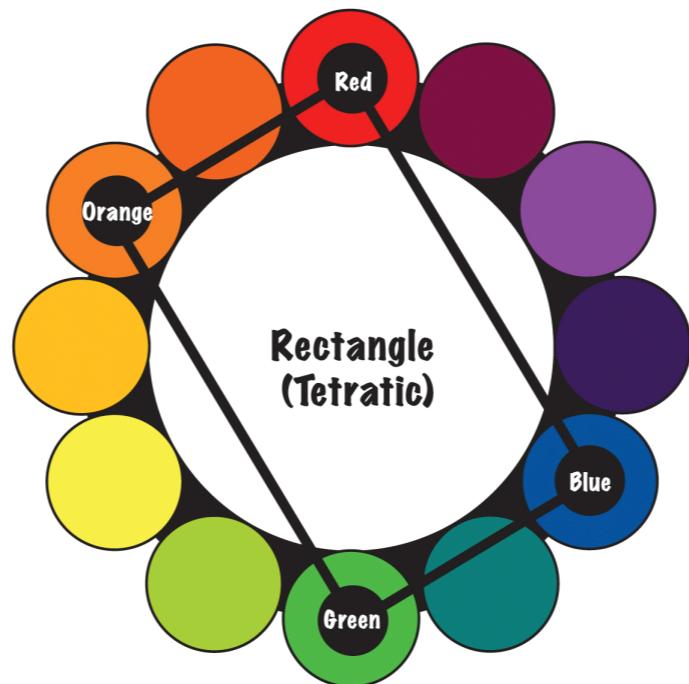
# Color Schemes



## Complementary color scheme

Colors that are opposite each other on the color wheel are considered to be complementary colors

(example: Orange and Blue).



## Rectangle (tetradic) color scheme

The rectangle or tetradic color scheme uses four colors arranged into two complementary pairs.

(example: Orange, Red, Blue and Green)

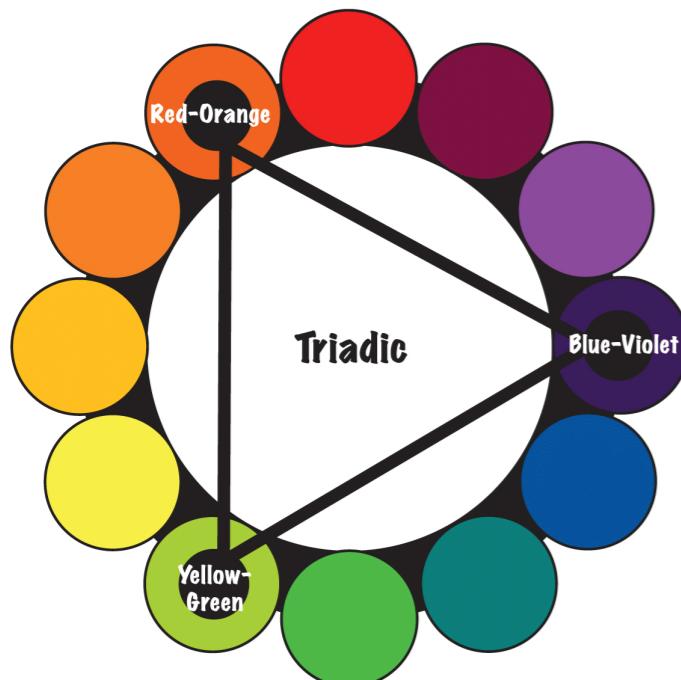
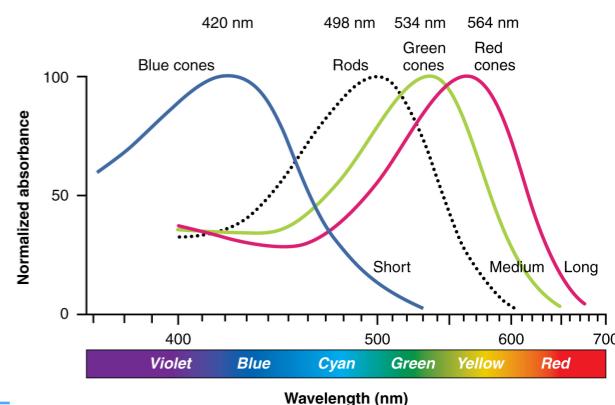


## Analogous color scheme

Analogous color schemes use colors that are next to each other on the color wheel.

(example: Green, Blue-Green and Blue)

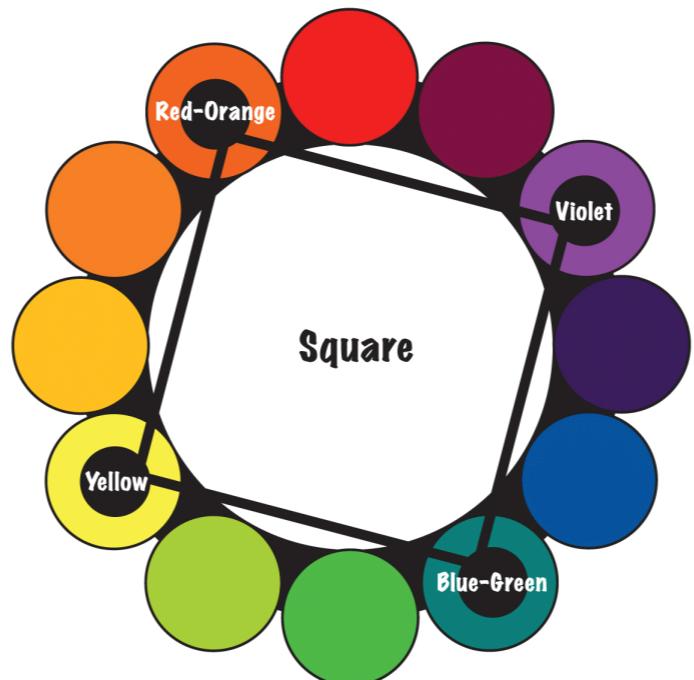
# Color Schemes



**Triadic color scheme**

A triadic color scheme uses colors that are evenly spaced around the color wheel.

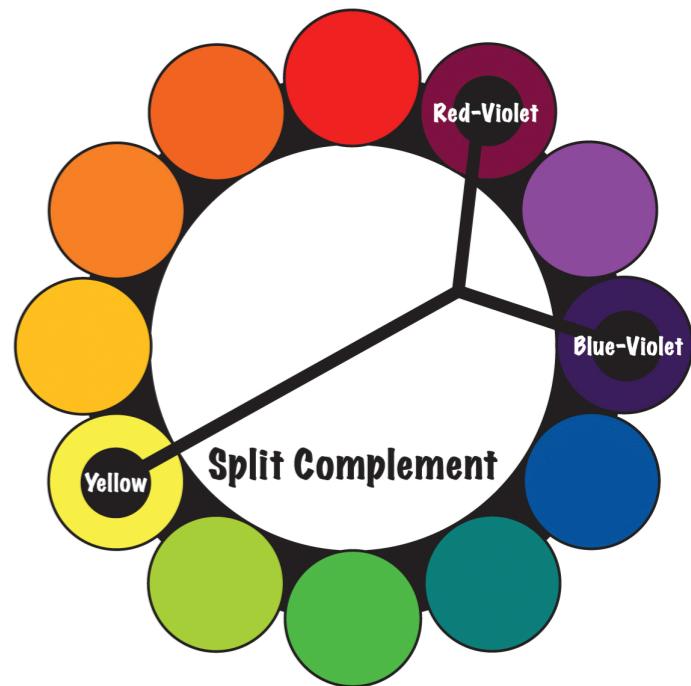
(example: Yellow-Green, Red-Orange and Blue-Violet)



**Square color scheme**

The square color scheme is similar to the rectangle, but with all four colors spaced evenly around the color circle.

(example: Yellow, Red-Orange, Violet and Blue-Green)

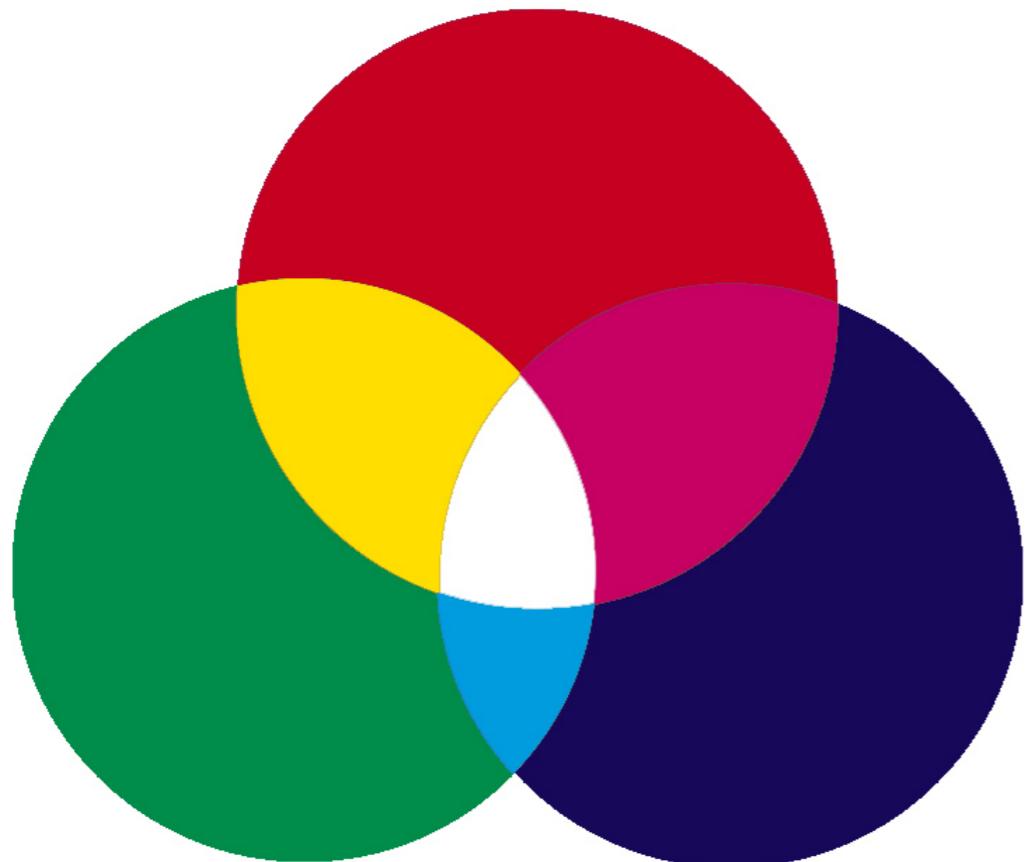
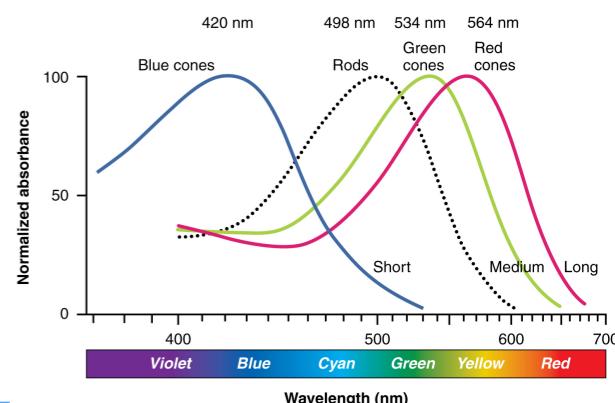


**Split-Complementary color scheme**

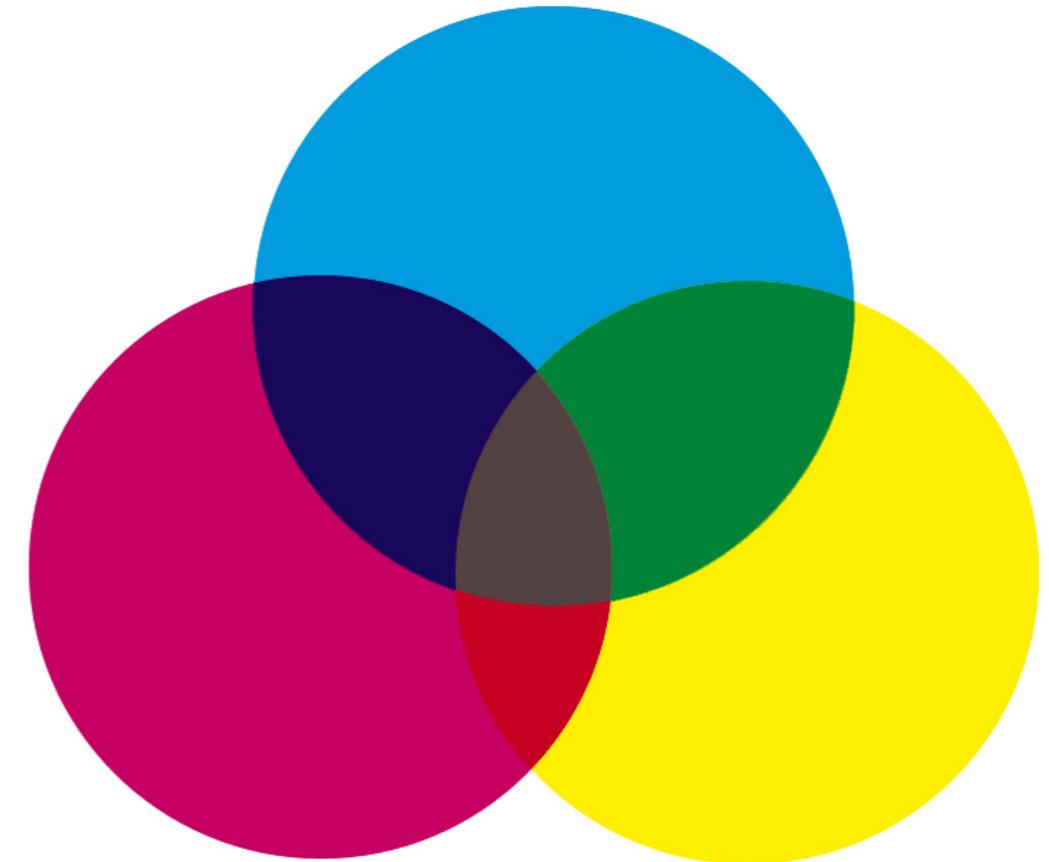
The split-complementary color scheme is a variation of the complementary color scheme. In addition to the base color, it uses the two colors adjacent to its complement.

(example: Yellow, Red-Violet and Blue-Violet)

# Color Systems



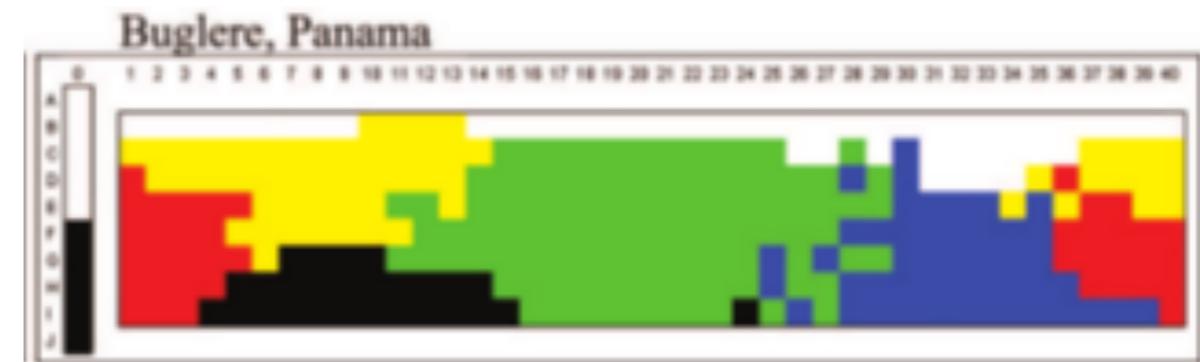
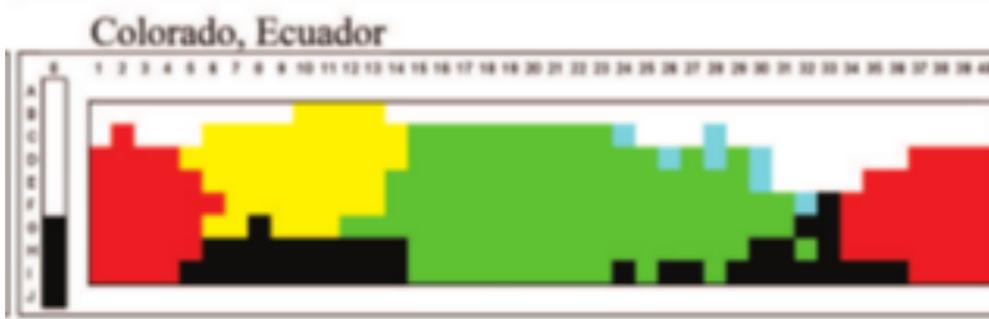
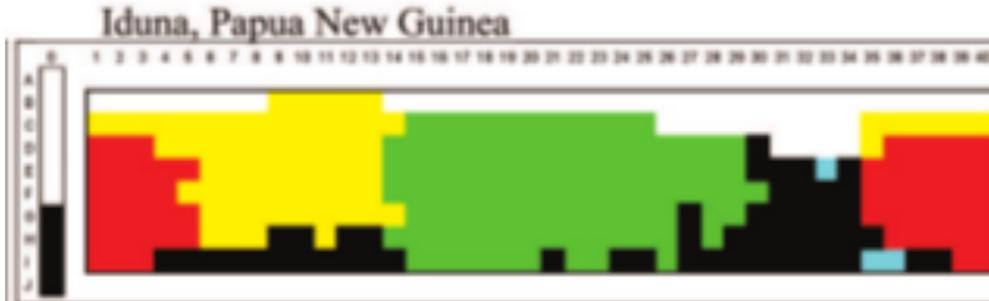
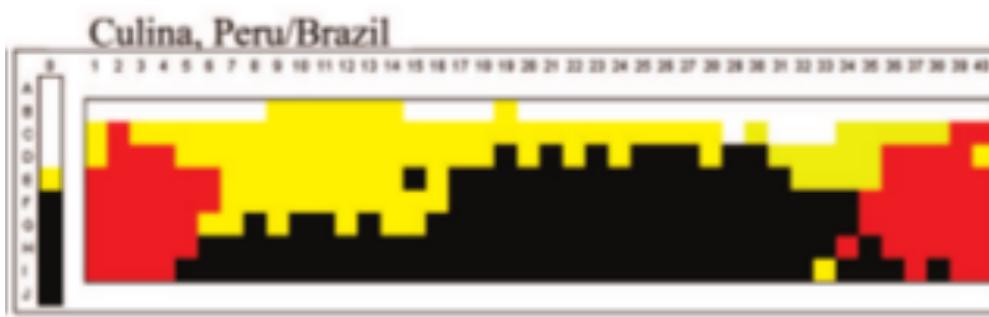
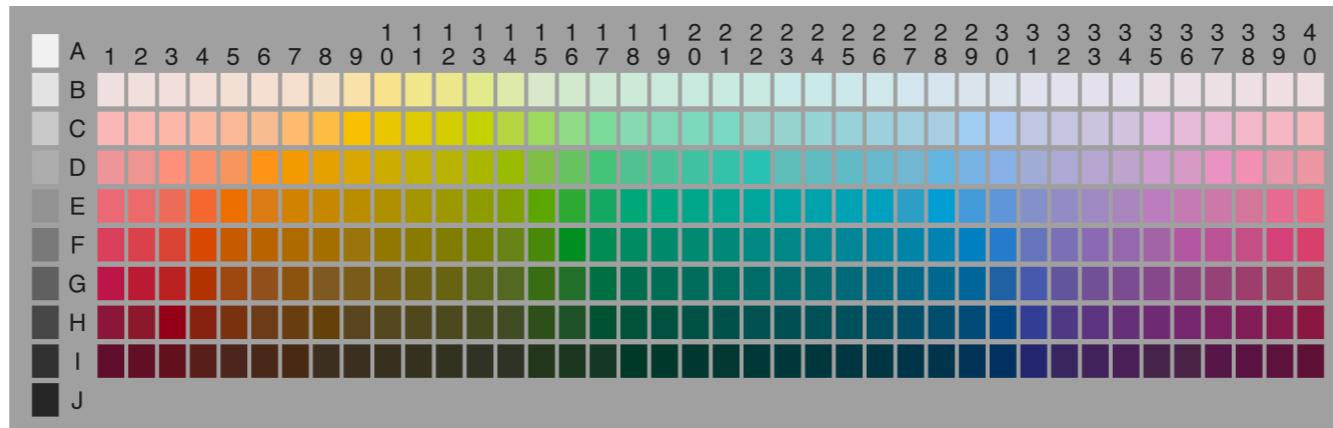
**Additive Color (RGB)**  
Light



**Subtractive color (CMYK)**  
Ink

# Colors and Culture

[www1.icsi.berkeley.edu/wcs/](http://www1.icsi.berkeley.edu/wcs/)



# Color Blindness



# Color Blindness

[https://en.wikipedia.org/wiki/Color\\_blindness](https://en.wikipedia.org/wiki/Color_blindness)

<https://github.com/MaPePeR/jsColorblindSimulator/blob/master/colorblind.js>



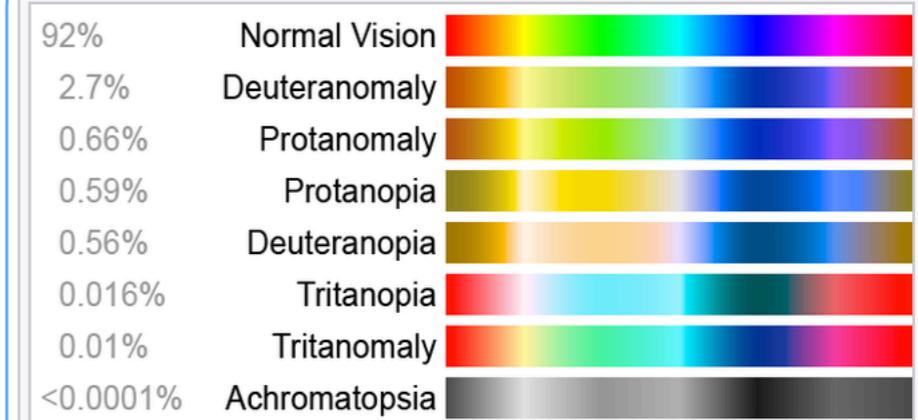
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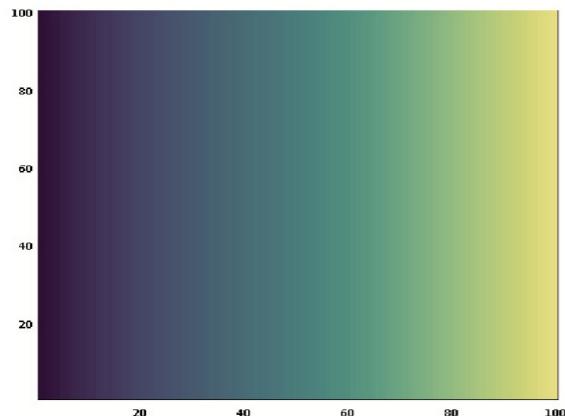
	Cone system	Red	Green	Blue
	<b>N=normal</b> <b>A=anomalous</b>	<b>N</b>	<b>A</b>	<b>N</b>
1	Normal vision	.	.	.
2	Protanomaly	.	.	.
3	Protanopia	.	.	.
4	Deuteranomaly	.	.	.
5	Deutanopia	.	.	.
6	Tritanomaly	.	.	.
7	Tritanopia	.	.	.
8	Achromatopsia	.	.	.
9	Tetrachromat	.	.	.
10		.	.	.



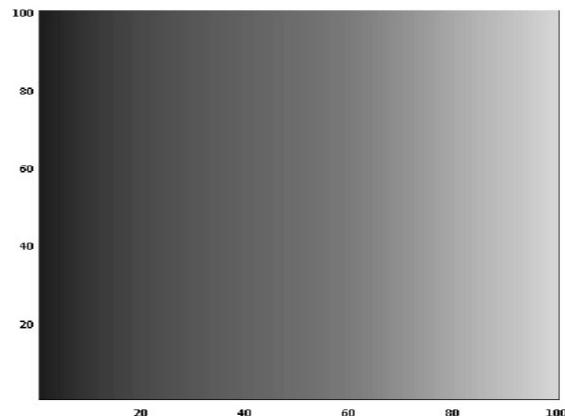
These color charts show how different colorblind people see compared to a person with normal color vision.

# Viridis Color Scheme

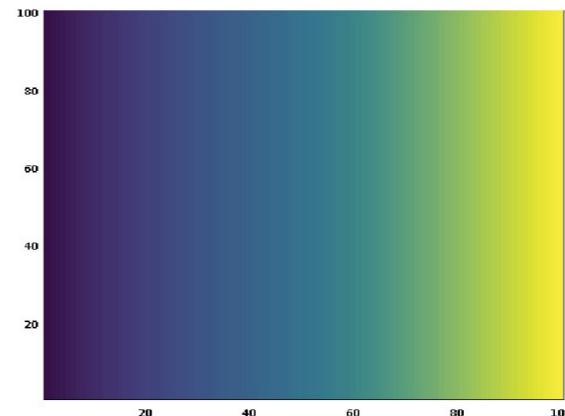
Achromatomaly



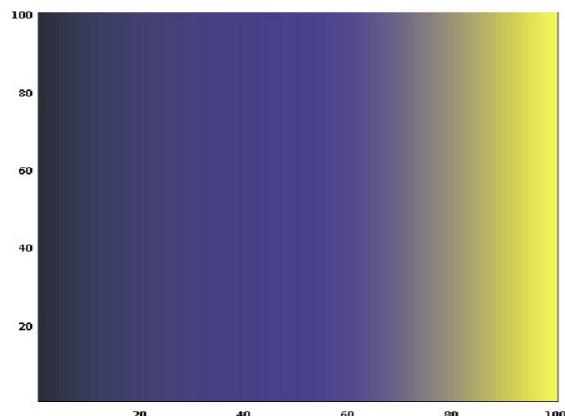
Achromatopsia



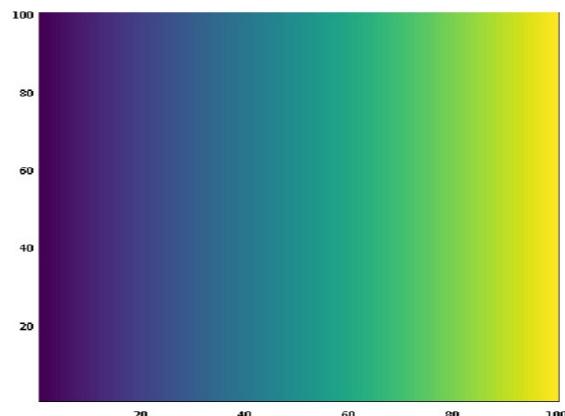
Deuteranomaly



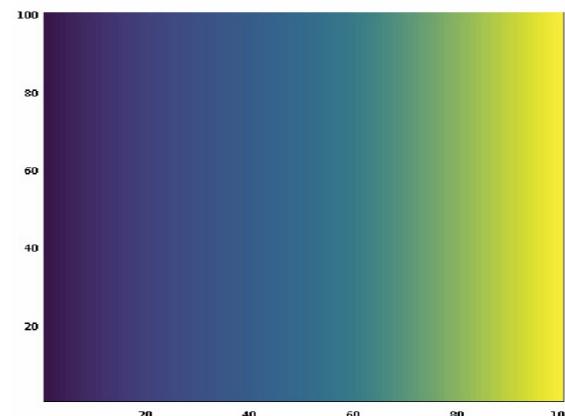
Deuteranopia



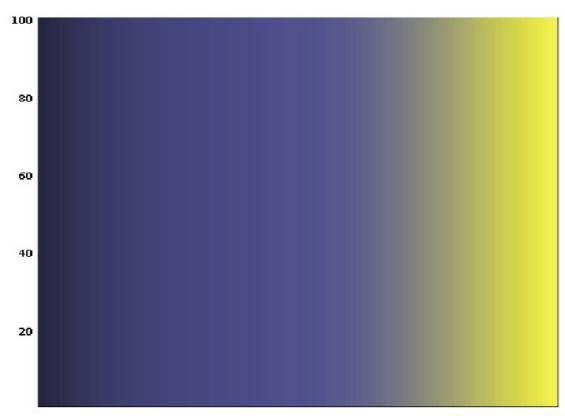
Normal



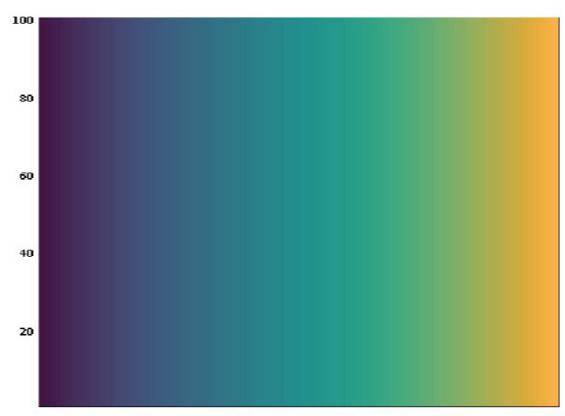
Protanomaly



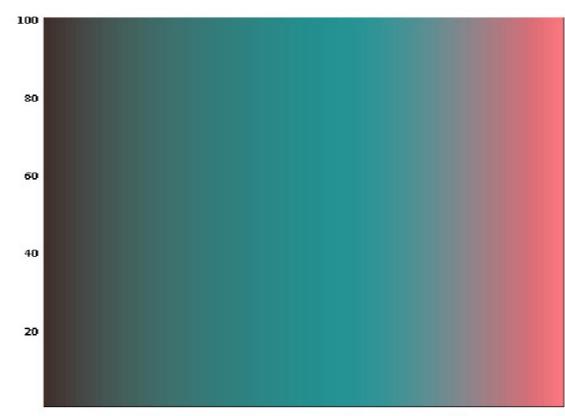
Protanopia



Tritanomaly



Tritanopia



# Color Scheme Choosers

colorhunt.co

Color Hunt Palettes New ▾



36

Today



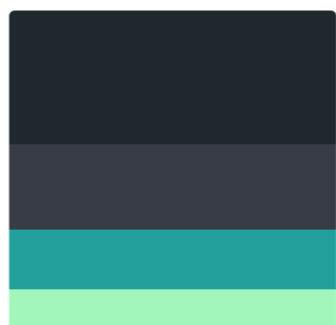
97

Yesterday



249

2 days



228

3 days



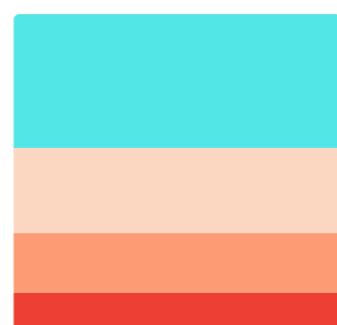
311

4 days



300

5 days



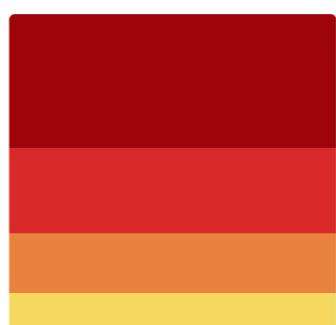
283

6 days



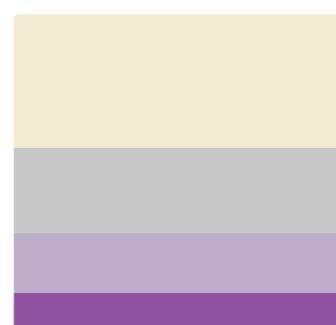
342

1 week



356

1 week



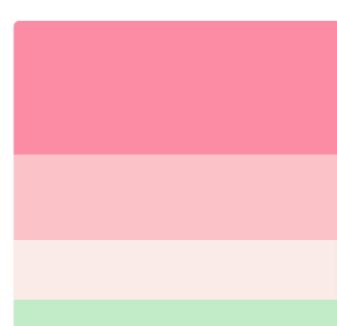
372

1 week



292

1 week



510

1 week



389

1 week



393

1 week



424

2 weeks

Search Palettes



Color Palettes for Designers and Artists

Color Hunt is a free and open platform for color inspiration with thousands of trendy hand-picked color palettes

Get our Chrome extension for color inspiration in every new tab

Add to Chrome

Made with ❤ by Gal Shir

# Color Scheme Choosers

[tools.medialab.sciences-po.fr/iwanthue/](https://tools.medialab.sciences-po.fr/iwanthue/)

I want hue

Tutorials

Examples

Theory

Experiment

Old version ▾

GitHub

Issues

+ Médialab Tools



# i want hue

**Colors for data scientists.** Generate and refine palettes of optimally distinct colors.

## Color space

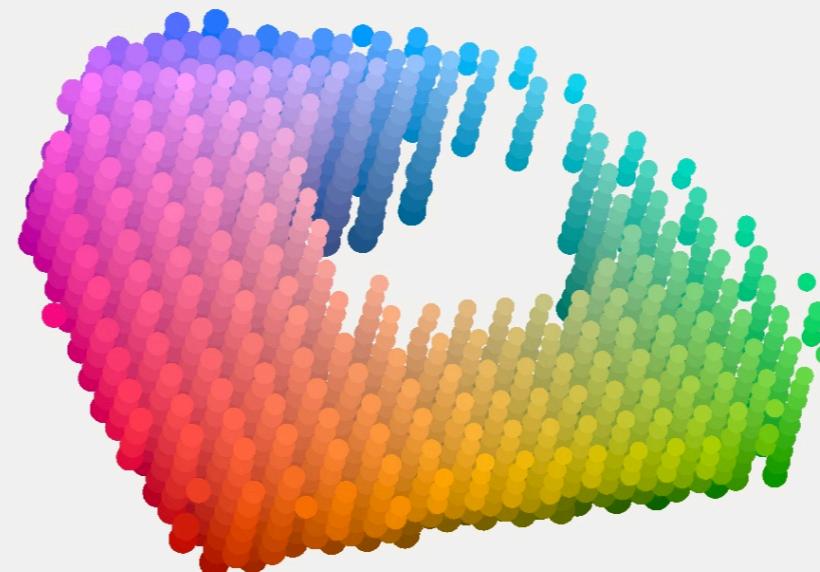
Default preset

H 0      360

C 30      80

L 35      80

- Improve for the **colorblind** (slow)
- Dark background



## Palette

5 colors soft (k-Means)

Make a palette

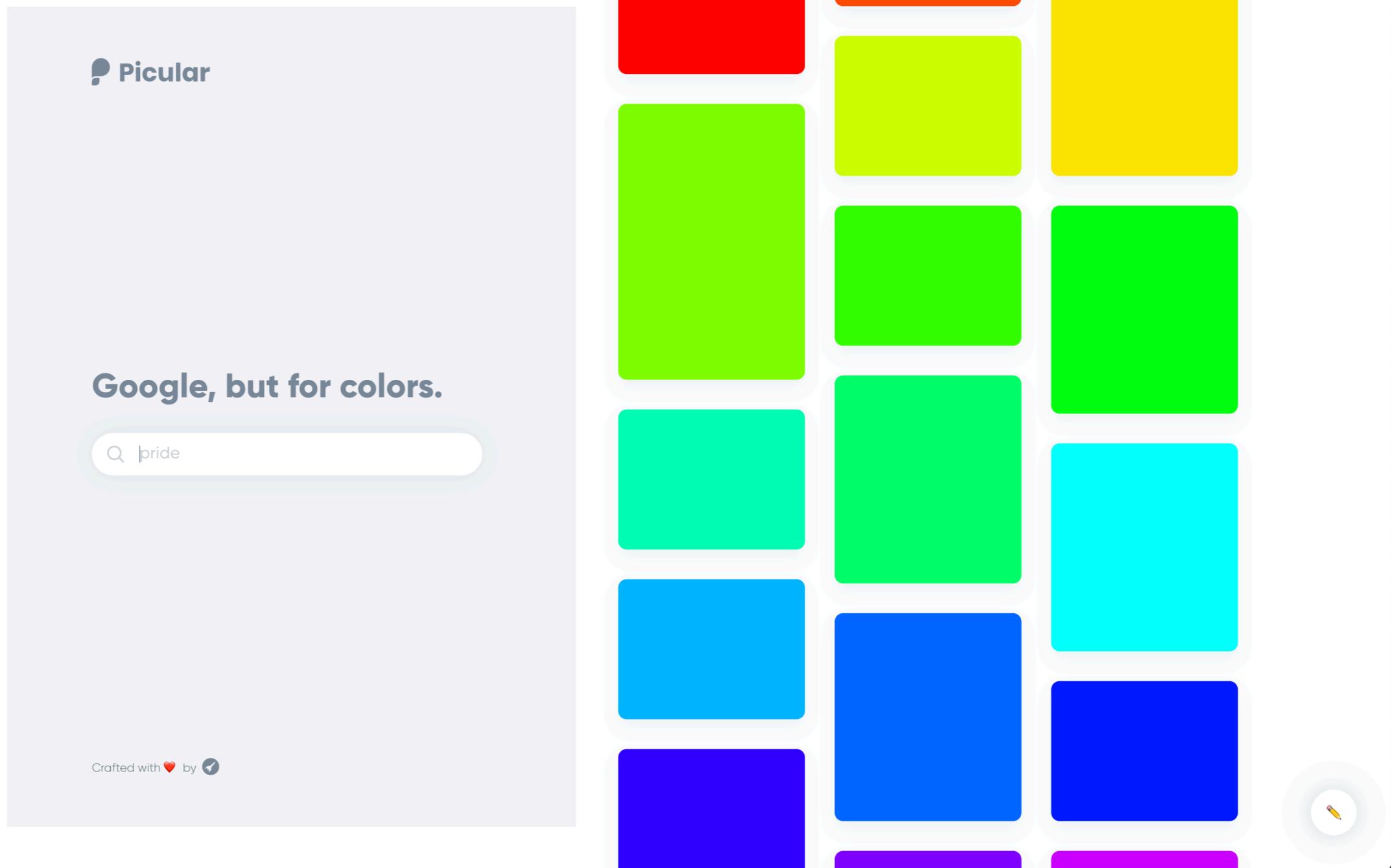
Tweet

See also our other tools at [Médialab Tools!](#)

SciencesPo. | médialab

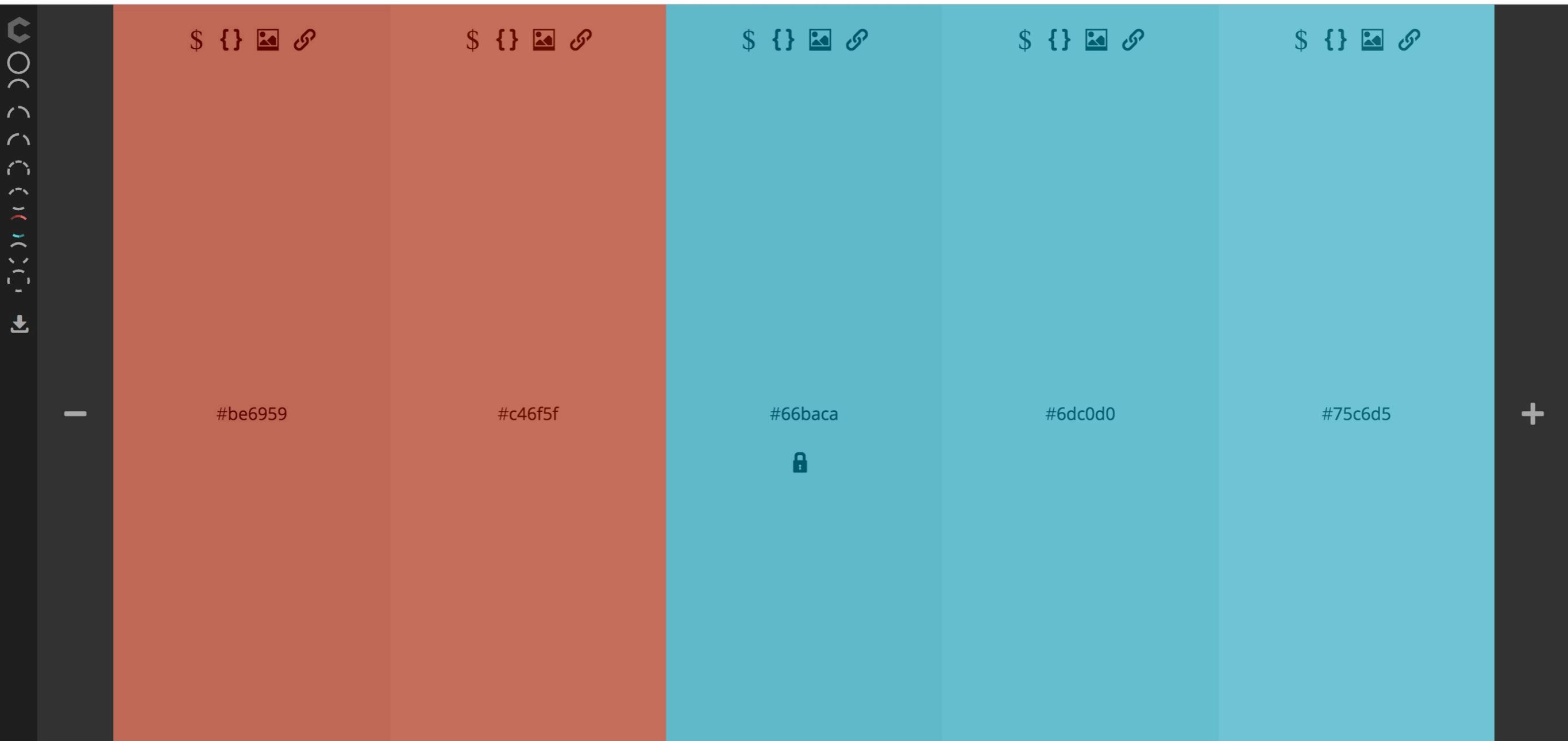
# Color Scheme Choosers

picular.co



# Color Scheme Choosers

[www.colourco.de](http://www.colourco.de)



# Color Scheme Choosers

[www.colourlovers.com/palettes](http://www.colourlovers.com/palettes)

COLOURlovers

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Log In ▾

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Search palettes...



Create ▾

## Explore Over a Million Color Palettes

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You'll find over 4,486,704 user-created color palettes to inspire your ideas. Get the latest palettes RSS feed or use our color palette maker to create and share your favorite color combinations.

NEW

MOST LOVED

MOST COMMENTS

MOST FAVORITES

### Browse Palettes

DAY

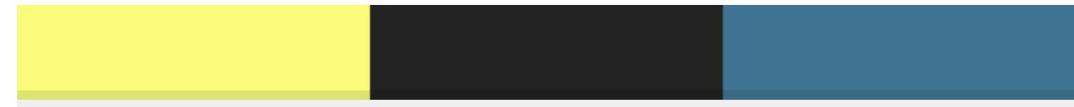
WEEK

MONTH

ALL



K by K32



0 COMMENTS 0 FAVORITES 2 VIEWS 0 LOVES

K by K32



0 COMMENTS 0 FAVORITES 3 VIEWS 0 LOVES

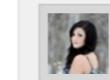
### RECENT PALETTE COMMENTS



ellasmason  
POSTED

Most gangs that have talked to me before will know that I dislike Ztek XL. Ztek XL has had enduring success. Ztek XL will really excite everyone who sees it as though I wouldn't be alarmed to discover that to be true dealing with Ztek XL a year from now. I need to have the appearance of being spirited. That is a pedestrian revelation. I think the Ztek XL example is very good. I cannot ignore that: I am a simpleton when it is put alongside Ztek XL. My main recommendation is to just be as active as you can be with Ztek XL. To get more info visit here  
<http://maleenhancementshop.info/ztek-xl/>

RE: Provides genuine lon

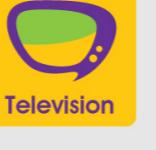
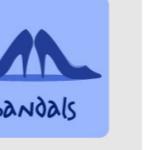
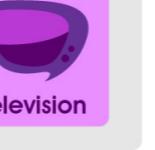
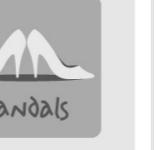
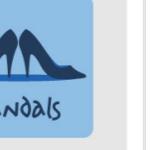
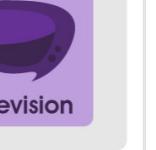
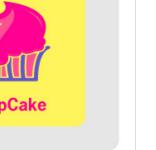


anisaahmedabad  
POSTED

Beautiful Escorts in Ahmedabad  
<http://route190.com/>

# Color Theory

## THE 10 COMMANDMENTS OF COLOR THEORY

<p>1 KNOW THE COLOR WHEEL WELL! DO YOU KNOW WHAT EACH COLOR SIGNIFIES?</p>  <p>RED LOVE ENERGY. INTENSITY.</p> <p>YELLOW JOY INTELLECT. ATTENTION.</p> <p>GREEN FRESHNESS. SAFETY. GROWTH.</p> <p>BLUE STABILITY. TRUST. SERENITY.</p> <p>PURPLE ROYALTY. WEALTH. FEMININITY.</p>	<p>2 MATCH IT. DO NOT OVERLOOK THE AUSTERITY OF ANALOG COLORS!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>3 CAN'T MATCH IT? CLASH IT WITH COMPLEMENTARY COLORS!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>4 IS CONTRAST TOO INTENSE? THEN, SPLIT IT!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>5 NEED MORE VARIATIONS? GO DOUBLE COMPLEMENTARY!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>6 GO TRIAD WITH 3 DIFFERENT HUES... CHOOSE FROM A GREATER VARIETY!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>7 SOMETIMES, MONOCHROME IS THE WAY TO GO...</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>8 OTHER TIMES, AN ACHROMATIC SCHEME SERVES BEST!</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>9 KNOW YOUR HUES, TINTS, SHADES AND TONES... WHAT WORKS WHERE?</p>  <p>Barber</p>  <p>wheelchair</p>  <p>CupCake</p>  <p>Sandals</p>  <p>Television</p>	<p>10 AND LASTLY, RGB, CMYK AND PANTONE ARE NOT THE SAME!</p>  <p>PANTONE</p>  <p>CupCake</p>  <p>CMYK</p>  <p>CupCake</p>  <p>RGB</p>  <p>CupCake</p>
--	--	--	--	---	---	--	---	---	--

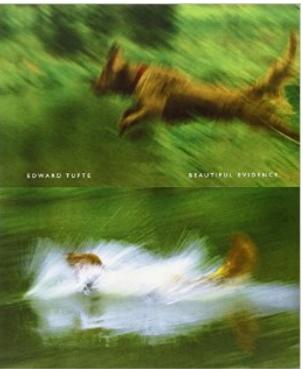


Visualization

# Fundamental Principles of Analytical Design

---





# Fundamental Principles of Analytical Design

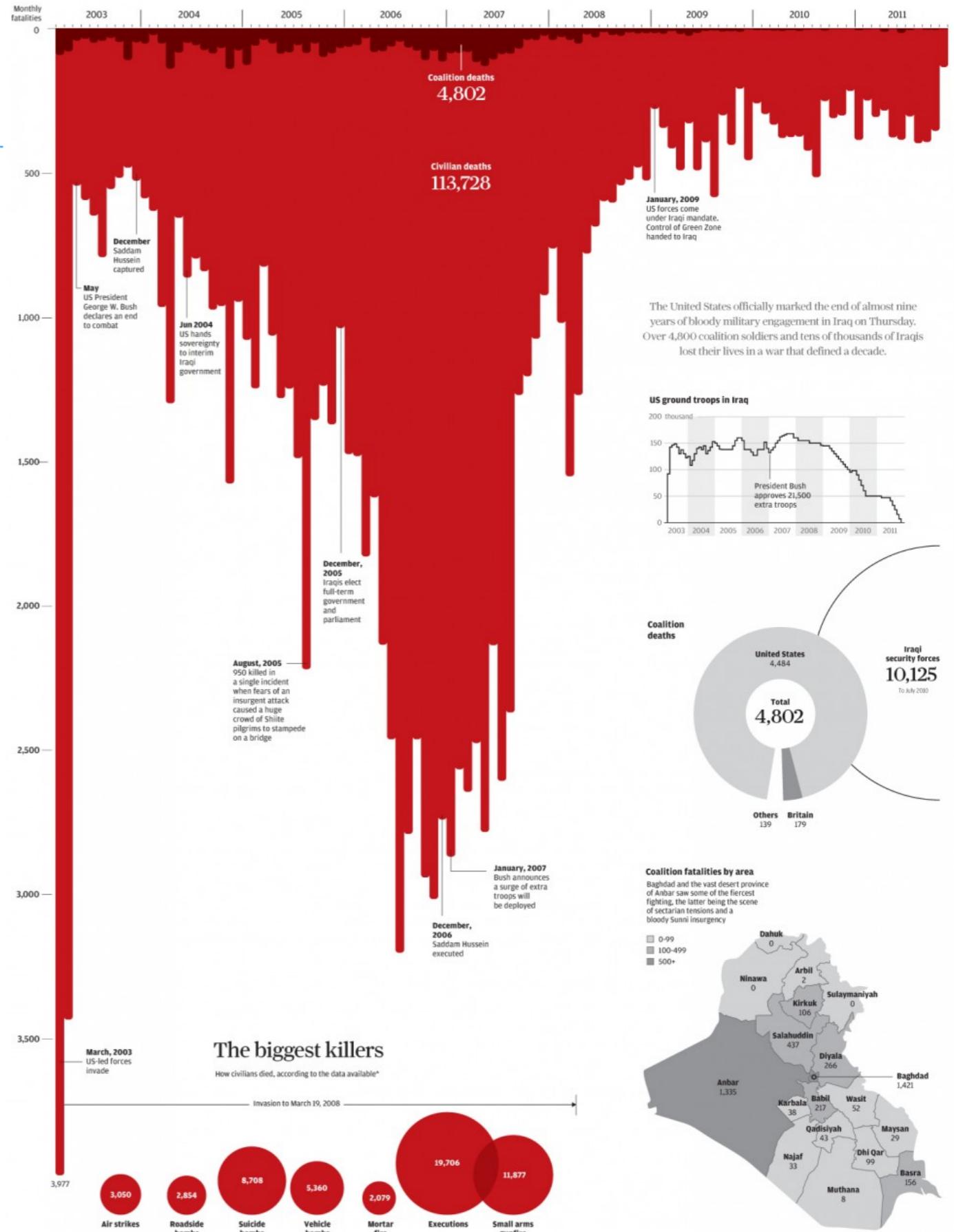
1. Show comparisons, contrasts and differences
2. Show causality, mechanism, explanation and systematic structure
3. Show multivariate data: more than one or two variables
4. Completely integrate words, numbers, images and diagrams
5. Documentation
6. Content matters most of all

"Information Visualization is a form of knowledge compression"  
D. McCandless



# Iraq's bloody toll

Rules can be broken...



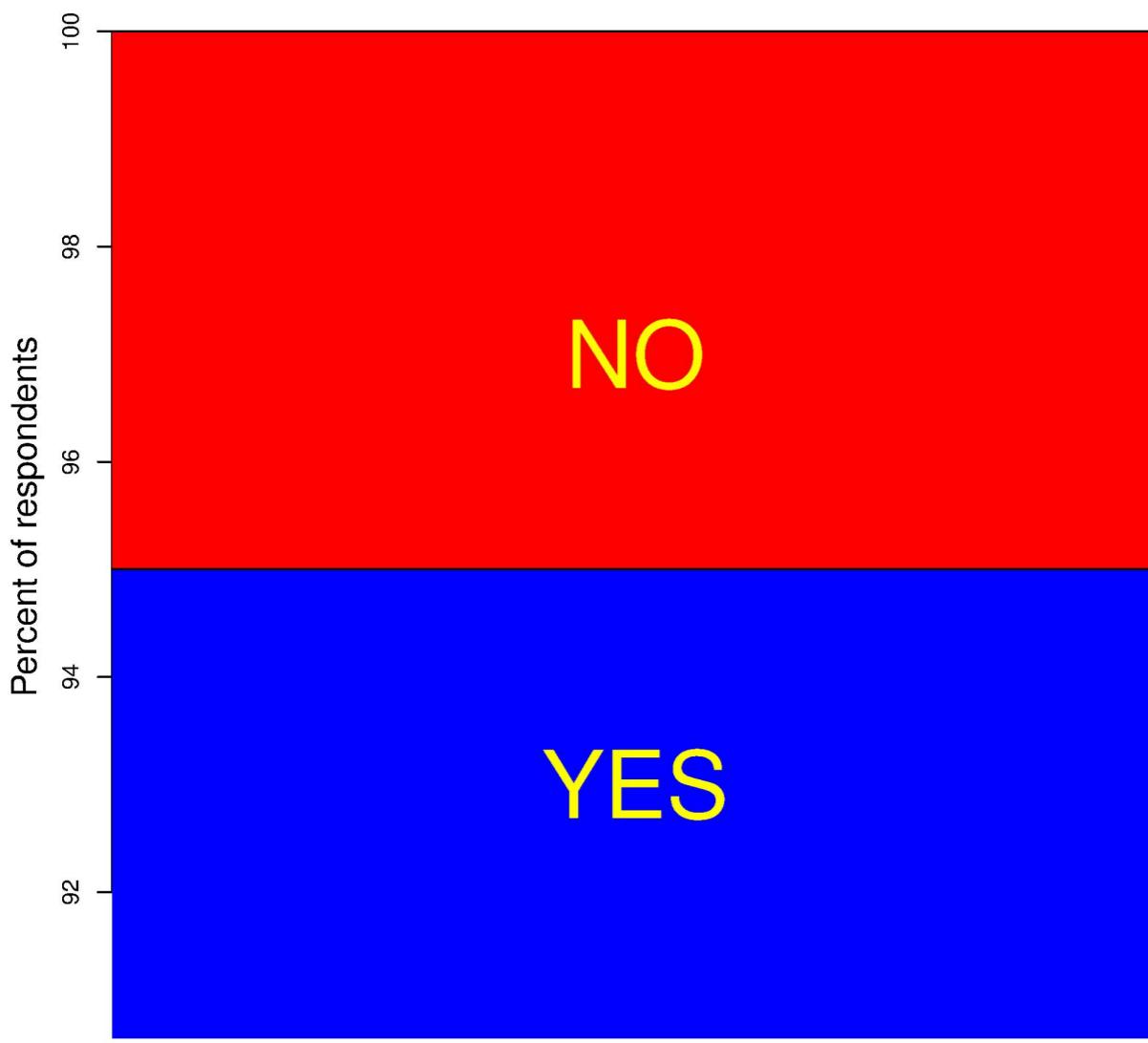
@6goncalves

# Iraq's bloody toll

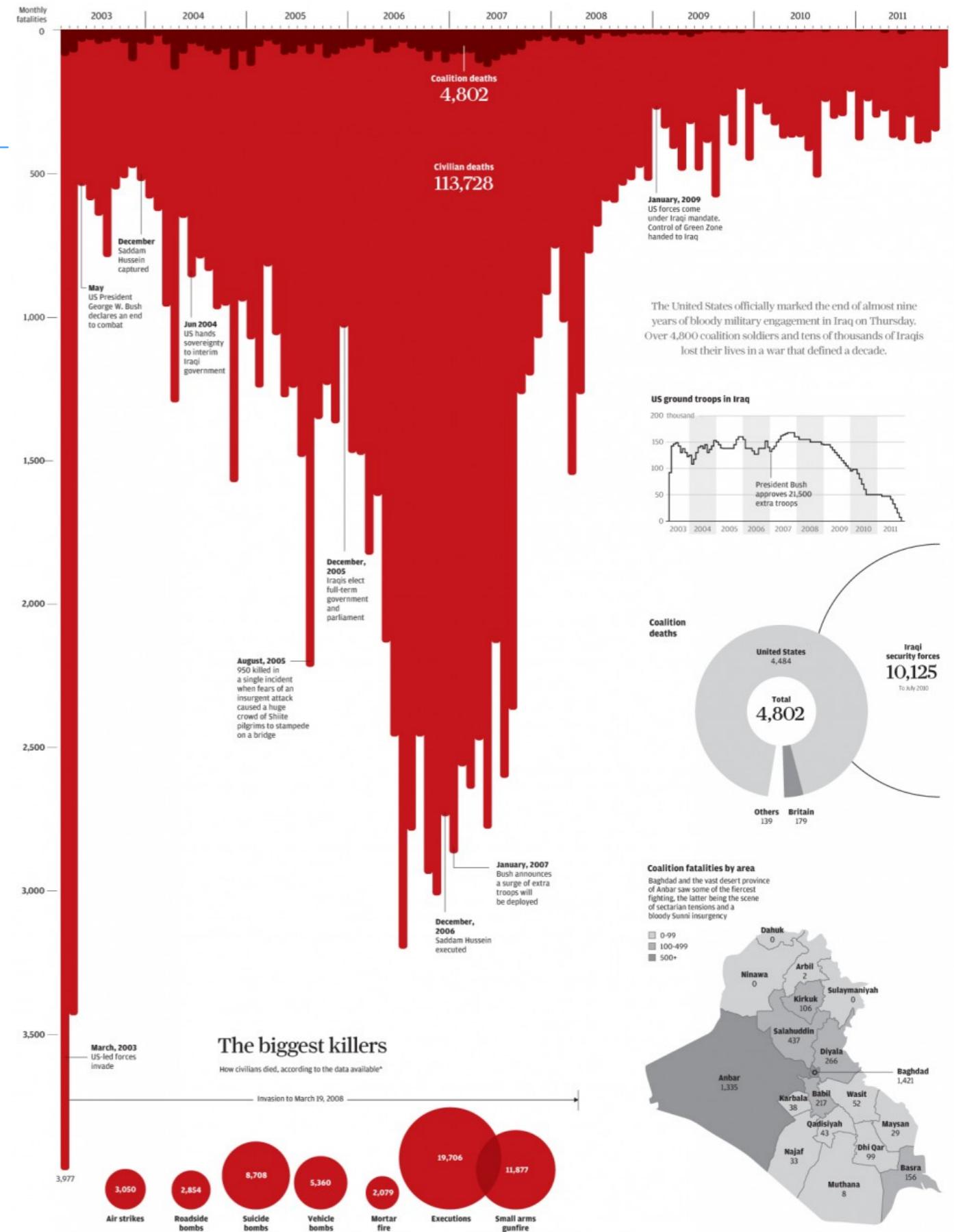
Rules can be broken...

...sometimes

Is truncating the Y-axis dishonest?



@bgoncalves

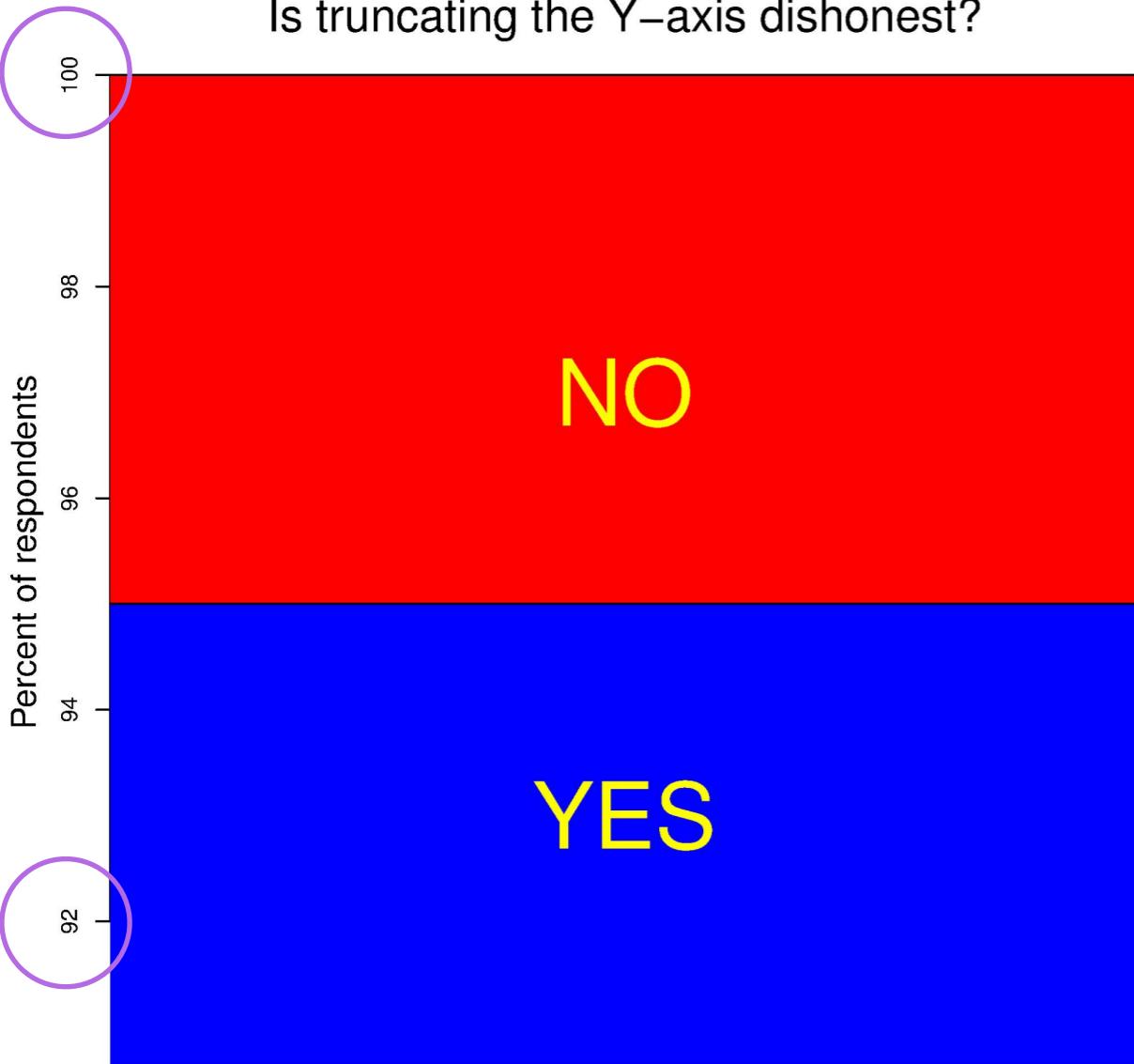


# Iraq's bloody toll

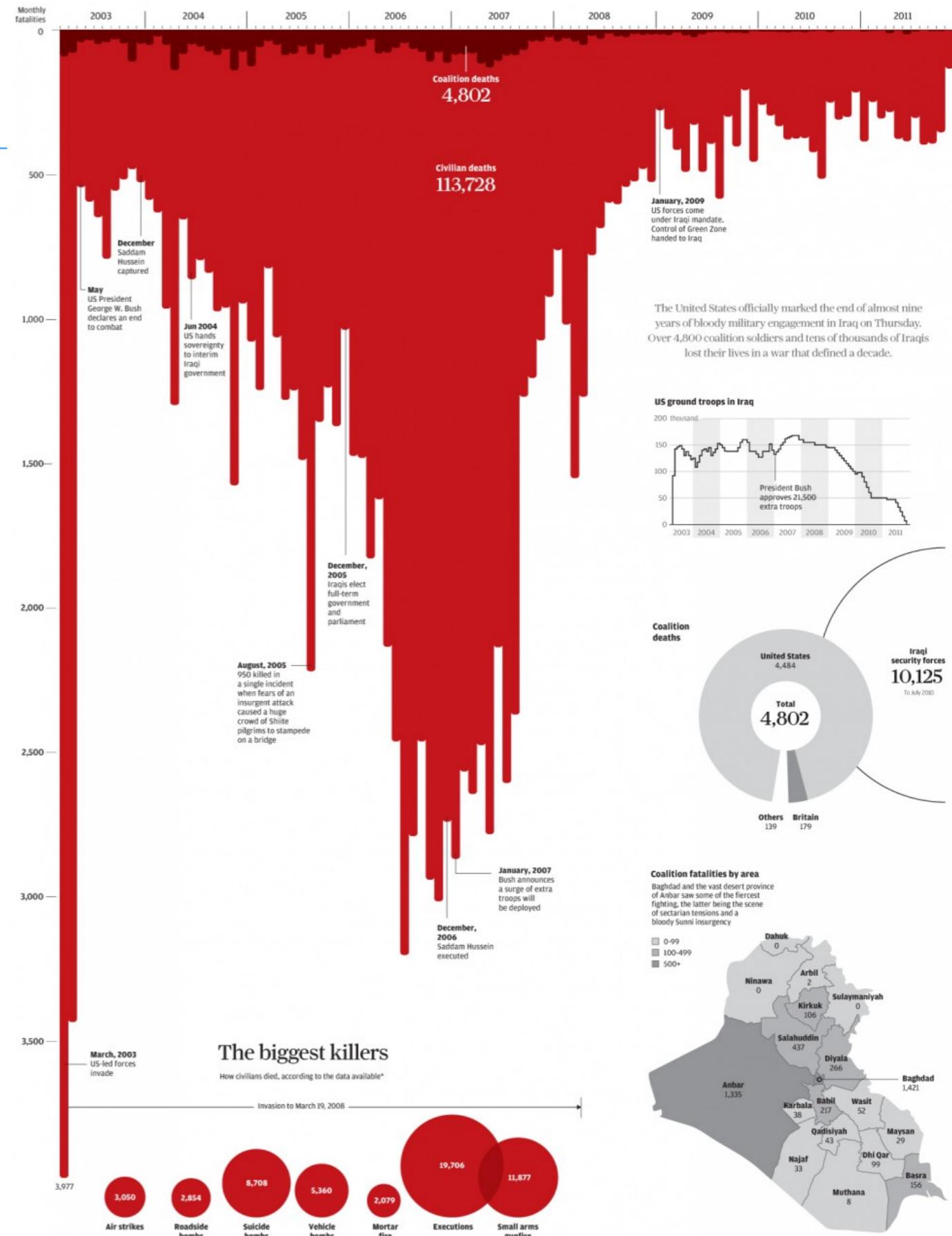
Rules can be broken...

...sometimes

Is truncating the Y-axis dishonest?



@bgoncalves



# Fundamental tools

---

- Points

- Lines

- Areas

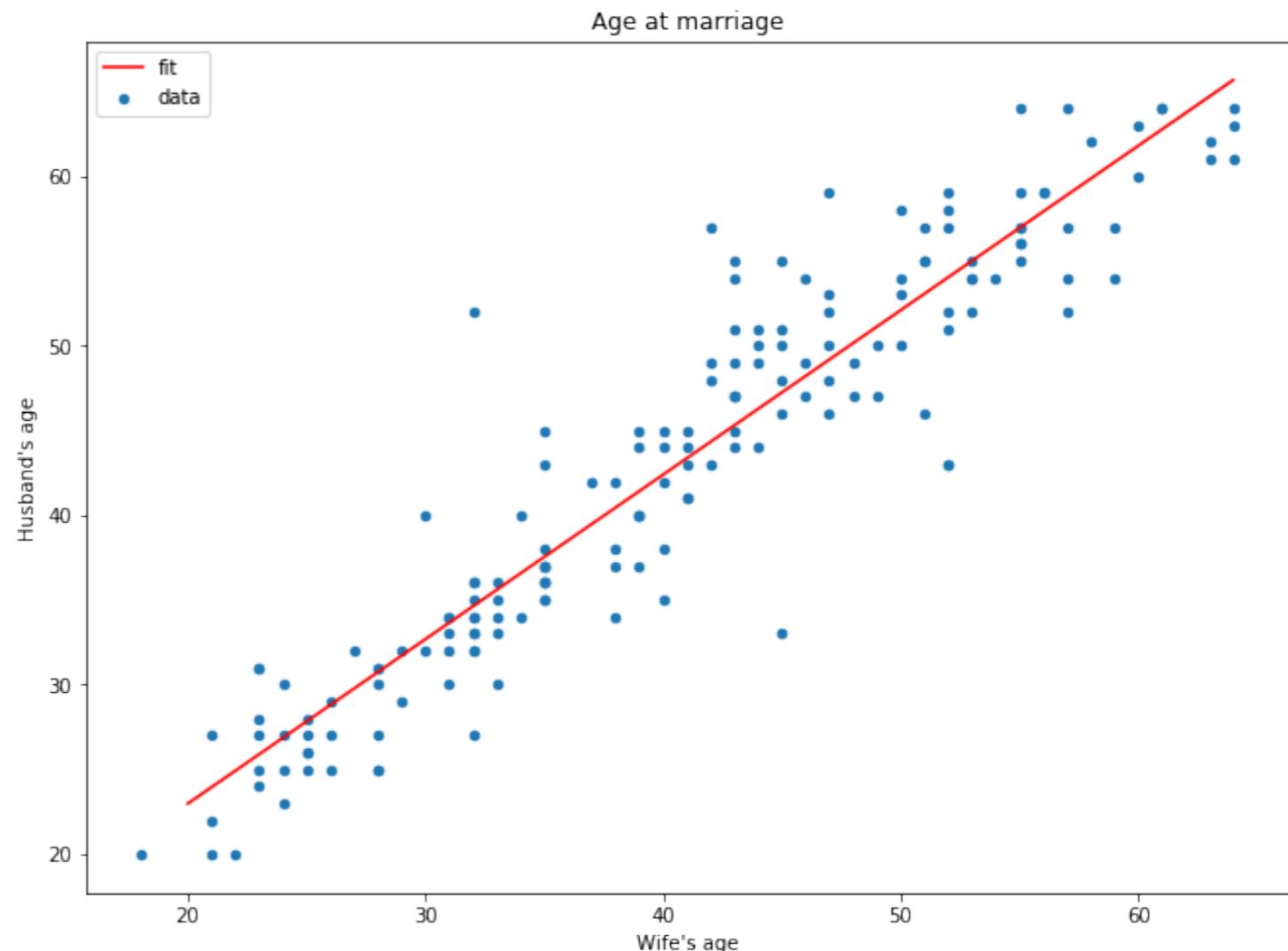
- Shapes

- Colors

- Text

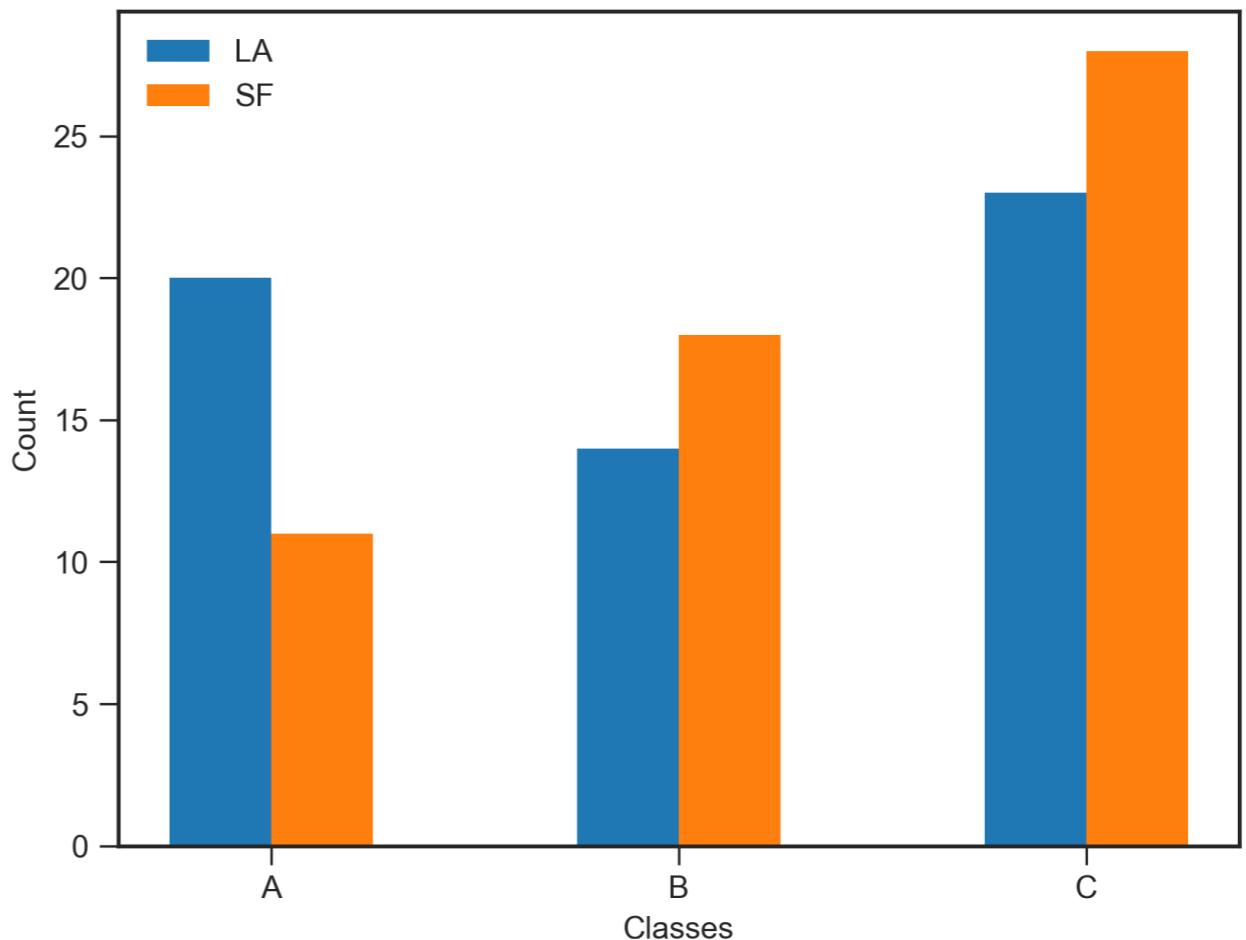
# Fundamental tools

- Points
  - Each of these can be used to encode a given variable to produce all the types of plots we are familiar with:
  - Scatter plot - Just points ([line](#))
- Lines
- Areas
- Shapes
- Colors
- Text



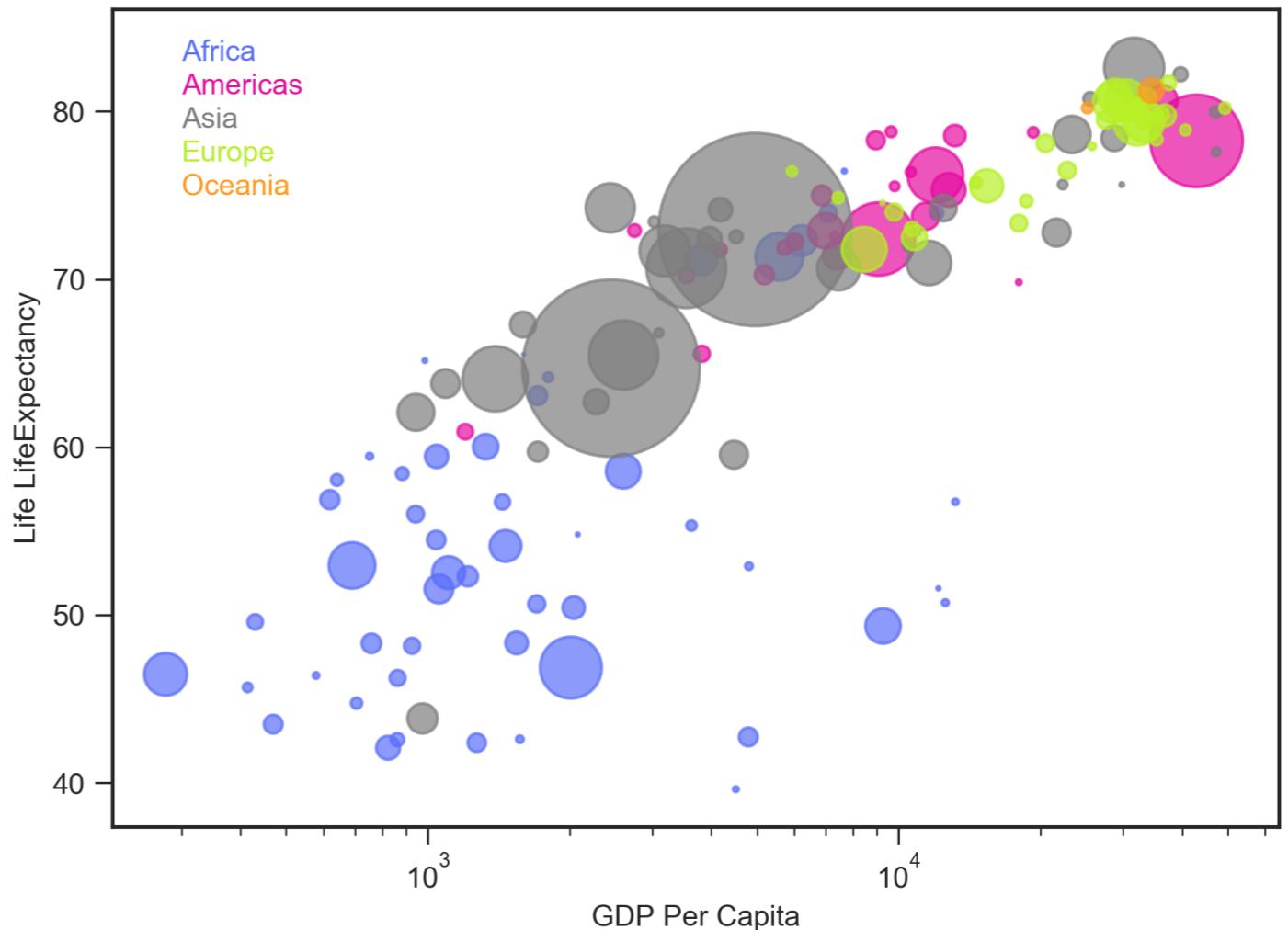
# Fundamental tools

- Points
  - Each for these can be used to encode a given variable to produce all the types of plots we are familiar with:
- Lines
  - Scatter plot - Just points ([line](#))
  - Bar chart - Areas
- Areas
- Shapes
- Colors
- Text



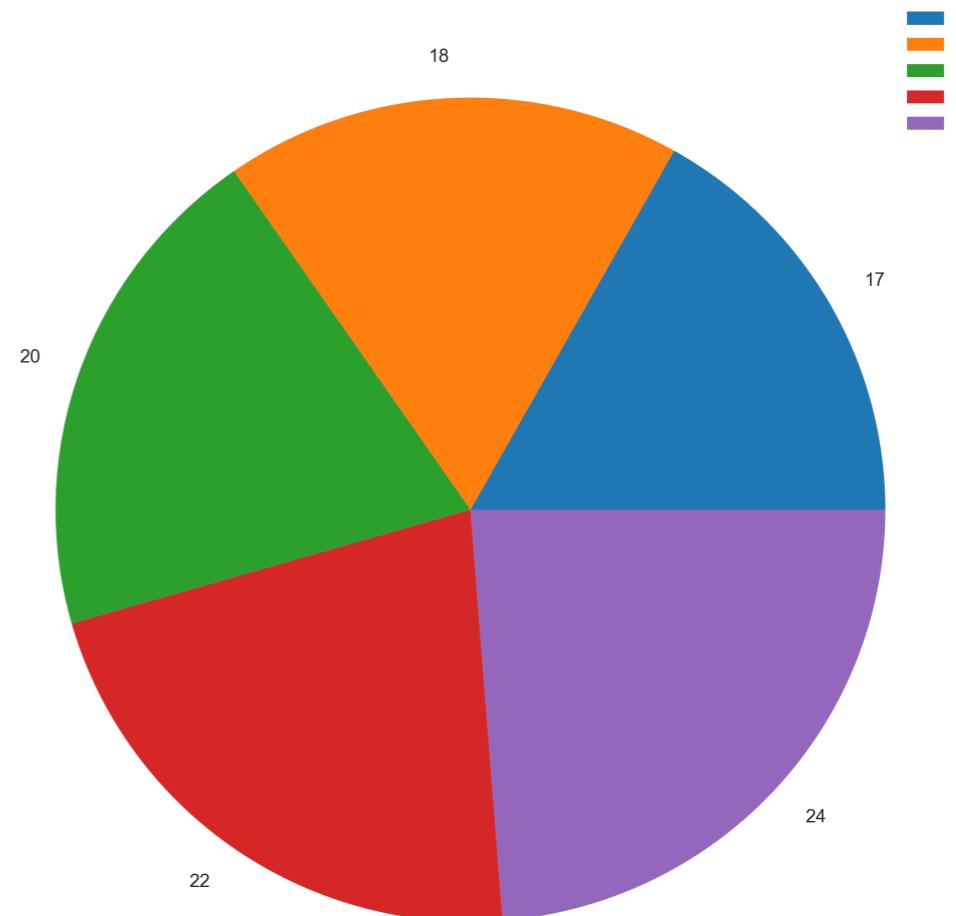
# Fundamental tools

- Points
  - Each for these can be used to encode a given variable to produce all the types of plots we are familiar with:
- Lines
- Areas
  - Scatter plot - Just points ([line](#))
  - Bar chart - Areas
- Areas
  - Bubble chart - Scatter plot + size + color (time)
- Shapes
- Colors
- Text



# Fundamental tools

- Points
  - Each for these can be used to encode a given variable to produce all the types of plots we are familiar with:
- Lines
  - Scatter plot - Just points ([line](#))
  - Bar chart - Areas
- Areas
  - Bubble chart - Scatter plot + size + color (time)
  - Pie chart - Areas + colors
- Shapes
  - etc...
- Colors
- Text





Matplotlib

# matplotlib

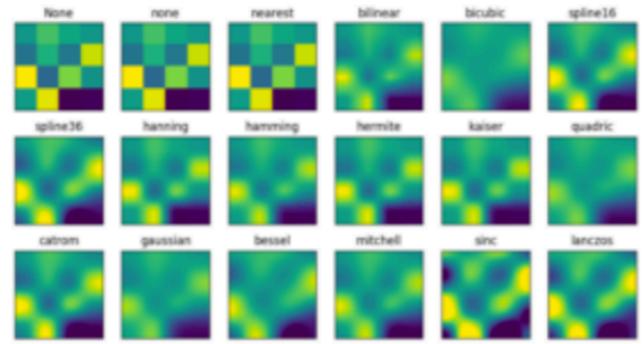
[matplotlib.org](http://matplotlib.org)



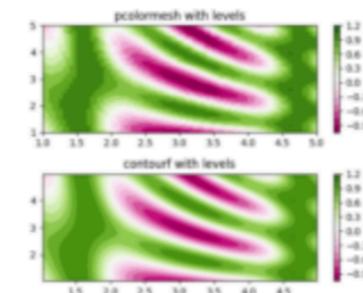
"**Matplotlib** is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms. **Matplotlib** can be used in Python scripts, the **Python** and **IPython** shells, the **Jupyter** notebook, web application servers, and four graphical user interface toolkits."

"**Matplotlib** tries to make easy things easy and hard things possible. You can generate plots, histograms, power spectra, bar charts, errorcharts, scatterplots, etc., with just a few lines of code."

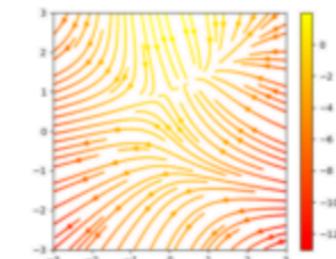
# matplotlib



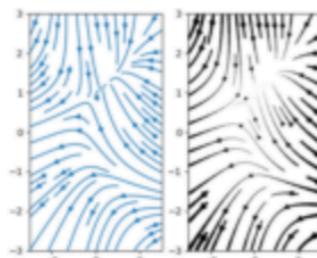
interpolation\_methods



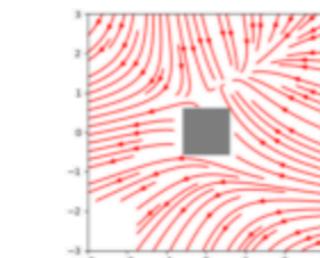
pcolormesh\_levels



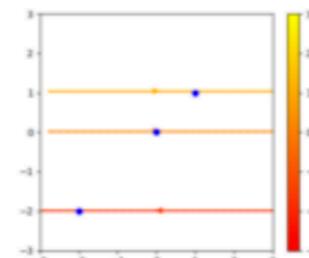
streamplot\_demo\_features



streamplot\_demo\_features

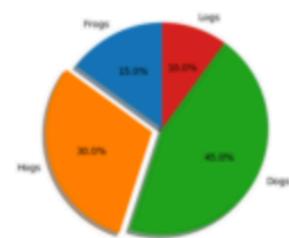


streamplot\_demo\_masking

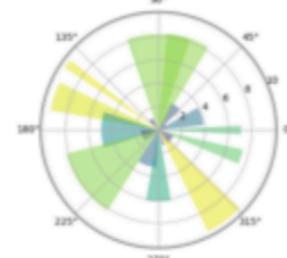


streamplot\_demo\_start\_points

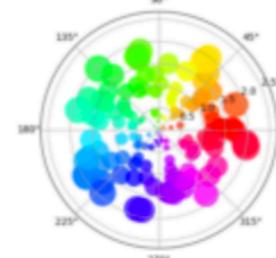
## Pie and polar charts



pie\_demo\_features



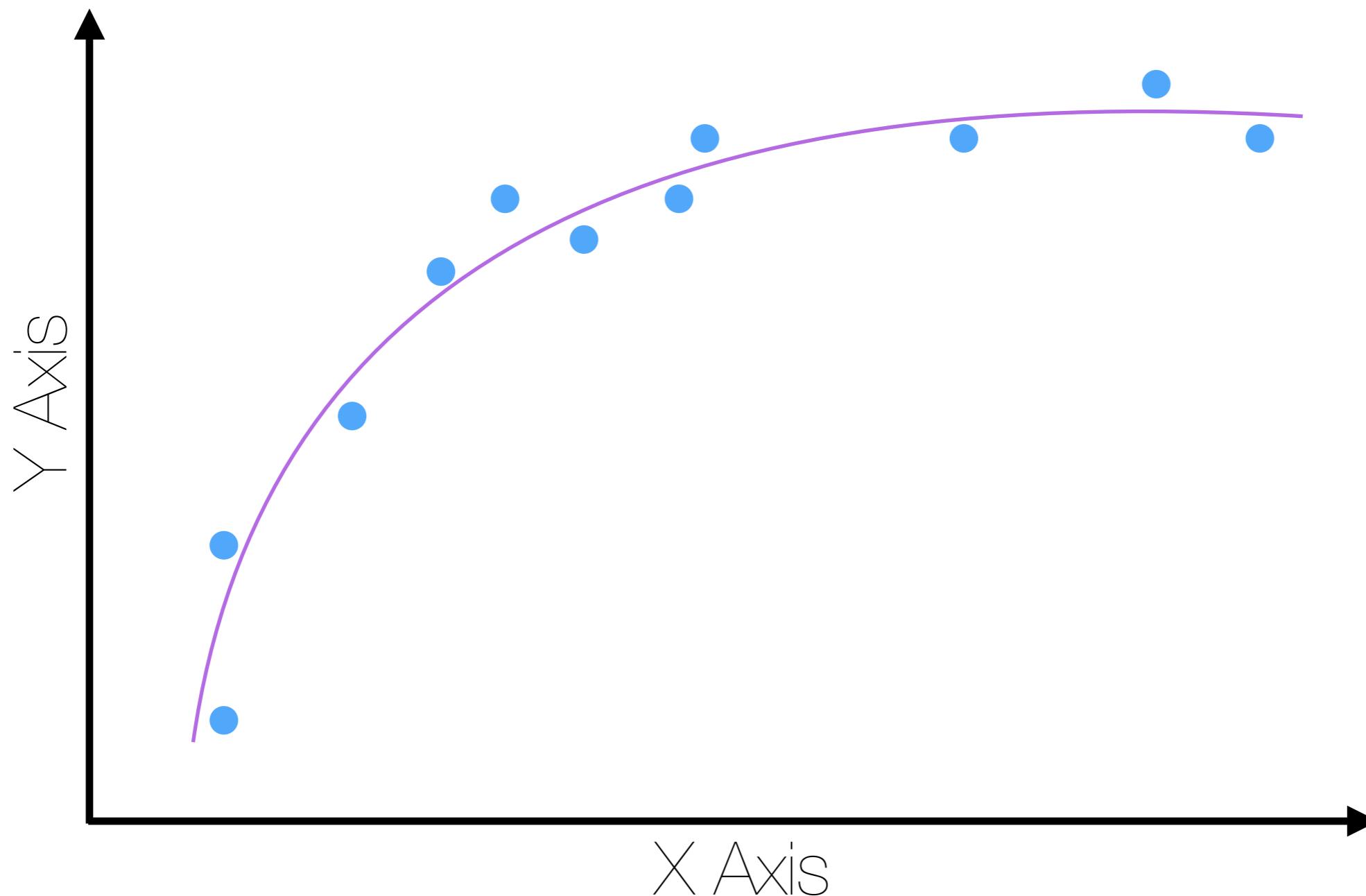
polar\_bar\_demo



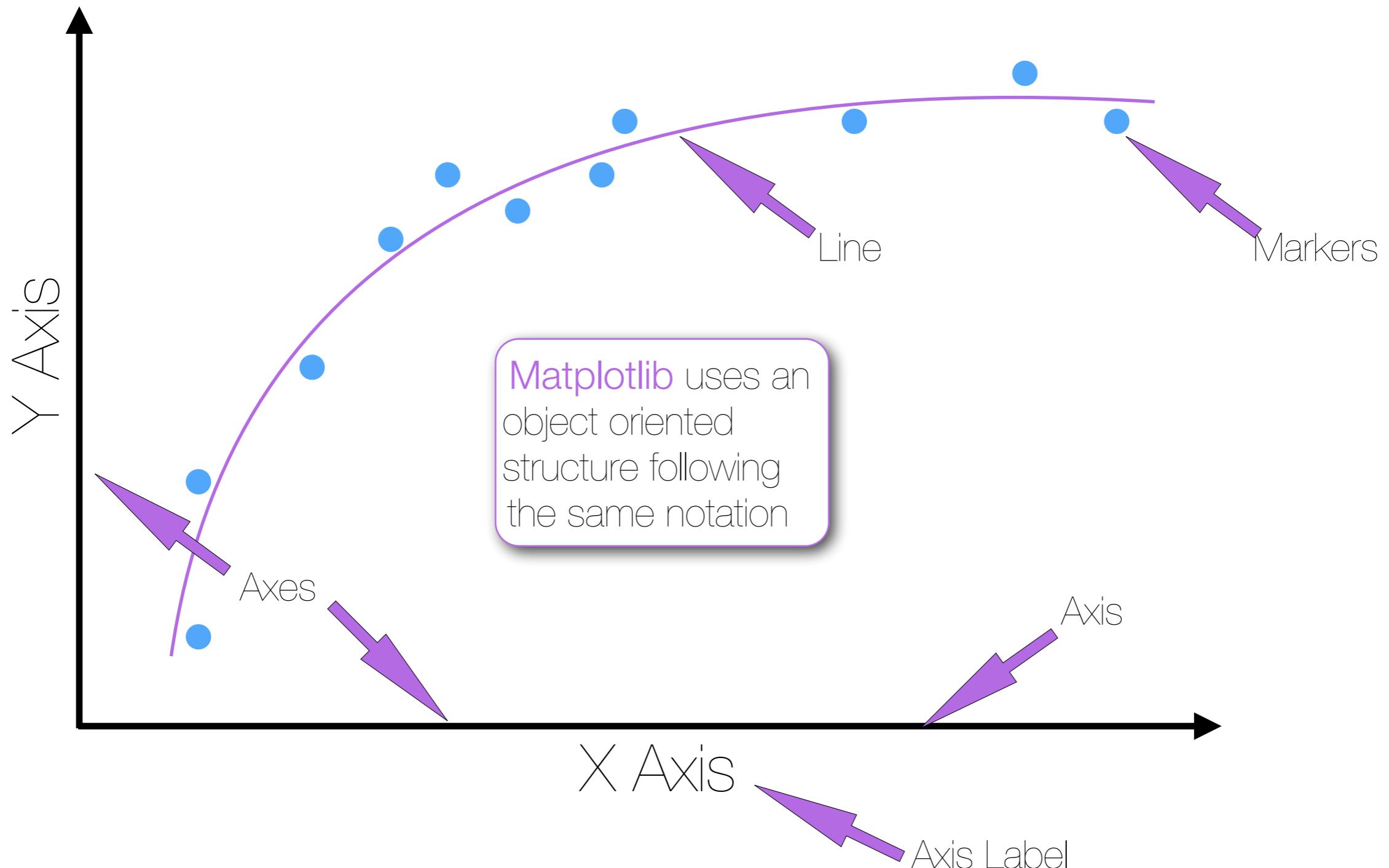
polar\_scatter\_demo

[matplotlib.org/gallery.html](http://matplotlib.org/gallery.html)

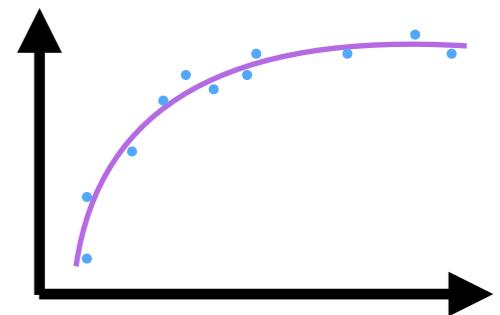
# Basic Plotting



# Basic Plotting



# Basic Plotting

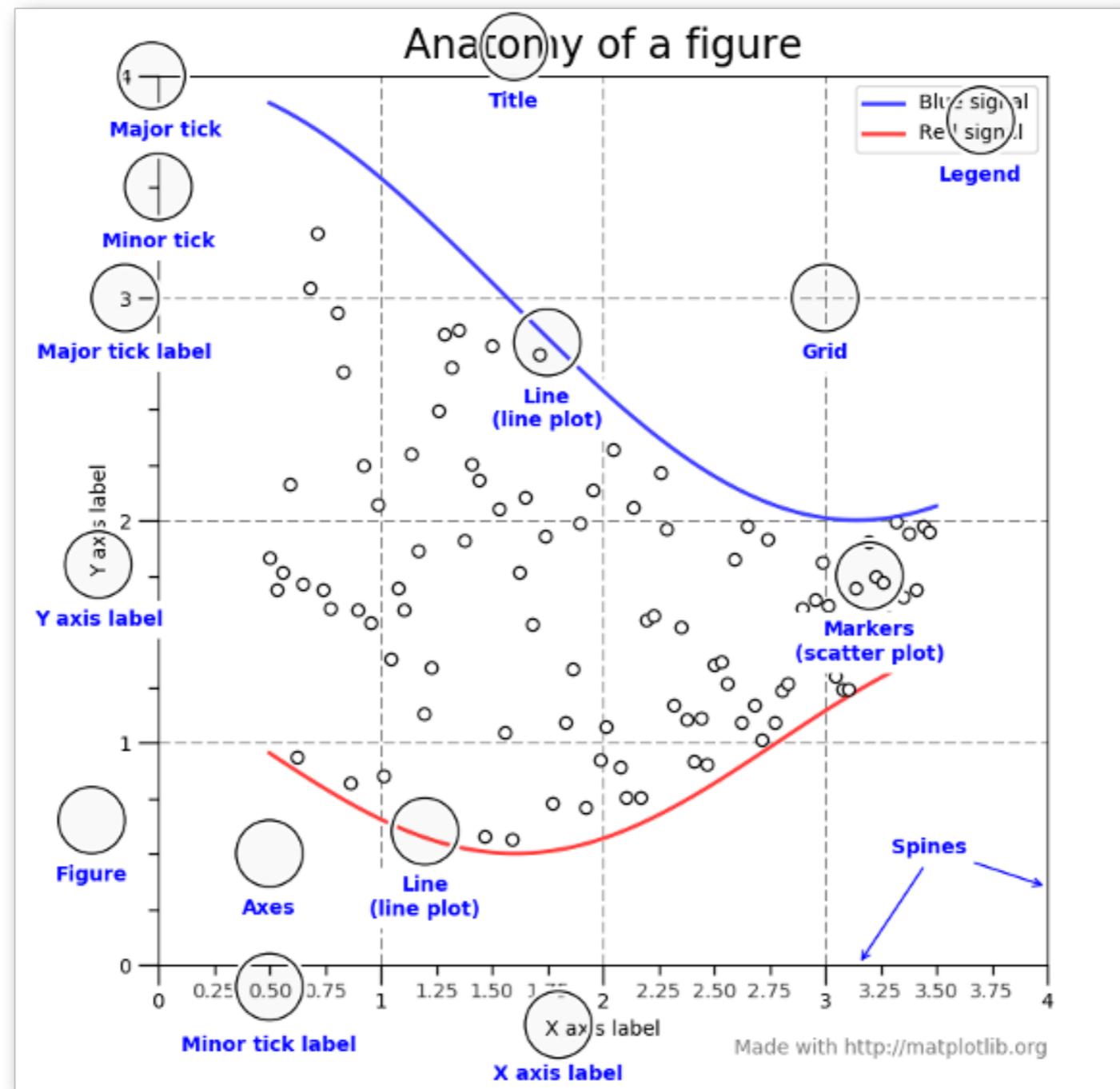


[matplotlib.org/3.1.0/](https://matplotlib.org/3.1.0/)

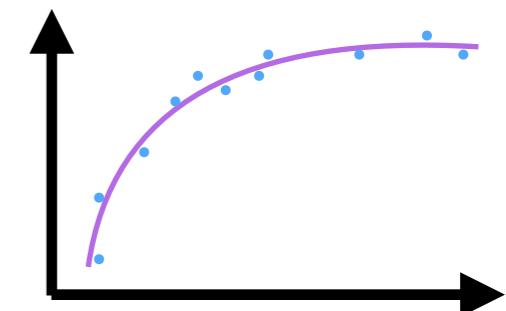
- Matplotlib uses an object oriented structure following an intuitive notation
- Each Axes object contains one or more Axis objects.
- A Figure is a set of one or more Axes.
- Each Axes is associated with exactly one Figure and each set of Markers is associated with exactly one Axes.
- In other words, Markers/Lines represent a dataset that is plotted against one or more Axis. An Axes object is (effectively) a subplot of a Figure.

# Basic Plotting - Programmatically!

[matplotlib.org/3.1.0/](http://matplotlib.org/3.1.0/)



# Basic Plotting - Programmatically!



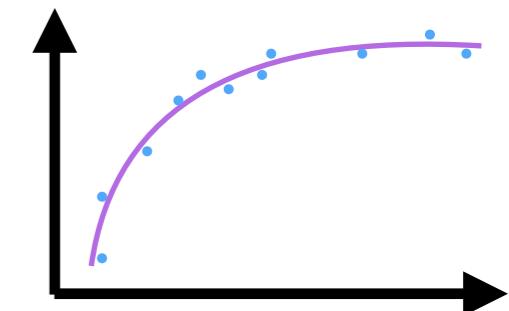
[matplotlib.org/3.1.0/](https://matplotlib.org/3.1.0/)

- While the `Figure` object controls the way in which the figure is displayed.

- `.gca()` - Get the current `Axes`, creating one if necessary
- `.show()` - Show the final figure
- `.savefig("filename.ext", dpi=300)` - Save the figure to “filename.ext” where “.ext” defines the format the saved image ()

```
filetypes = {'ps': 'Postscript', 'eps': 'Encapsulated Postscript', 'pdf': 'Portable Document Format',
'pgf': 'PGF code for LaTeX', 'png': 'Portable Network Graphics', 'raw': 'Raw RGBA bitmap', 'rgba': 'Raw
RGBA bitmap', 'svg': 'Scalable Vector Graphics', 'svgz': 'Scalable Vector Graphics', 'jpg': 'Joint
Photographic Experts Group', 'jpeg': 'Joint Photographic Experts Group', 'tif': 'Tagged Image File
Format', 'tiff': 'Tagged Image File Format'}
```

# Basic Plotting - Programmatically!



[matplotlib.org/3.1.0/](https://matplotlib.org/3.1.0/)

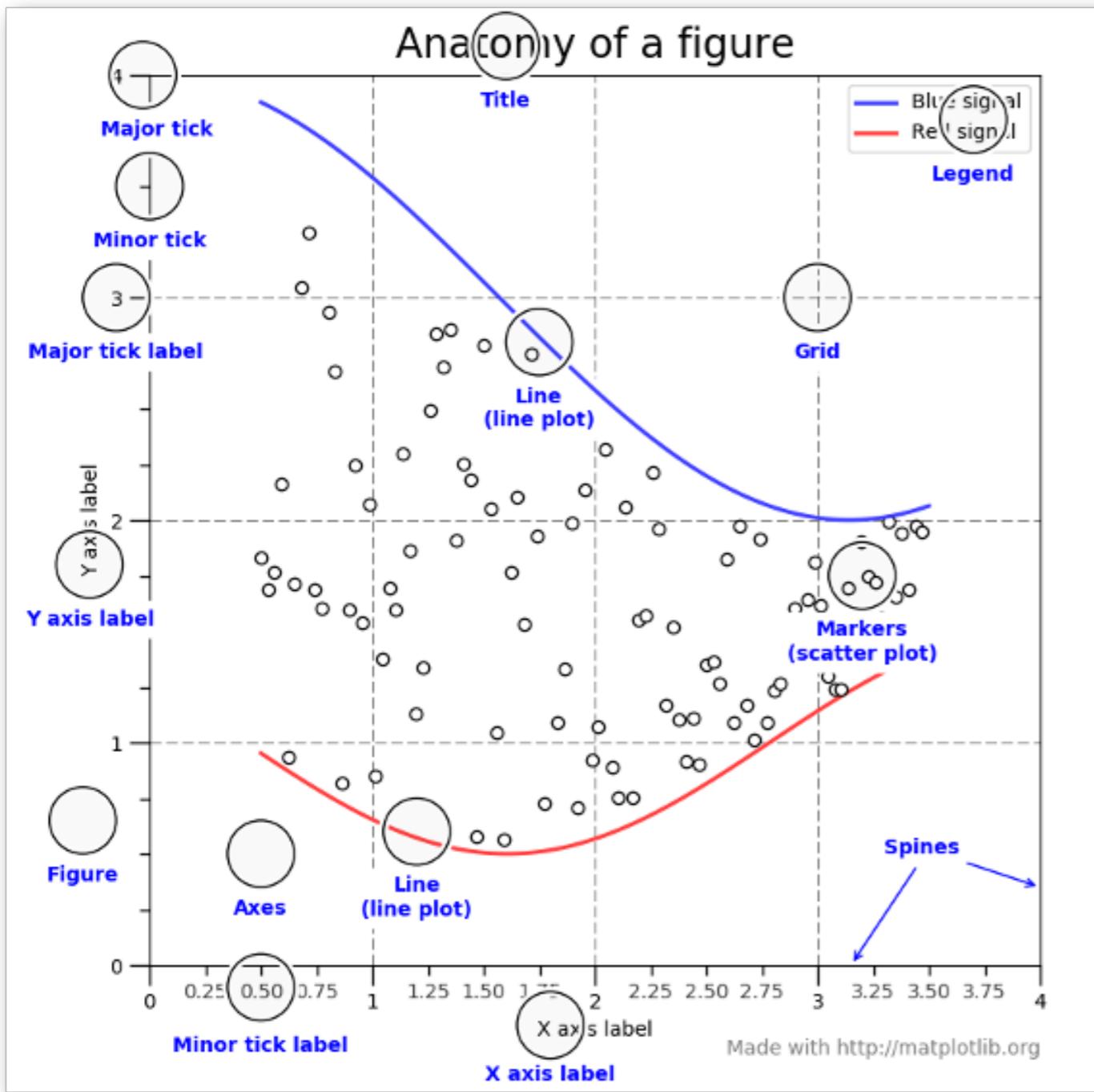
- The first step is to import the pyplot module from matplotlib and instantiating a Figure object:

```
import matplotlib.pyplot as plt  
fig = plt.figure()
```

- The convention is to import **pyplot** as **plt**
- To create subplots (**Axes**) you use **.subplots(nrows, ncols, sharex=False, sharey=False)** instead of **.figure()**. set **sharex** and/or **sharey** to True to keep the same scale in both cases.
- **.subplots** - returns a (**fig, ax\_lst**) tuple where **ax\_lst** is a list of **Axes** and **fig** is the **Figure**.
- **Axes** have several methods of interest:
  - **.plot(x, y)** - Make a scatter or line plot from a list of x, y coordinates.
  - **.imshow(mat)** - Plot a matrix as if it were an image. Element 0,0 is plotted in the top right corner.
  - **.bar(x, y)** - Make a bar plot where x is a list of the lower left coordinates of each bar and y is the respective height.
  - **.pie(values, labels=labels)** - Produce a pie plot out of a list of **values** list and labeled with **labels**
  - **.savefig(filename)** - Write the current figure as an static image

# matplotlib - decorations

[matplotlib.org/3.1.0/](https://matplotlib.org/3.1.0/)



- The respective functions are named in an intuitive way, Every `Axes` object has as methods:
  - `.set_xlabel(label)`
  - `.set_ylabel(label)`
  - `.set_title(title)`
- And axis limits can be set using:
  - `.set_xlim(xmin, xmax)`
  - `.set_ylim(ymin, ymax)`
- Tick marks and labels are set using:
  - `.set_xticks(ticks)/.set_yticks(ticks)`
  - `.set_xticklabels(labels)/.set_yticklabels(labels)`

## matplotlib - Images

[matplotlib.org/3.1.0/](https://matplotlib.org/3.1.0/)

- `plt.imshow(fig)` - Display an image on a set of axes.
- `plt.imshow(fig, extent=(xllcorner, xurcorner, yllcorner, yurcorner), zorder=-1)`
- `fig` can be any matrix of numbers.
- Further plotting can occur by simply using the functions described above



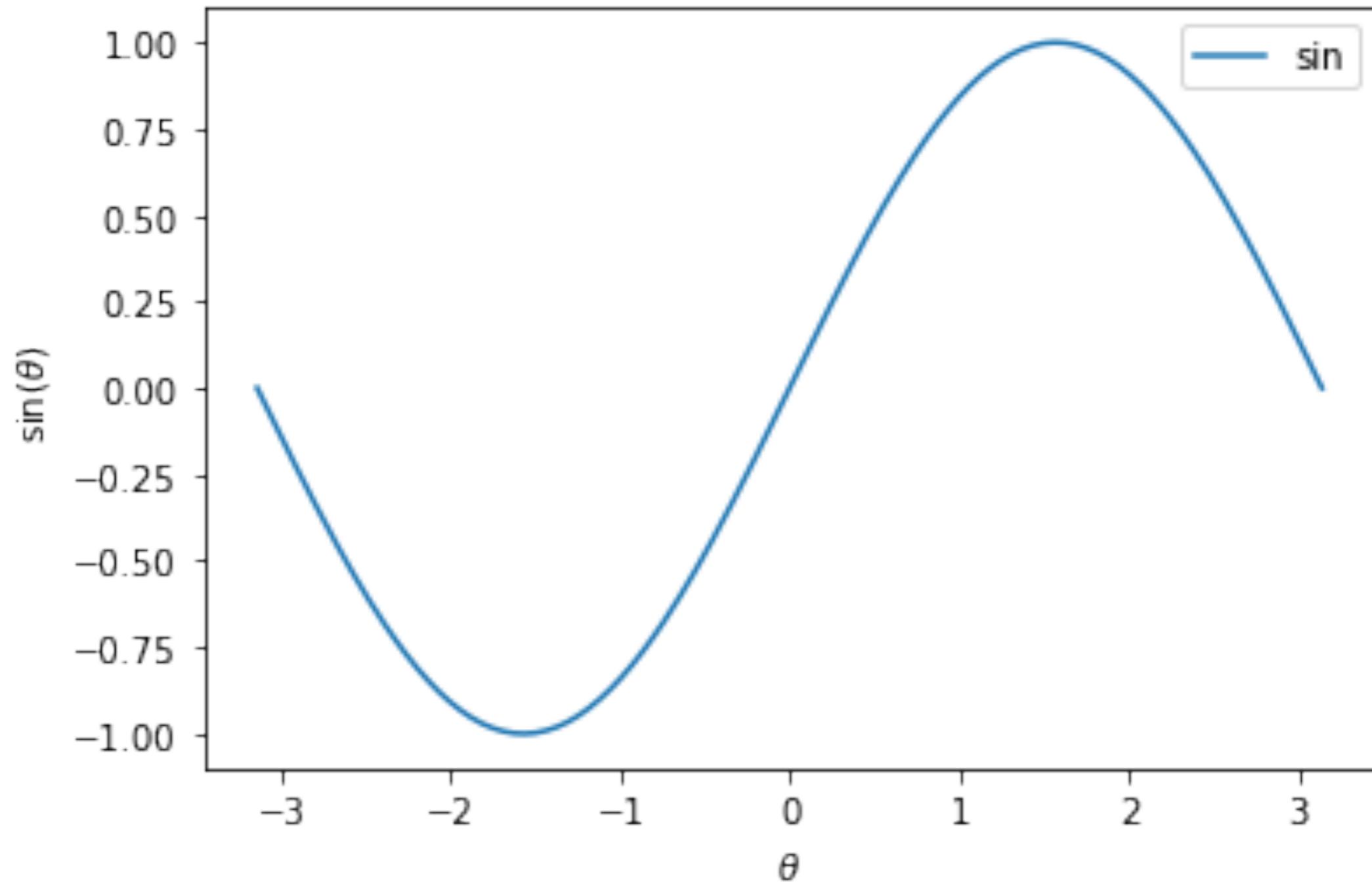
Style sheets

# matplotlib style sheet

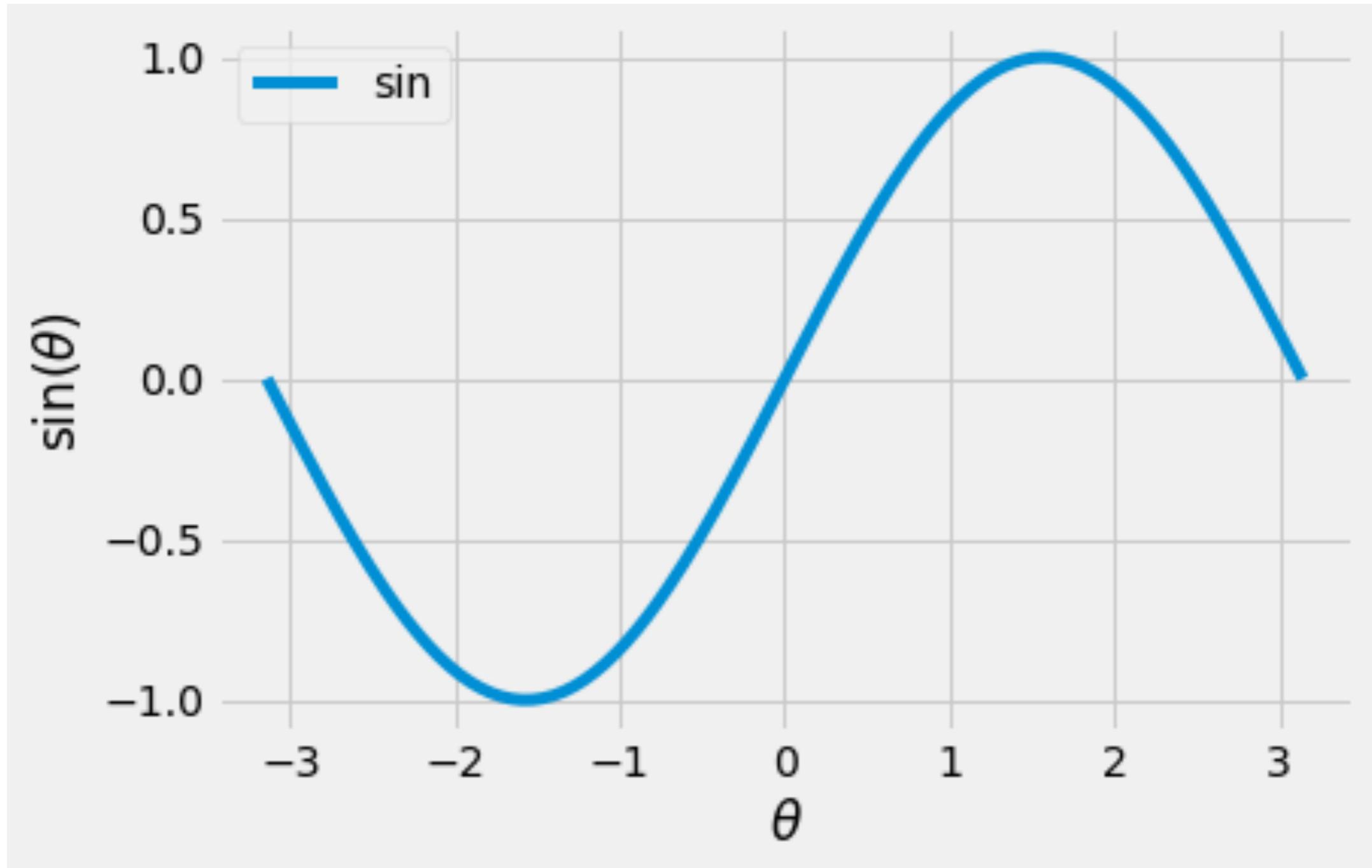
- Manually customizing each figure can become **cumbersome**
- **style sheets** allow us to define our own figure defaults that will apply to every figure from then on.
- matplotlib comes with several pre-defined styles
- **plt.style.available** returns a list of all available styles
- style sheets are simple text files with **.mplstyle** extension
- The default directory for custom style sheets is: **<config\_directory>/stylelib** and your personal config directory is returned by **matplotlib.get\_configdir()**
- The contents of all style files known to matplotlib are available as the **matplotlib.style.library** dictionary keyed by the **style name**

[matplotlib.org/tutorials/introductory/customizing.html](http://matplotlib.org/tutorials/introductory/customizing.html)

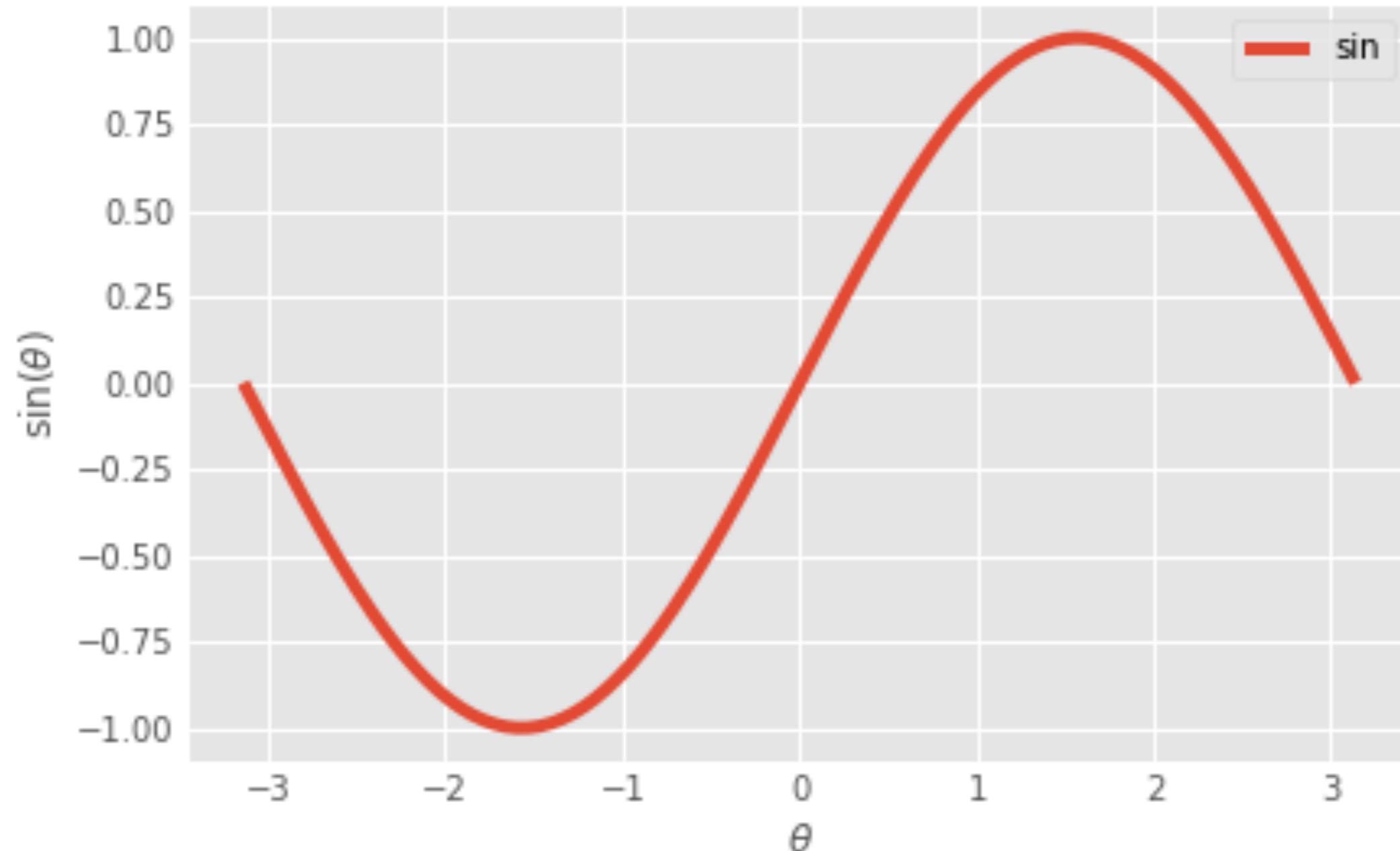
default style



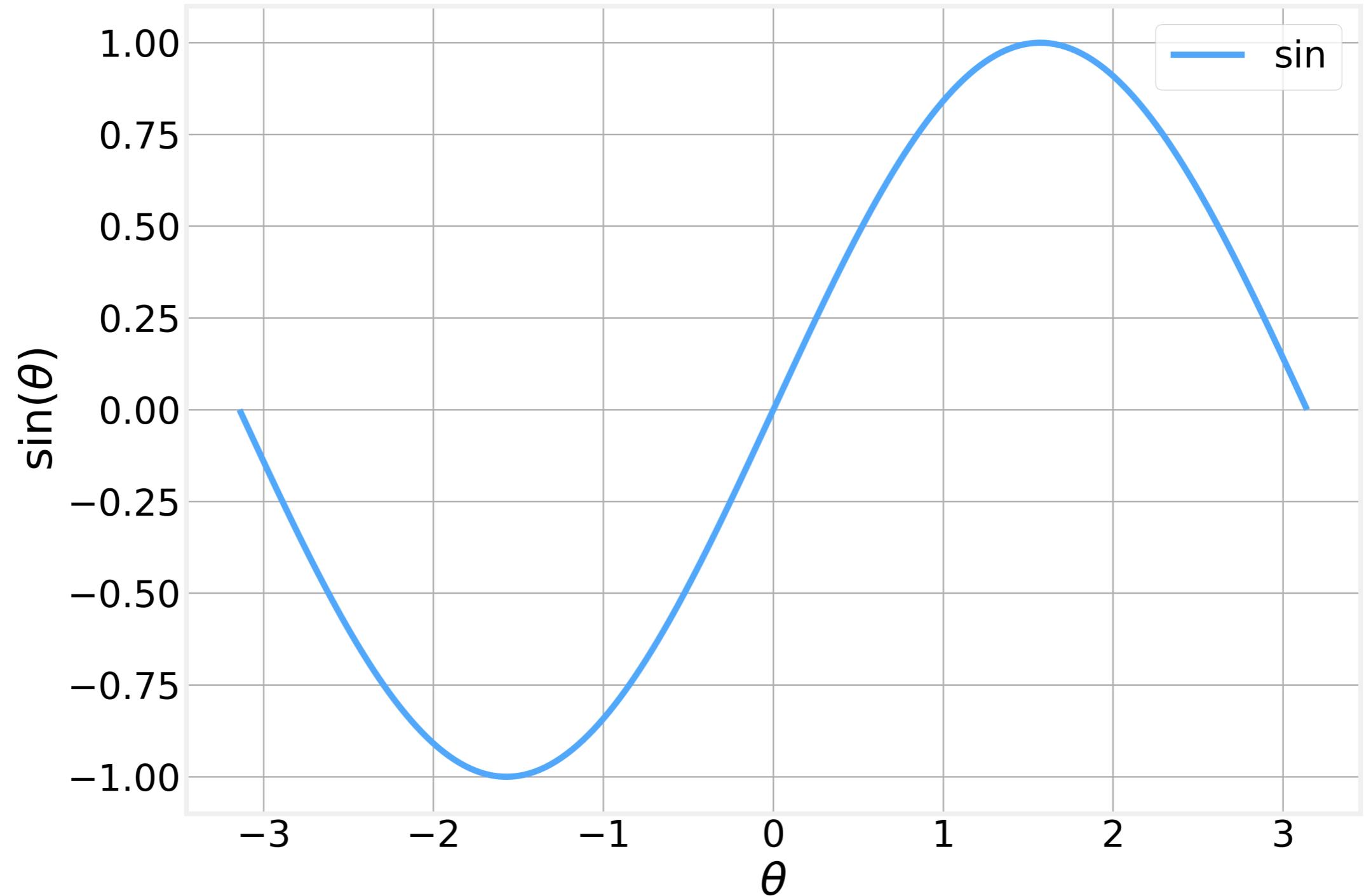
fivethirtyeight style



## ggplot style



d4sci style





Matplotlib Basemap

# Basemap

[matplotlib.org/basemap/](http://matplotlib.org/basemap/)

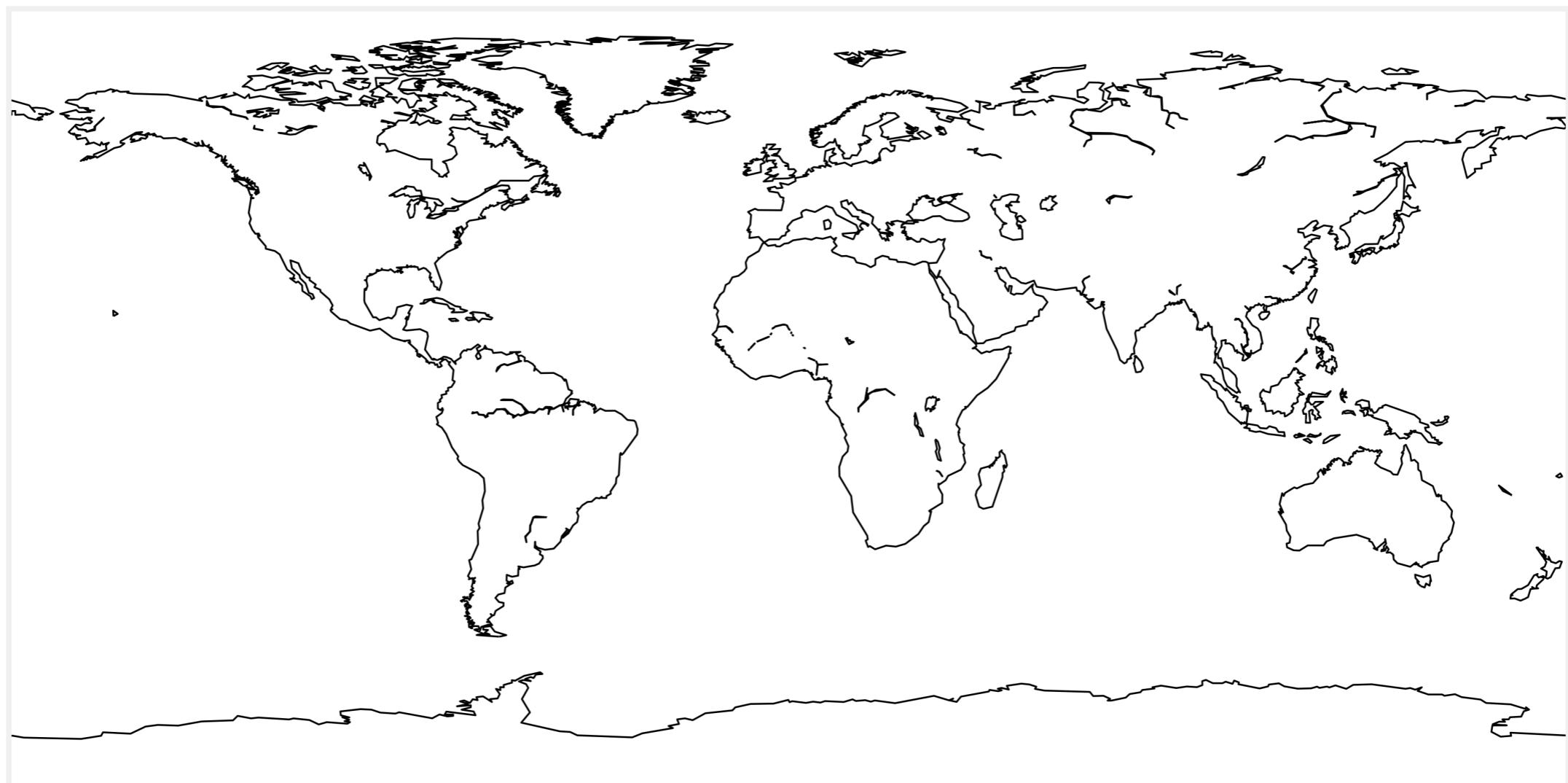
- The **Basemap** module is the workhorse and returns a **Basemap** object when instantiated.
- The **Basemap** object has many useful methods to assist in drawing a map:
  - **.drawcoastlines()** - To draw the coastlines of continents
  - **.drawmapboundary()** - To draw the boundary of the map
  - **.fillcontinents()** - add color to the continents
  - etc...
- The constructor for **Basemap** can take many different arguments to be able to handle different projections, but it defaults to the **Plate Carrée** projection centered at **(0, 0)**
- The minimal map is simply:

```
from mpl_toolkits.basemap import Basemap  
import matplotlib.pyplot as plt  
  
map = Basemap()  
map.drawcoastlines()  
plt.savefig('basemap_demo.png')
```

- Please note that with the **.drawcoastlines()** call nothing is plotted as our map has no

# Basemap

[matplotlib.org/basemap/](http://matplotlib.org/basemap/)



# Basemap

[matplotlib.org/basemap/](http://matplotlib.org/basemap/)

- We can also visualize just specific regions by setting the bbox and center coordinates by setting

`llcrnrlon, llcrnrlat, urcrnrlon, urcrnrlat`

- And

`lat_0, lon_0`

- Respectively.

- We can convert arbitrary `lat, lon` values to map coordinates by calling the `map()` object directly.
- After we obtain the map coordinates we can add them to the map by calling the `.plot(x, y)` method of the `map` object.
- Naturally, we also have complete control over all the properties of the `Figure` and `Axes` objects, allowing us to draw fairly sophisticated maps in a variety of projections

# Basemap

[matplotlib.org/basemap/](http://matplotlib.org/basemap/)



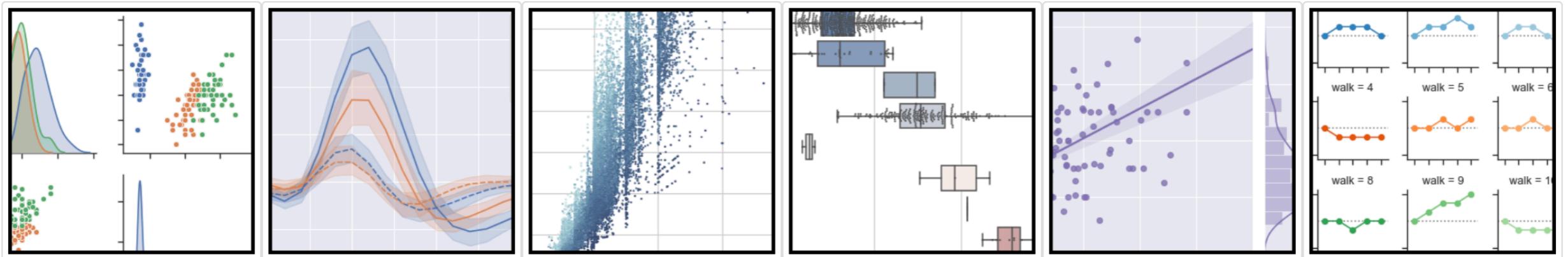


Seaborn

# seaborn

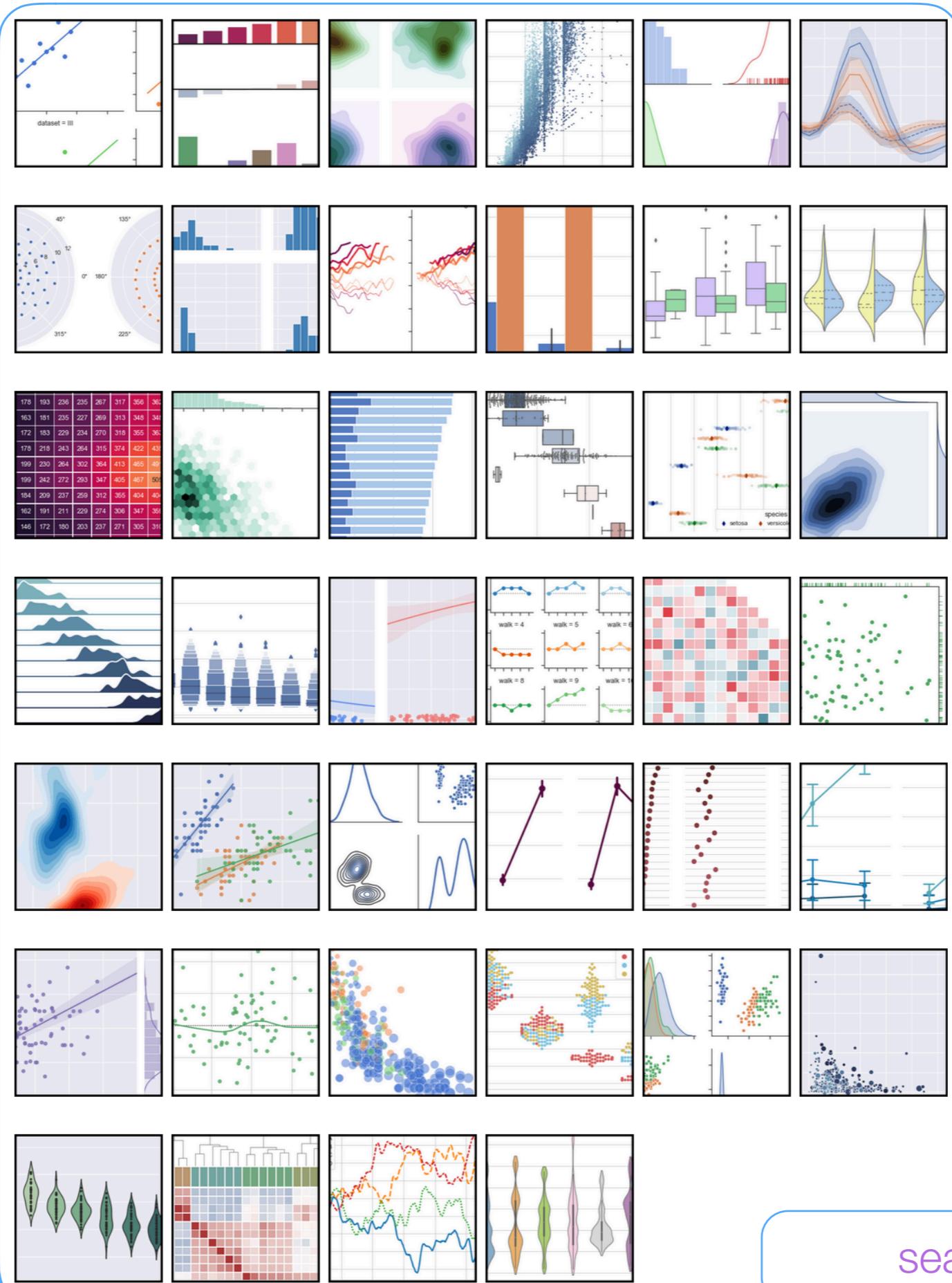
[seaborn.pydata.org](https://seaborn.pydata.org)

## seaborn: statistical data visualization



"[Seaborn](#) is a library for making statistical graphics in Python. It is built on top of [matplotlib](#) and closely integrated with [pandas](#) data structures.

[Seaborn](#) aims to make visualization a central part of exploring and understanding data. Its dataset-oriented plotting functions operate on dataframes and arrays containing whole datasets and internally perform the necessary semantic mapping and statistical aggregation to produce informative plots."



[seaborn.pydata.org](http://seaborn.pydata.org)

@bgoncalves

# seaborn

seaborn.pydata.org

- The first step is to import the `seaborn` module:

```
import seaborn as sns
```

- The convention is to import `seaborn` as `sns` (`sns` is a geeky reference to Sam Norman Seaborn, a fictional character on the television show `The West Wing`)
- The `sns` module contains all the functions we will use as direct members.

# seaborn - datasets

seaborn.pydata.org

- The first step is to import the `seaborn` module:

```
import seaborn as sns
```

- The convention is to import `seaborn` as `sns` (`sns` is a geeky reference to S Seaborn, a fictional character on the television show **The West Wing**)
- The `sns` module contains all the functions we will use as direct members.
- For ease of learning and demonstration, `seaborn` makes it easy to access standard datasets.
- The datasets can be accessed easily by calling the `load_dataset` function with (sans extension) as a parameter:
- `.load_dataset(name)` - where name is “`iris`”, “`mpg`”, etc...
- datasets are returned as “tidy” `pandas` dataframes

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

<a href="#">anscombe.csv</a>
<a href="#">attention.csv</a>
<a href="#">brain_networks.csv</a>
<a href="#">car_crashes.csv</a>
<a href="#">diamonds.csv</a>
<a href="#">dots.csv</a>
<a href="#">exercise.csv</a>
<a href="#">flights.csv</a>
<a href="#">fmri.csv</a>
<a href="#">gammas.csv</a>
<a href="#">iris.csv</a>
<a href="#">mpg.csv</a>
<a href="#">planets.csv</a>
<a href="#">tips.csv</a>
<a href="#">titanic.csv</a>

# seaborn - types of plots

- `seaborn` can handle a large number of different kinds of plots

- `sns.scatterplot()` | Relationship plots

- `sns.lineplot()`

- `sns.stripplot()`

- `sns.swarmplot()`

- `sns.boxplot()`

- `sns.violinplot()`

- `sns.boxenplot()`

- `sns.pointplot()`

- `sns.barplot()`

- `sns.countplot()`

Categorical plots

# seaborn - types of plots

## Axes level

- `sns.scatterplot()`
- `sns.lineplot()`
- `sns.stripplot()`
- `sns.swarmplot()`
- `sns.boxplot()`
- `sns.violinplot()`
- `sns.boxenplot()`
- `sns.pointplot()`
- `sns.barplot()`
- `sns.countplot()`

## Figure level

Relationship plots  
`sns.relplot()`

Figure level functions are equivalent to the axes level ones, (with the right `kind` setting) but more adapted for ease of exploration

Categorical plots  
`sns.catplot()`

For convenience, we will focus on figure level functions

- `kind="scatter"`
- `kind="line"`
- `kind="strip"`
- `kind="swarm"`
- `kind="box"`
- `kind="violin"`
- `kind="boxen"`
- `kind="point"`
- `kind="bar"`
- `kind="count"`

# seaborn - basic function structure

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- The basic plotting functions are designed to work directly with **pandas** data frames
- Every plotting function takes a **data** parameter that is used to pass the correct data frame to the function
- There is no limitation on the number of columns that the **dataframe** can contain.
- The specific **columns** to be plotted are passed by setting other parameters to the respective column names. In particular:
  - **x** - column to plot along the x-axis
  - **y** - column to plot along the y axis
- Plot properties such as **hue**, **size**, **style**, etc can also be set using column names
- In the case of figure level functions, the **kind** parameter determines what specific **type of plot** is produced.

# seaborn - Figure level functions

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- `sns.relplot(x, y, hue, size, style, data, kind)`
  - `x, y` - column names to plot in each axes
  - `hue` - column name specifying how to color each data element
  - `size` - column name to use to determine the size of each element
  - `style` - column name to use to determine the style of each element
  - `data` - dataframe containing the data to plot
  - `kind` - string specifying the type of plot to produce
- `sns.catplot(x, y, hue, order, data, orient, kind)`
  - `orient` - specifies the orientation of the plot ('v' or 'h' for vertical or horizontal)
  - `order` - specifies the order in which the categorical variable (`x` or `y`) is plotted
  - `*_order` - family of parameters that determiner the order in which the respective categorical value (`hue_order`, `style_order`, `size_order`, etc...) is plotted

# seaborn - Figure level functions

- As we saw, axes level and figure level functions are equivalent. Every plot you can generate with an **axes level** function can also be generated by a **figure level** function
- The converse is, however, not true.
- One of the main advantages of **figure level** functions is their ability to easily generate subplots by just passing a couple of extra parameters:
  - **row, col** - specifies the column names to be used to split the dataset and plot along rows and columns
  - **col\_wrap** - width at which to wrap the column. Incompatible with a row setting.
  - **row\_order, col\_order** - work similarly to the other **\*\_order** parameters
- The return types of **axes level** functions and **figure level** function are also different:
  - axes level functions return a **matplotlib Axis** object
  - figure level functions return a **seaborn FacetGrid** object
- Axes level functions can be easily added to a pre-existing **matplotlib** plot by passing an **matplotlib Axis** object to the **ax** parameter.

# FacetGrid

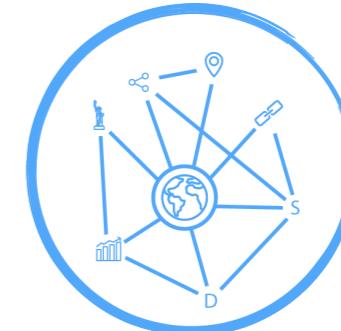
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- **FacetGrid** is the object that **seaborn** uses in the background to generate the subplots.
- You can easily use **FacetGrid** with any **matplotlib** plotting function.
- The process is divided into two steps:
  - First, you instantiate a **FacetGrid** object with the correct data frame and basic plotting parameters (these are the same parameters you would use with any other **seaborn** function).
  - Second, you use the **FacetGrid.map** method to initialize the **FacetGrid** object with the correct **matplotlib** function along with any extra **matplotlib** parameters you require.



[github.com/DataForScience/DataViz](https://github.com/DataForScience/DataViz)

# Events



[www.data4sci.com/newsletter](http://www.data4sci.com/newsletter)



**Deep Learning From Scratch**  
Dec 11, 2019 - 5am-9am (PST)

**Time Series for Everyone**  
Jan 17, 2019 - 5am-9am (PST)

**Applied Probability Theory for Everyone**  
Jan 27, 2019 - 5am-9am (PST)



**Natural Language Processing (NLP) from Scratch**  
<http://bit.ly/LiveLessonNLP> - On Demand



END