Plotly and the Plotly Figure

INTRODUCTION TO DATA VISUALIZATION WITH PLOTLY IN PYTHON

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What is Plotly?

- A JavaScript graphing library
  - Don't worry - no need to know JavaScript!
- Plotly has a Python wrapper

Why Plotly?

Plotly has a number of unique advantages:

- Fast and easy to use
- Low code/low effort options using `plotly.express`
- (If desired) Extremely customizable
- Built-in interactivity

Creating Plotly Figures

Plotly graphs can be created:

1. With `plotly.express` for quick plots (`px`)
2. With `plotly.graph_objects` (`go`) for more customization

 We will spend most of our time on `px`

The importance of documentation

Save the links to key documentation!

1. **Interactive documentation**
2. **Detailed reference page** for specific plots

For Scatter plots:

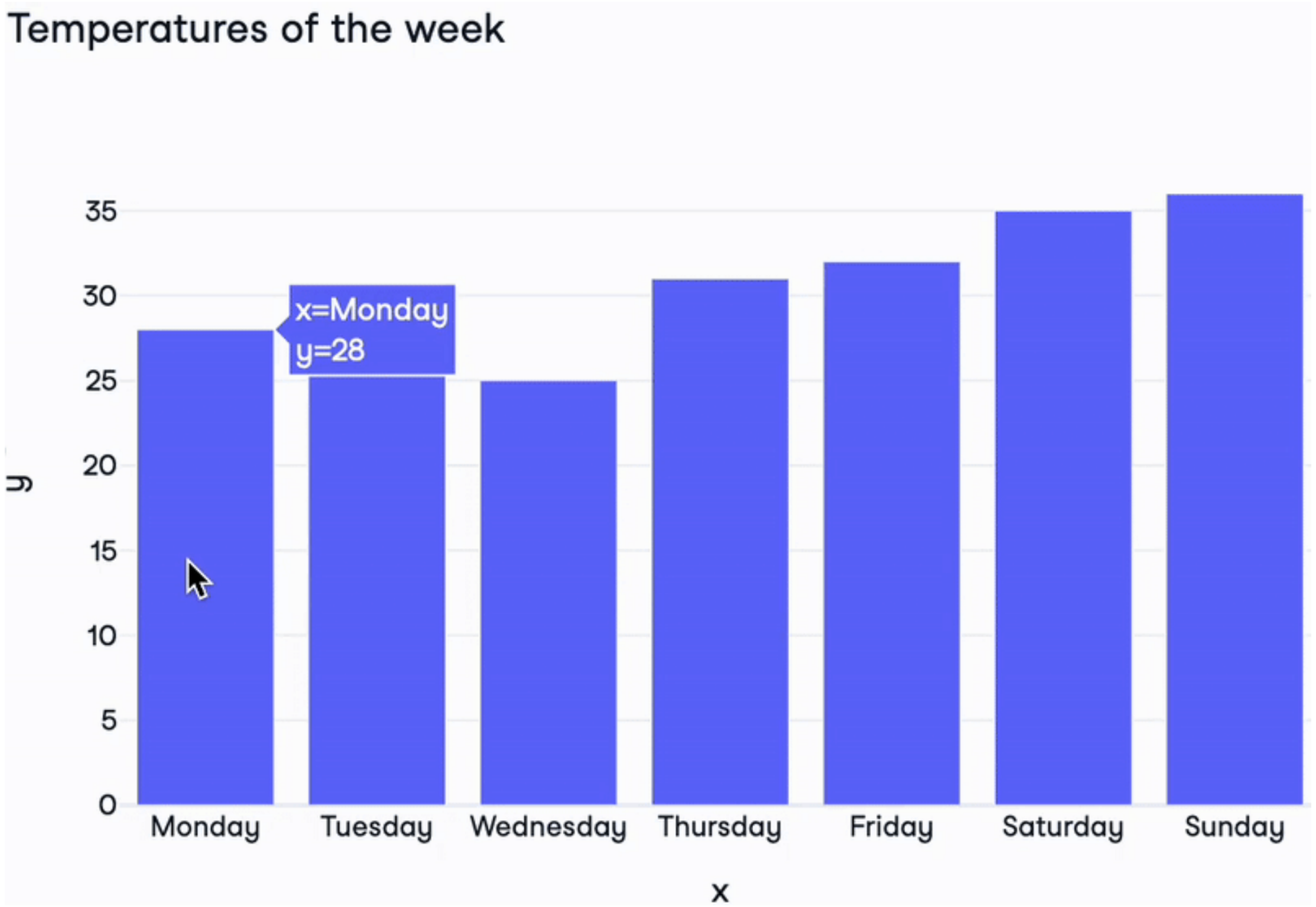
- `plotly.express` **page** with examples
- **Technical reference** for the underlying object

Creating our Figure

A basic plotly figure:

```
import plotly.express as px
days = ["Monday", "Tuesday", "Wednesday", "Thursday",
        "Friday", "Saturday", "Sunday"]
temperatures = [28, 27, 25, 31, 32, 35, 36]
fig = px.bar(
    x=days,
    y=temperatures,
    title="Temperatures of the week")
fig.show()
```

Our Figure revealed



The Plotly Figure

Plotly Figure components:

- `layout` : Dictionary controlling style of the figure
  - One `layout` per figure
- `data` : List of dictionaries setting graph type and data itself
  - Data + type = a `trace` . There are over 40 types!
  - Can have multiple traces per graph
- `frames` : For animated plots (beyond this course)

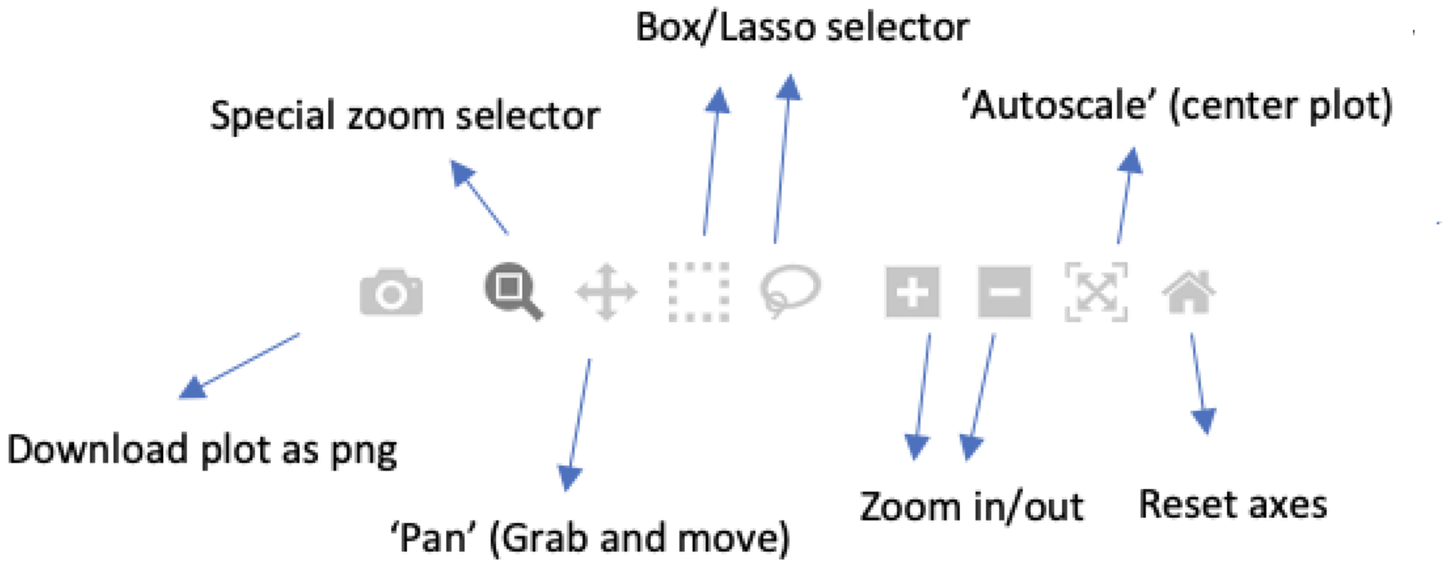
Inside a Plotly Figure

```
print(fig)
```

```
Figure({'data': [{'type': 'bar',
              'x': array(['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday'
              , 'Saturday','Sunday'], dtype=object),
              'y': {'bdata': 'HBsZHyAjJA==....'}],
    'layout': {'title': {'text': 'Temperatures of the week'}}})
```

Plotly's instant interactivity

- Hover over data points
- Extra interactive buttons



Let's practice!

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Univariate visualizations

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What are univariate plots?

- Univariate plots display only one variable

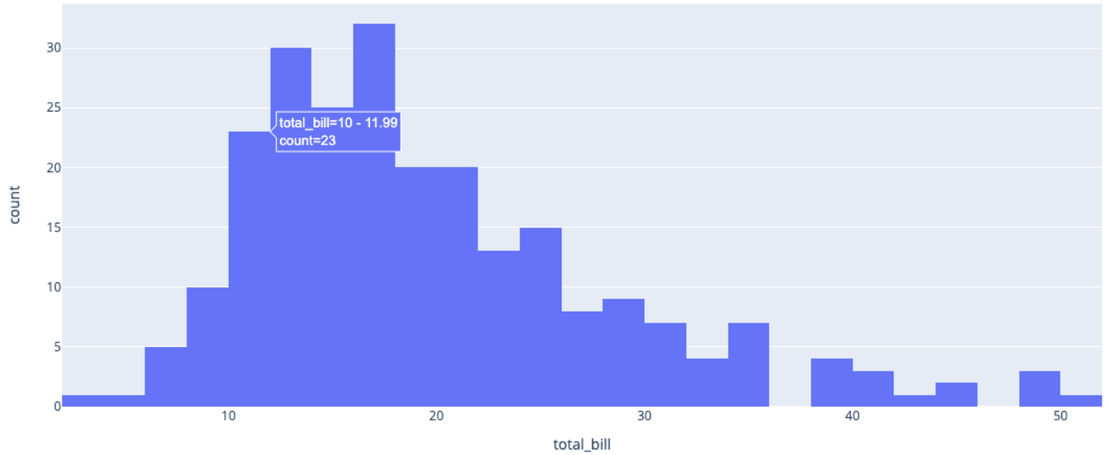
Common univariate plots:

- Bar chart
- Histogram
- Box plot
- Density plots

Histograms

Histograms have:

- Multiple columns (called "bins") representing a range of values
  - The height of each bar = count of samples within that bin range
- The number of bins can be manual or automatic



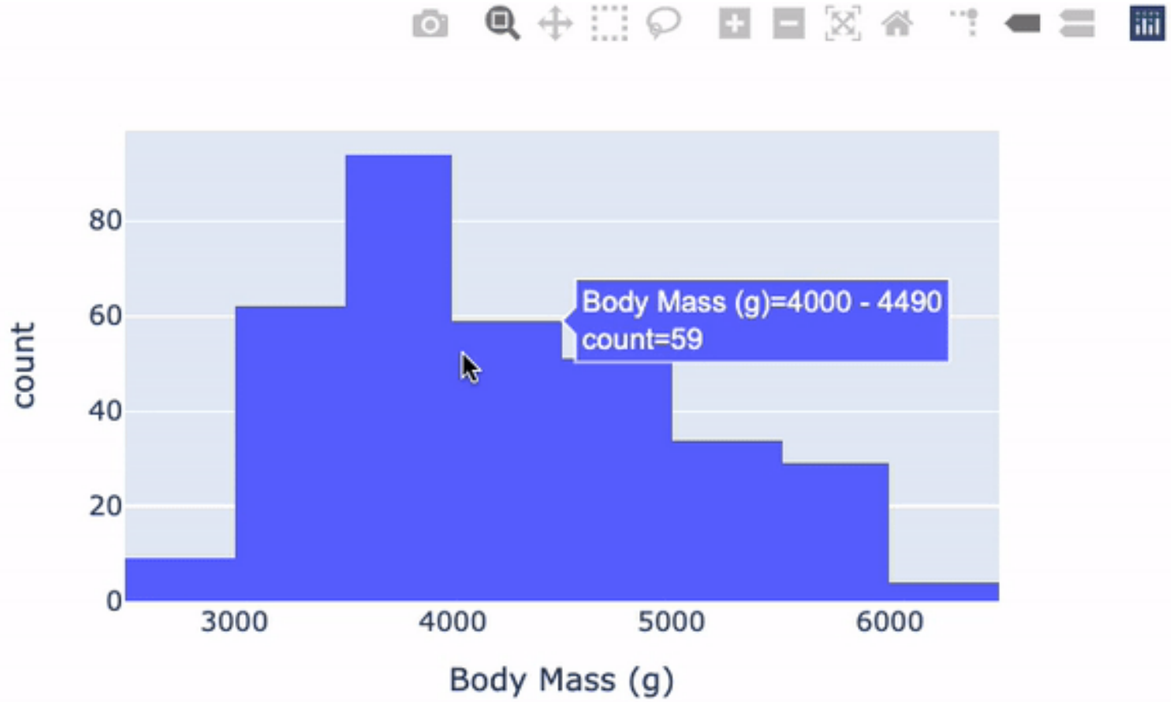
Our dataset

The dataset collected by scientific researchers on Penguins:

- Contains various body measurements like beak size, weight, etc.
- Contains different species, genders, and ages of penguins

Histograms with plotly.express

```
fig = px.histogram(
            data_frame=penguins,
            x="Body Mass (g)",
            nbins=10)
fig.show()
```



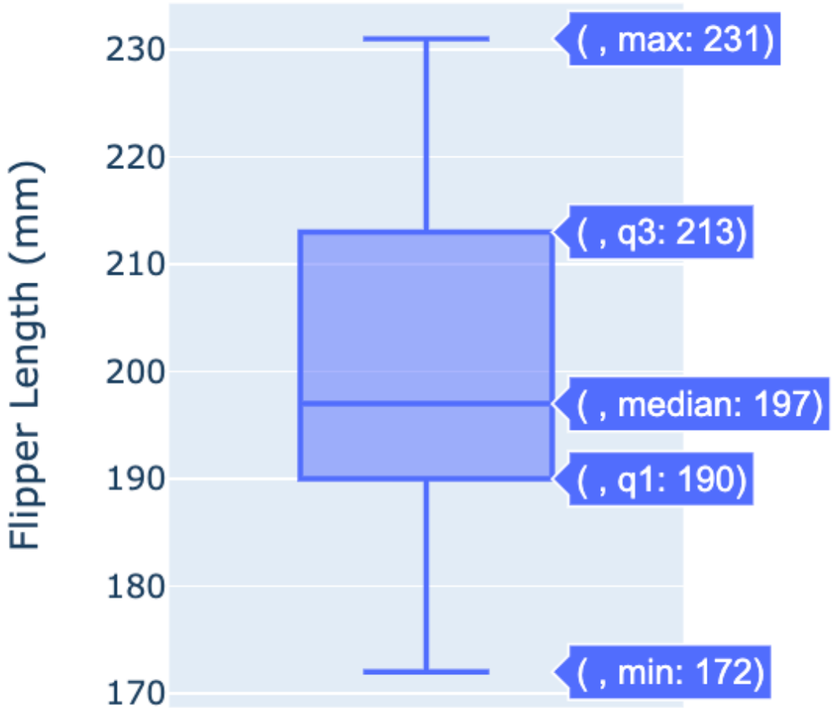
Useful histogram arguments

- `orientation` : To orient the plot vertically (`v`) or horizontally (`h`)
- `histfunc` : Set the bin aggregation (eg: average, min, max).

Check the **documentation** for more

Box (and whisker) plots

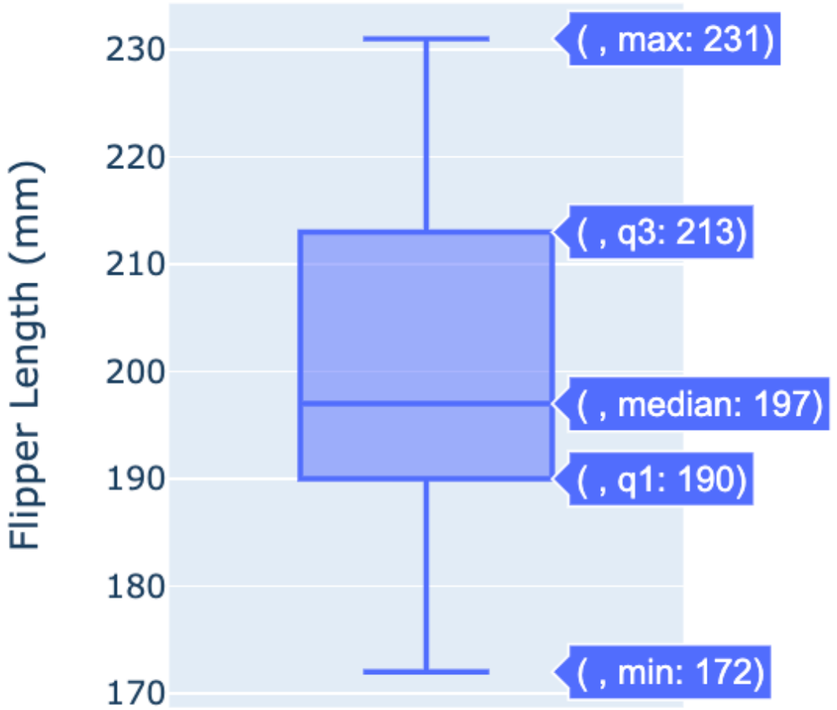
Summarizes a variable using quartile calculations



- Middle area represents *interquartile range*
  - Top line = 3rd quartile (75th percentile)
  - Middle line = median (50th percentile)
  - Bottom line = first quartile (25th percentile)
- Top/bottom bars = min/max, excluding outliers
- Outlying dots are outliers

Box plots with plotly.express

```
fig = px.box(data_frame=penguins,
             y="Flipper Length (mm)")
fig.show()
```



Useful box plot arguments

- `hover_data` : A list of column name(s) to display on hover
  - Useful to understand outliers
- `points` : Further specify how to show outliers

Check the **documentation** for more

Let's practice!

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Customizing color

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Customization in general

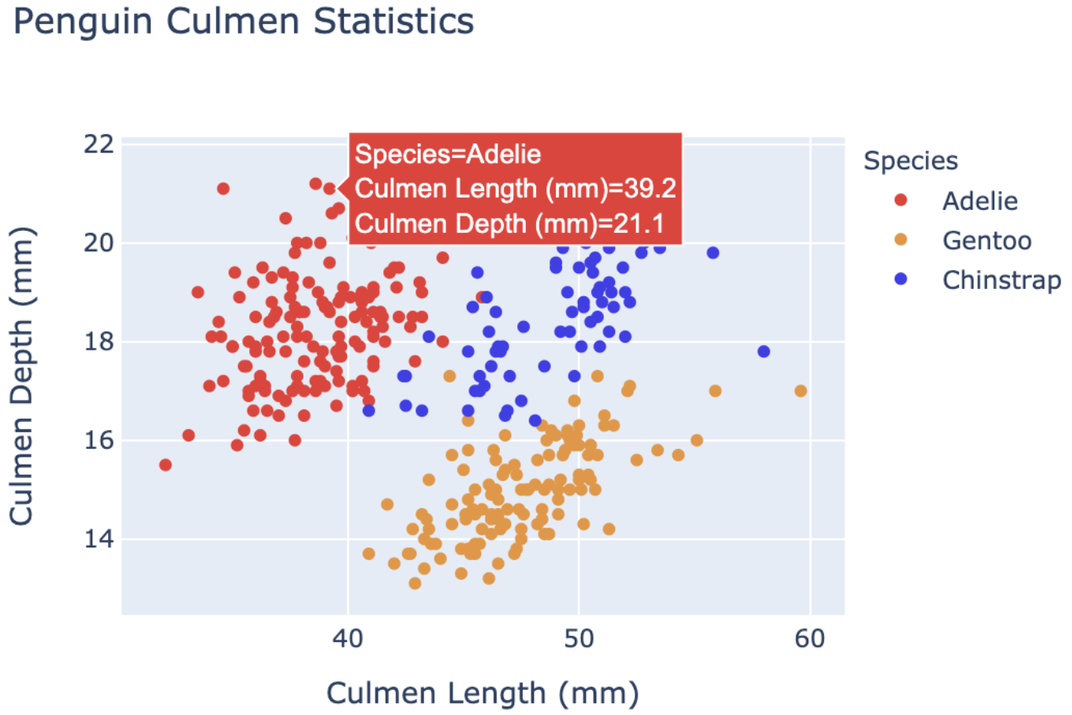
How to customize plots:

1. At plot creation, if an argument exists (like `color`)
2. After plot is created use `update_layout()`
   - Takes a dictionary
   - `fig.update_layout({"title":{"text":"A New Title"}})`

Why customize color?

Customizing color can help:

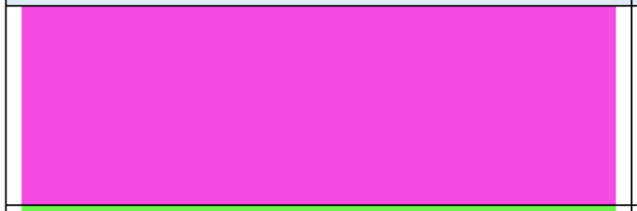
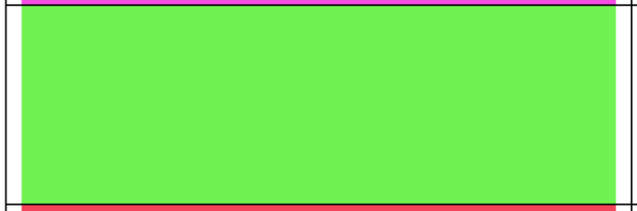
1. Make plots look awesome!
2. Convey analytical insights
   - Color in this scatterplot adds a 3rd dimension.



Some color theory

Computers use RGB encoding to specify colors:

- RGB = A 3-digit code (each 0-255) mixing **R**ed, **G**reen, **B**lue
  - (0,0,255) is blue and (255,255,0) is yellow

Color	RGB Code
	(245, 66, 230)
	(105, 245, 66)
	(245, 66, 87)
	(50, 47, 247)

See more in this **article**

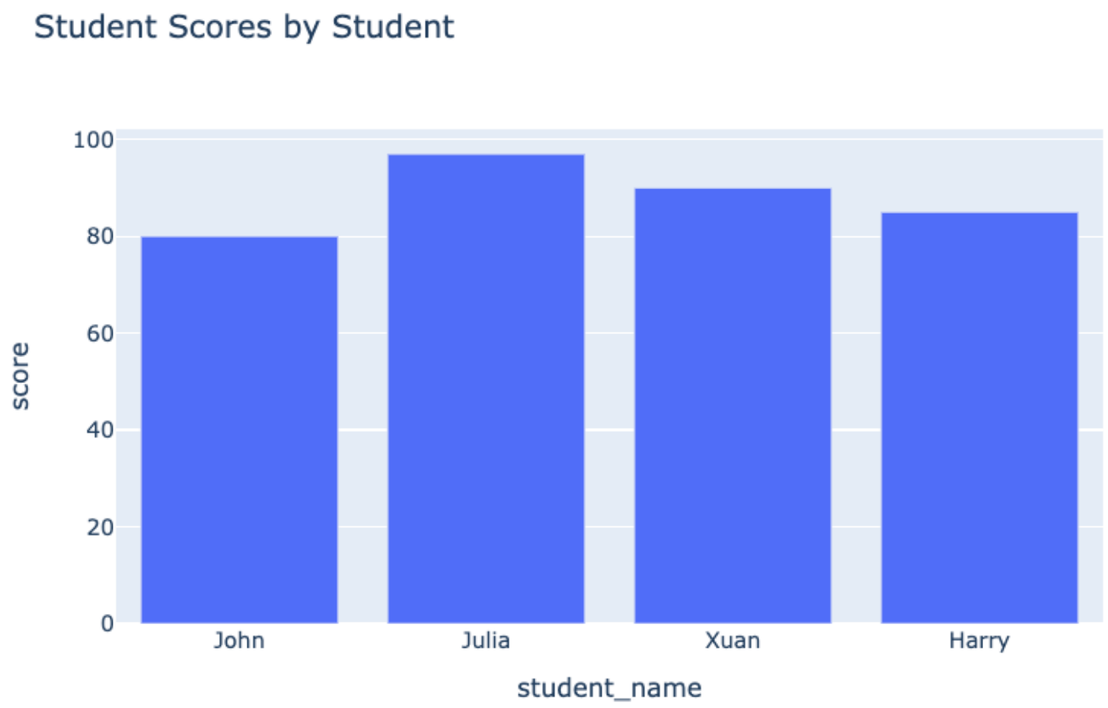
Specifying colors in plotly.express

- `color` argument (DataFrame column)
  - Each category gets a color (*automatically*)
  - A color scale is used for numerical columns

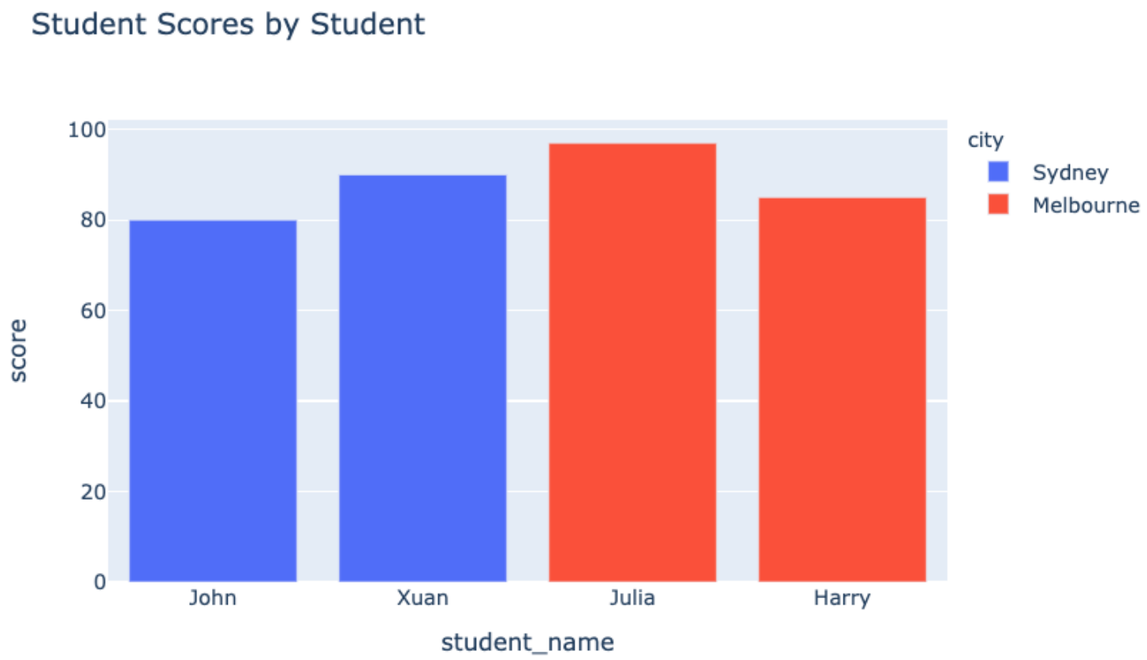
```
fig = px.bar(data_frame=student_scores,
       x="student_name",
       y="score",
       title="Student Scores by Student"
       color="city")
fig.show()
```

Our colors revealed

The plot before:



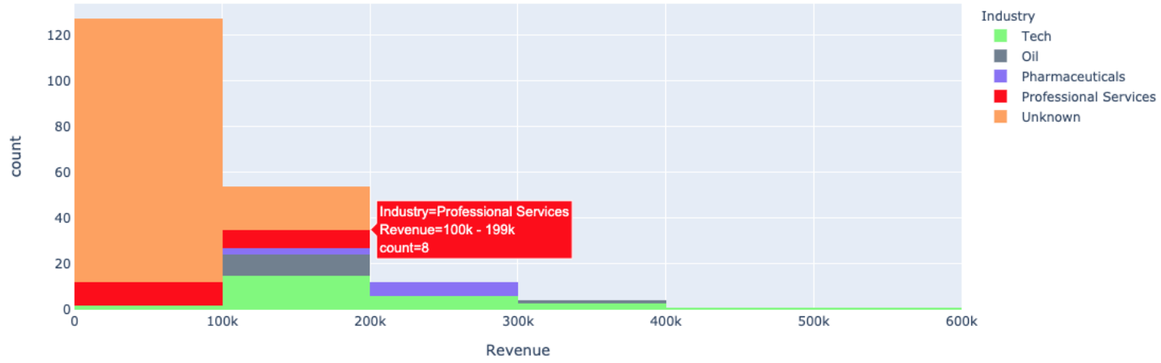
Our plot after:

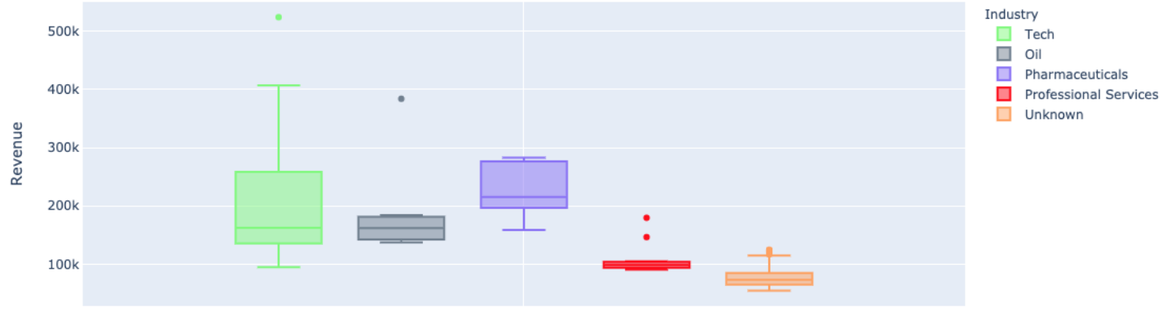


Color with univariate plots

Using `plotly.express` `color` argument with univariate (bar, histogram) plots:

- Histograms - stacked bars
- Box plots - produces multiple plots



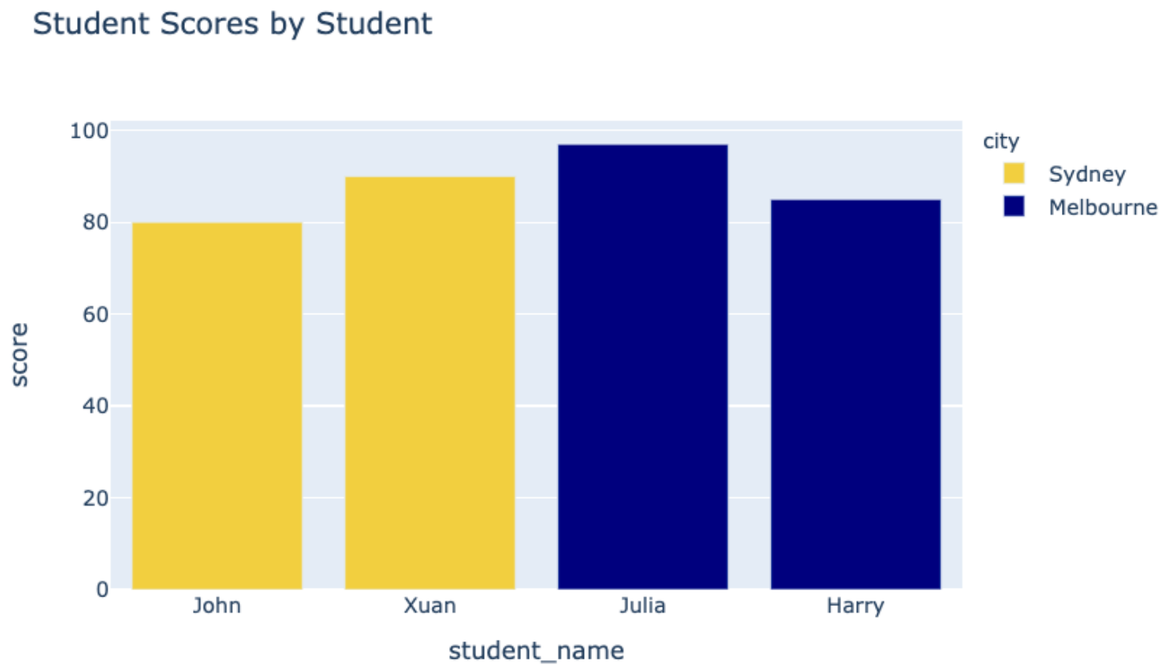


Specific colors in plotly.express

- `color_discrete_map` : A dictionary that maps categorical values to colors
- Can also express (basic) colors as strings such as `"red"` , `"green"` etc.

Our specific colors

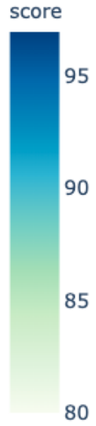
```
fig = px.bar(
    data_frame=student_scores,
    x="student_name", y="score",
    title="Student Scores by Student",
    color_discrete_map={
    "Melbourne": "rgb(0,0,128)",
    "Sydney": "rgb(235, 207, 52)"},
    color="city")
```



Color scales in plotly.express

- Single color scales (light to dark green)

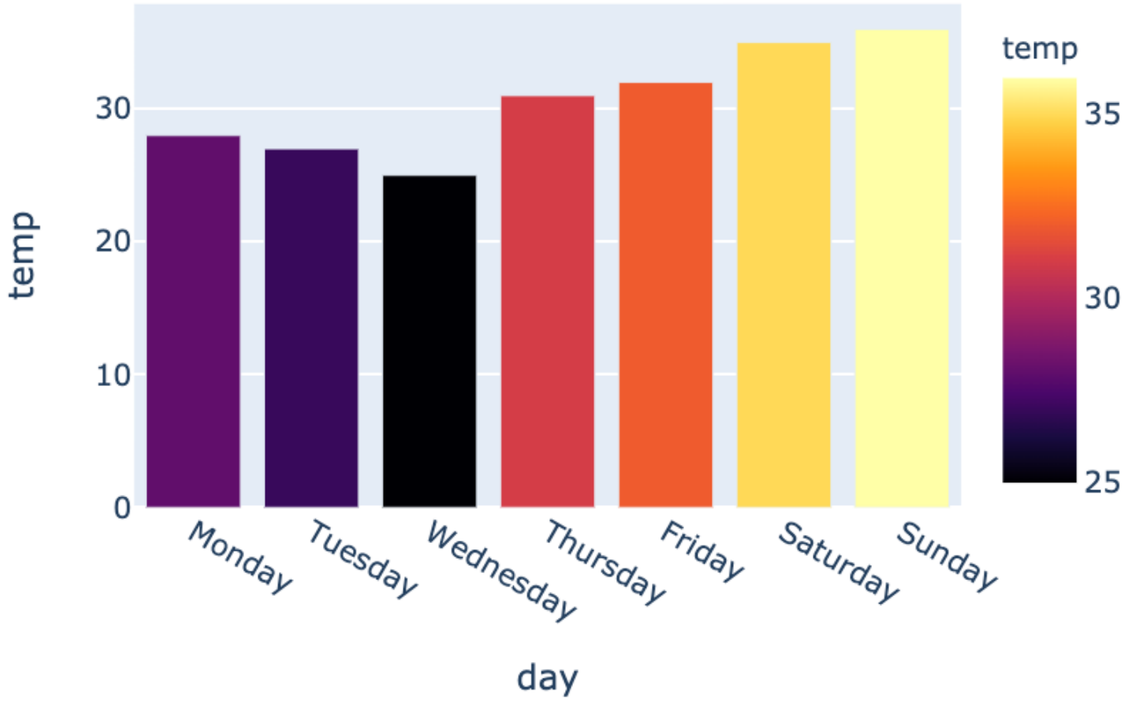
- Blended gradient (green into blue)



- `color_continuous_scale` argument for color scales.

Using built-in color scales

```
fig = px.bar(data_frame=weekly_temps,
    x="day", y="temp",
    color="temp",
    color_continuous_scale="inferno")
fig.show()
```

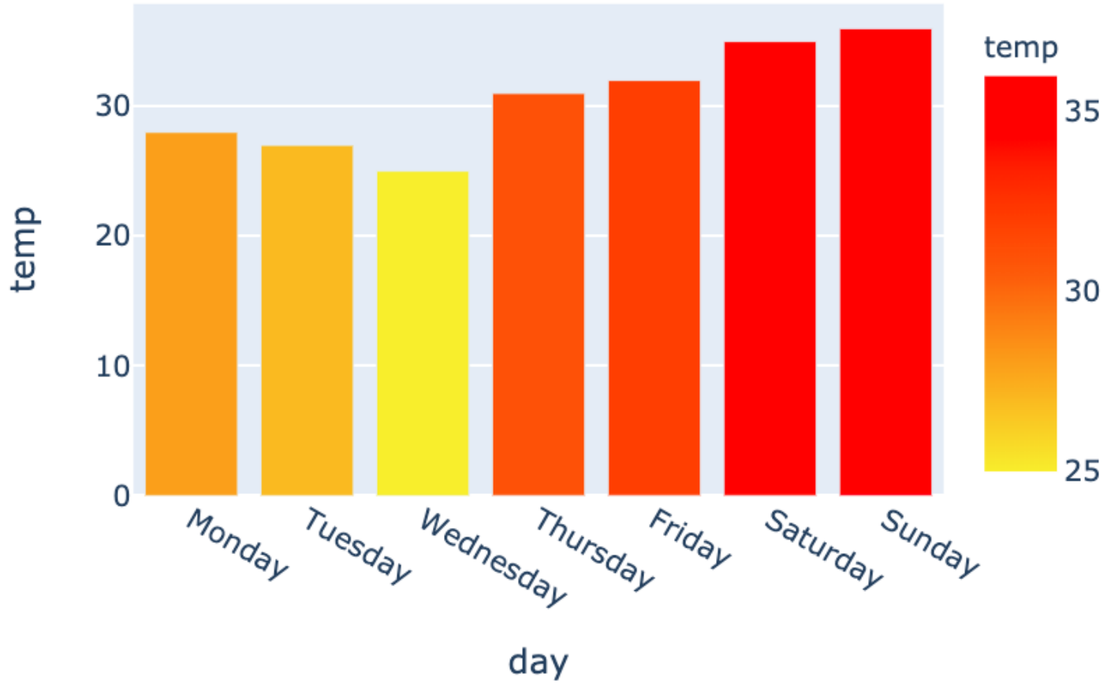


- Many **built-in scales** available

Constructing our own color range

- Custom color scale (yellow - orange - red)

```
my_scale=[("rgb(242, 238, 10)"),
          ("rgb(242, 95, 10)"),
          ("rgb(255,0,0)")]
fig = px.bar(data_frame=weekly_temps,
    x="day", y="temp",
    color_continuous_scale=my_scale,
    color="temp")
```



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