

Data Visualization

CAE Internship Workshop



National
Taiwan
University
國立臺灣大學



Authors

¹Jun-Wei (Gary) Ding

Ph.D. Student, Dept. of Civil Engineering, National Taiwan University

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Why Data Visualization?

Enhancing Information Transmission Efficiency

Through visual representations such as charts and graphs, readers can quickly grasp research findings without spending excessive time analyzing data tables or lengthy textual descriptions. This is particularly useful for complex data, mathematical models, or comparative analyses, where visualization can intuitively convey trends and relationships.

Increasing the Persuasiveness of Research

Well-designed and accurate charts enhance the credibility of research findings, making it easier for reviewers and readers to accept the study's conclusions.

Comparing Different Results

When comparing different experimental conditions, methods, or variable influences, bar charts, line graphs, and box plots effectively illustrate differences among multiple data sets.

•Highlighting Key Trends and Patterns

For instance, in wind energy forecasting, time series graphs can visually present wind speed variations over time, highlighting anomalies or periodic patterns in specific time periods.



What and Why Data Visualization?

● Uncover hidden patterns

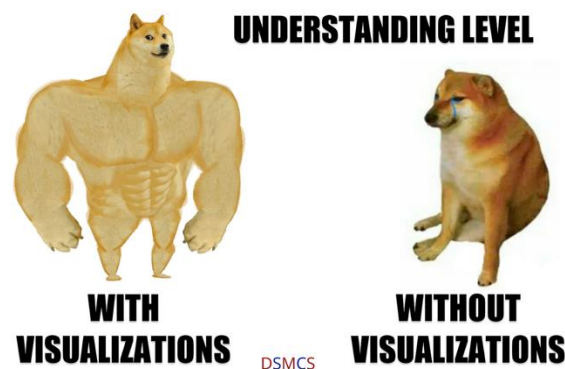
- ✓ trends, clusters, cycles, and anomalies

● Improve data quality

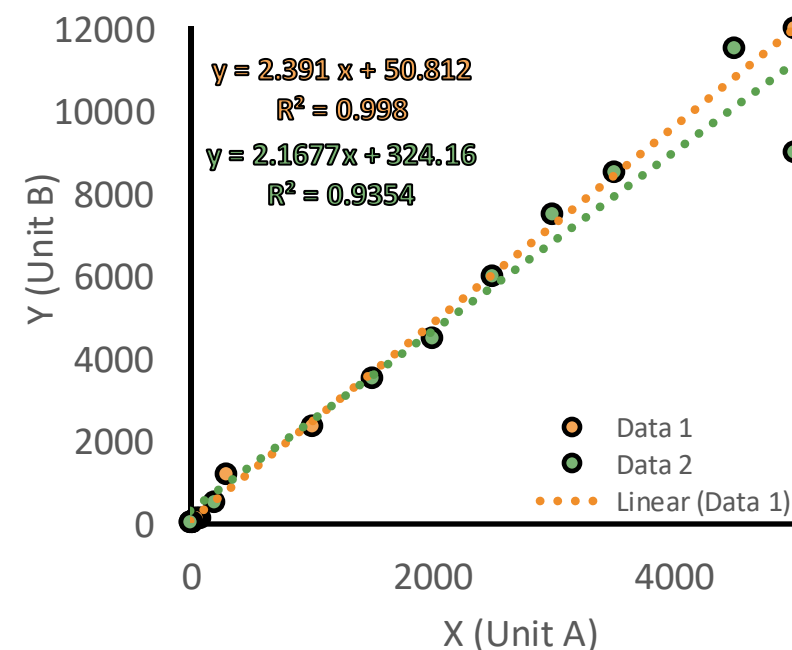
- ✓ missing values, inconsistencies, and outliers

● Clarity & communicate

- ✓ Weekey meeting
- ✓ presentation



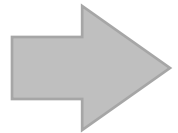
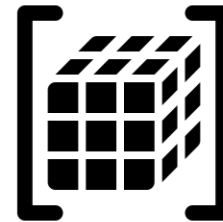
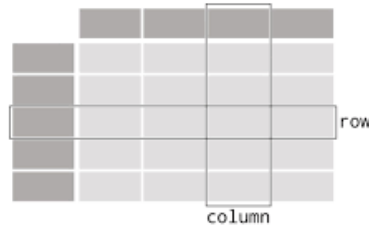
	p1	p2	p3	p4	p5	p6	p7	p8	p9
x1	0	1000	8	2	70	50	10	5000	300
y1	0	2350	30	10	120	125	20	12000	1200
x2	0	2000	3500	1500	4500	2500	3000	5000	200
y2	0	4500	8500	3500	11540	6000	7500	9000	500



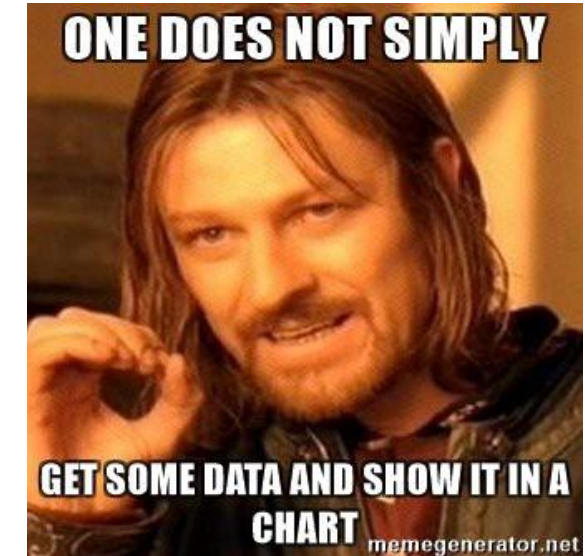


How to Data Visualization?

I got a lot of data, csv., dataframe, xarray

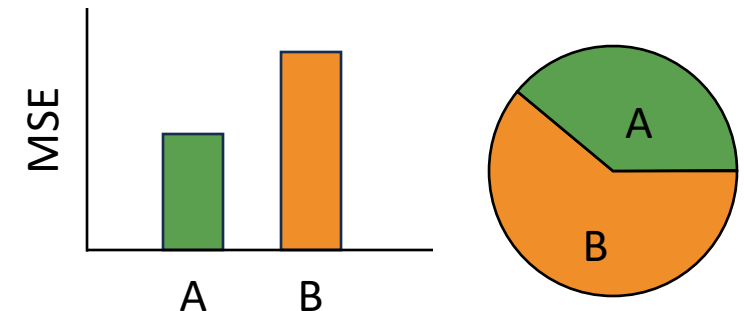


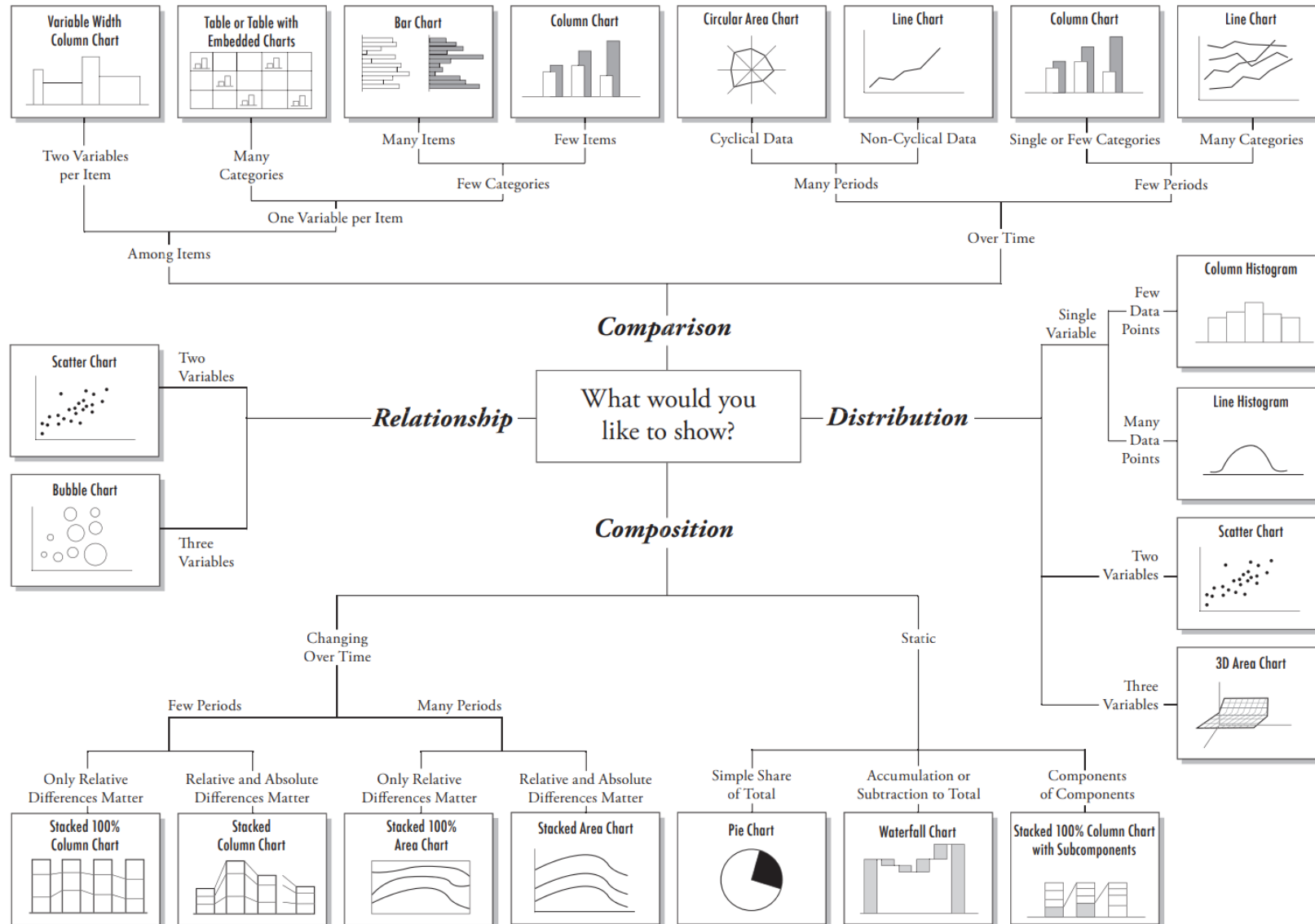
What do you want to tell?



1. A algorithm outperforms B algorithm with a significant margin of 10 MSE.

2. LCOH (\$100) is composed of Capital (\$70) and O&M (\$30).







How to Data Visualization?



Which one is better?

➔ Choose the tool you are comfortable with

My combination



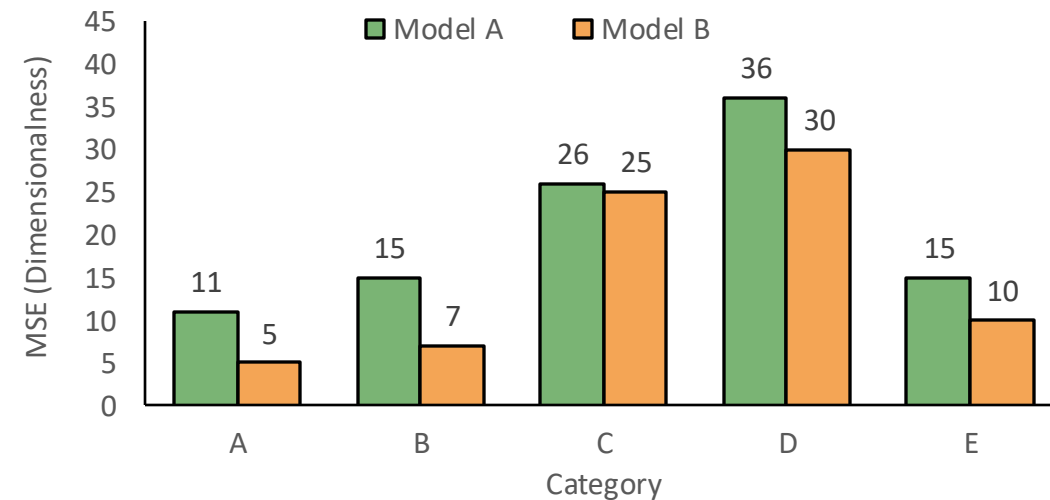
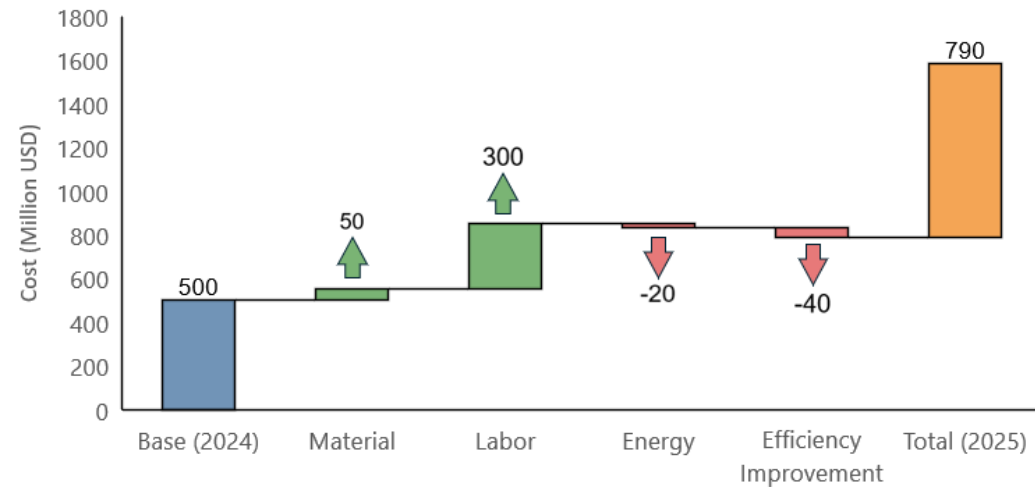
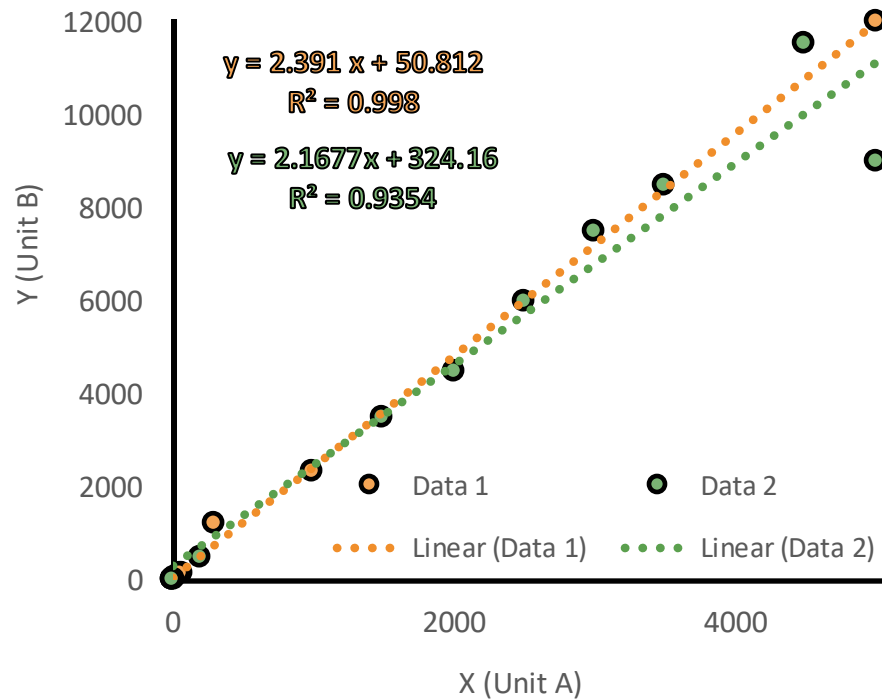
98%



2%



Yes, even Excel can shine sometimes





How to Data Visualization?

matplotlib

plotly

seaborn

hvPlot



How to Data Visualization?

matplotlib

- **Highly Customizable with Professional-Grade Output**
 - ✓ font, color, ticks, labels, legend, etc.
 - ✓ SVG, PNG, dpi
- **Rich Plot Types & Complex Layouts**
 - ✓ subplots, multi-axis figures, multi-panel figure
- **Strong Integration & Backend for Other Libraries**



seaborn



NumPy

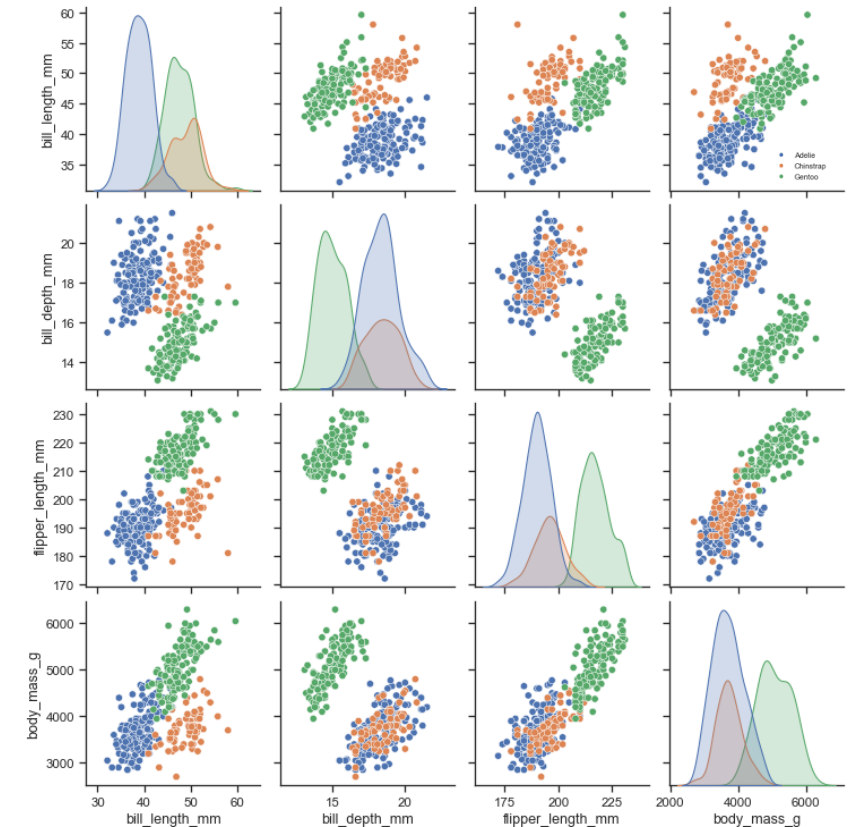
Section Navigation

Lines, bars and markers	▼
Images, contours and fields	▼
Subplots, axes and figures	▼
Statistics	▼
Pie and polar charts	▼
Text, labels and annotations	▼
Color	▼
Shapes and collections	▼
Style sheets	▼
Module - pyplot	▼
Module - axes_grid1	▼
Module - axisartist	▼
Showcase	▼
Animation	▼
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Miscellaneous	▼
3D plotting	▼
Scales	▼
Specialty plots	▼
Spines	▼
Ticks	▼
Units	▼
Embedding Matplotlib in graphical user interfaces	▼
Widgets	▼



How to Data Visualization?

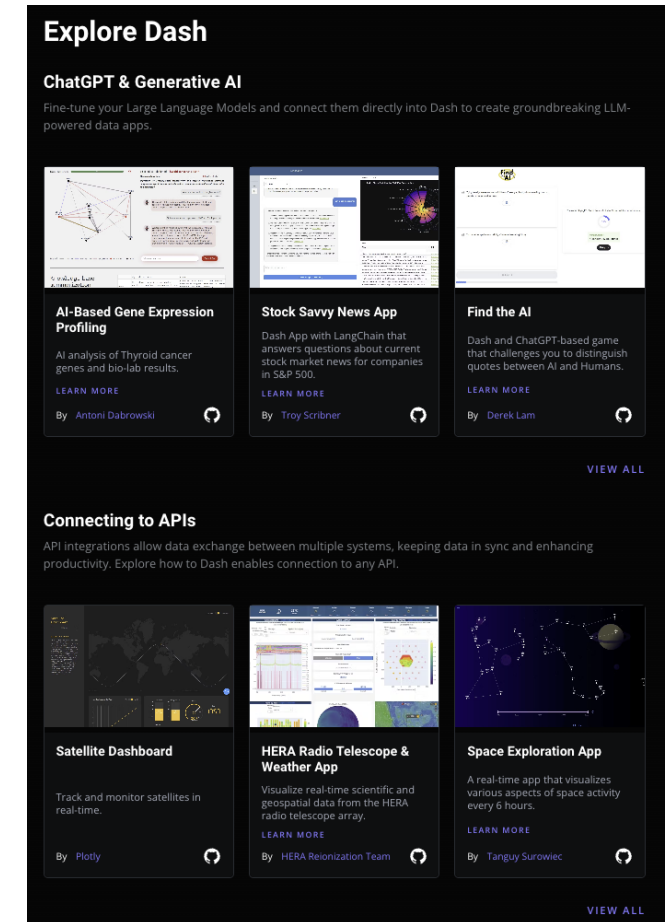
- **Simplified Interface for Matplotlib**
 - ✓ Easier syntax with beautiful default styles
 - ✓ Ideal for quick and clean visualizations
- **Built-in Statistical Plot Types**
 - ✓ Supports distributions, box plots, heatmaps, regression plots, and more
 - ✓ Great for exploring relationships and category-based data





How to Data Visualization?

- **Highly Interactive Visualizations**
 - ✓ Enhances data exploration through user interaction
- **Web-Ready and Shareable**
 - ✓ Outputs as standalone HTML or embeddable components
 - ✓ Easy to share via web apps or static HTML files
- **Integrates with Dash for App Development**
 - ✓ Suitable for building full-featured, interactive dashboards

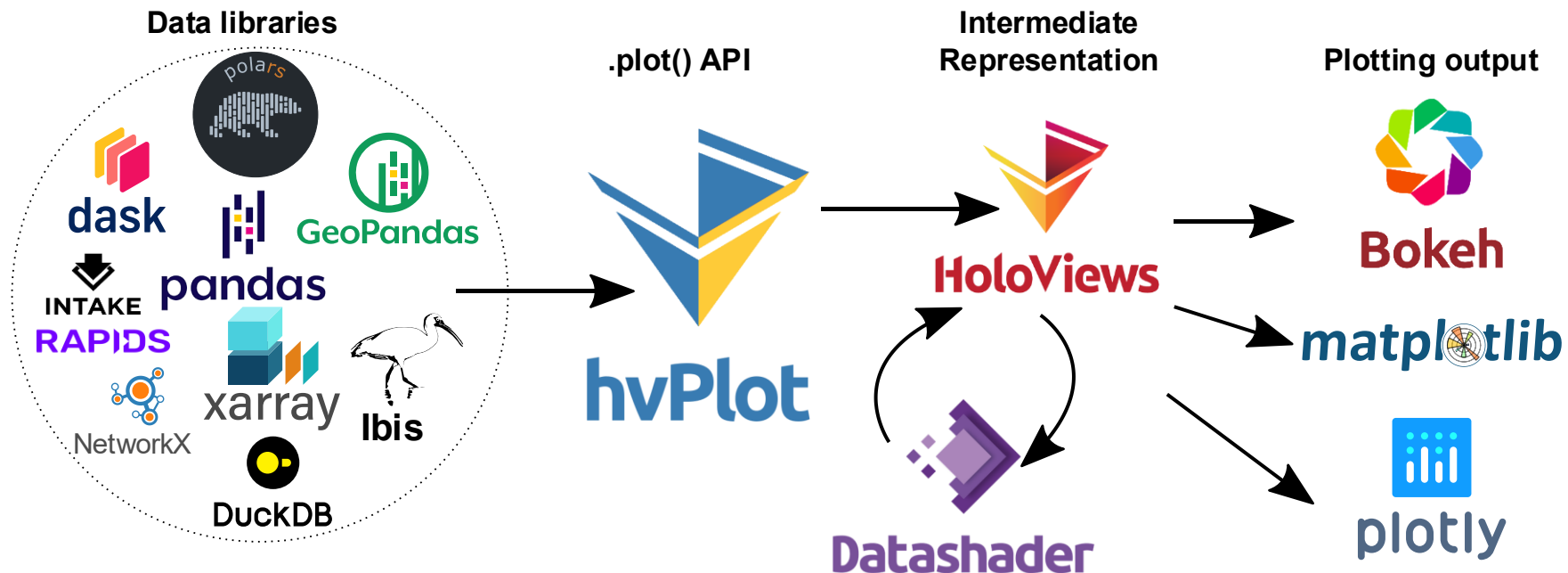




How to Data Visualization?



- **Supports Multiple Data Types**
- **Designed for Data Exploration**
- **Fast & Interactive Plotting**
- **Flexible Output Backends**





How to Data Visualization?



**Quick Exploration
& Initial Analysis**



**Result Production &
Fine-Tuned Control**



**Presentation, Sharing &
Interactive Dashboards**



What Makes a Chart Acceptable ?

1. Data
2. x, y label (with unit)
3. x, y tick
4. Legend
5. Caption
6. Title

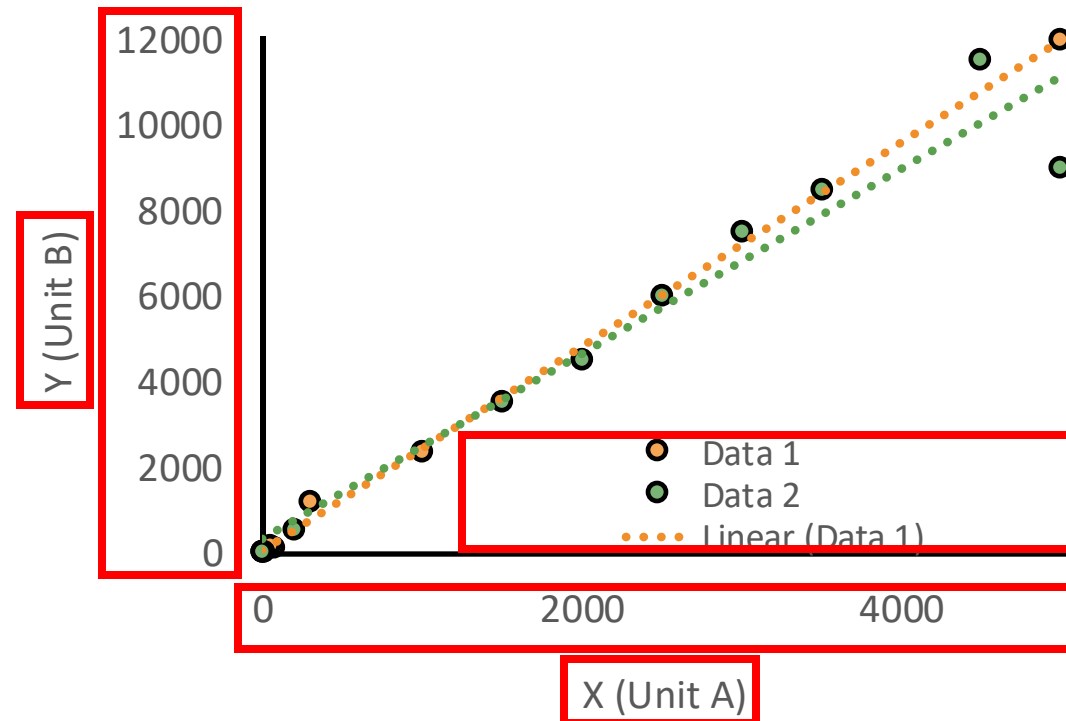


Figure X. Comparison of Data 1 and Data 2 with a linear trend line fitted to Data 1.



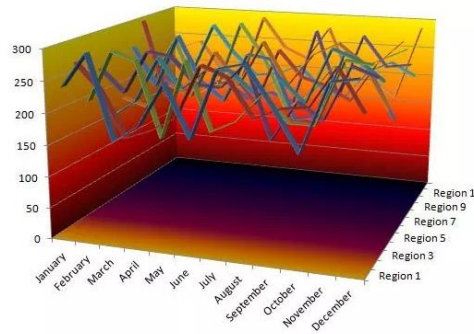
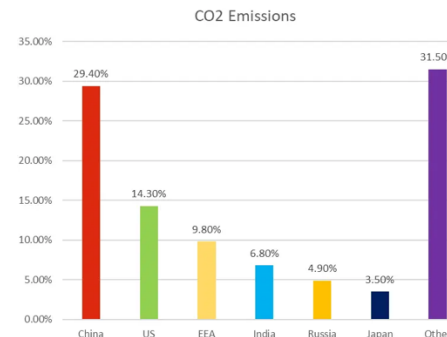
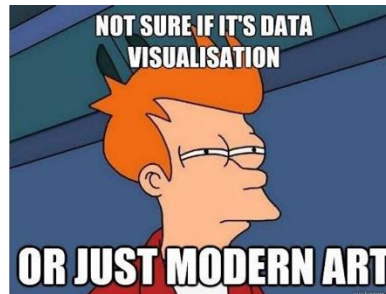
What Should Be Avoided in Data Visualization

"Above all else, show the data"

— Edward Tufte

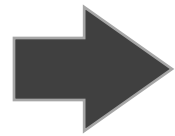
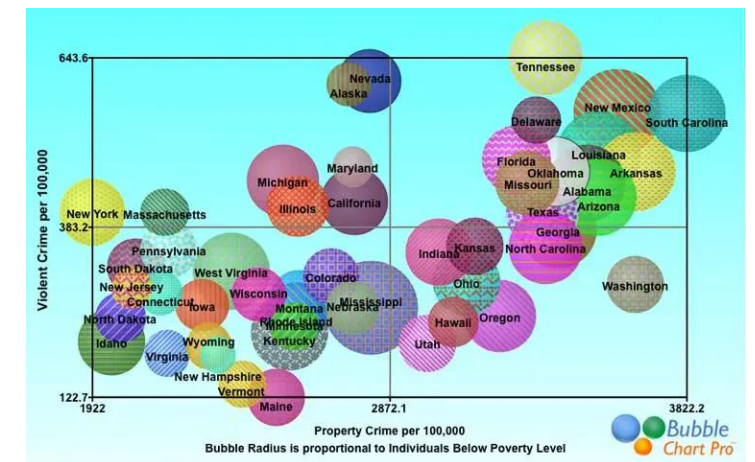
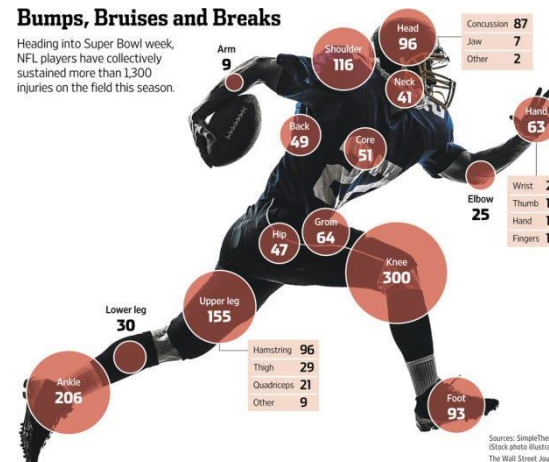
Chartjunk

- 3D effects
- Unnecessary icons or pictograms
- Poor font choices
- Too many colors



Bumps, Bruises and Breaks

Heading into Super Bowl week, NFL players have collectively sustained more than 1,300 injuries on the field this season.

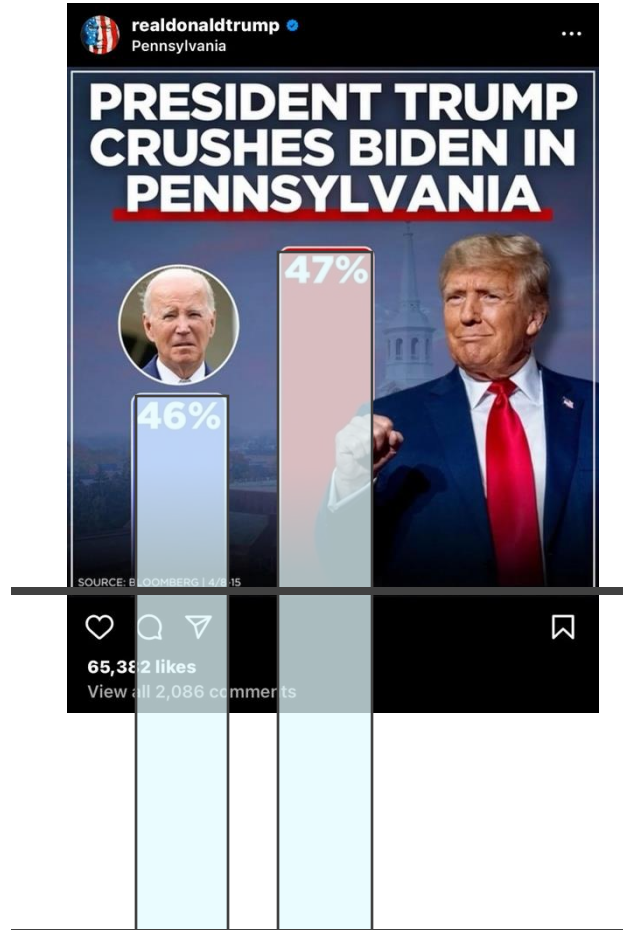


Keep it clean and clear.

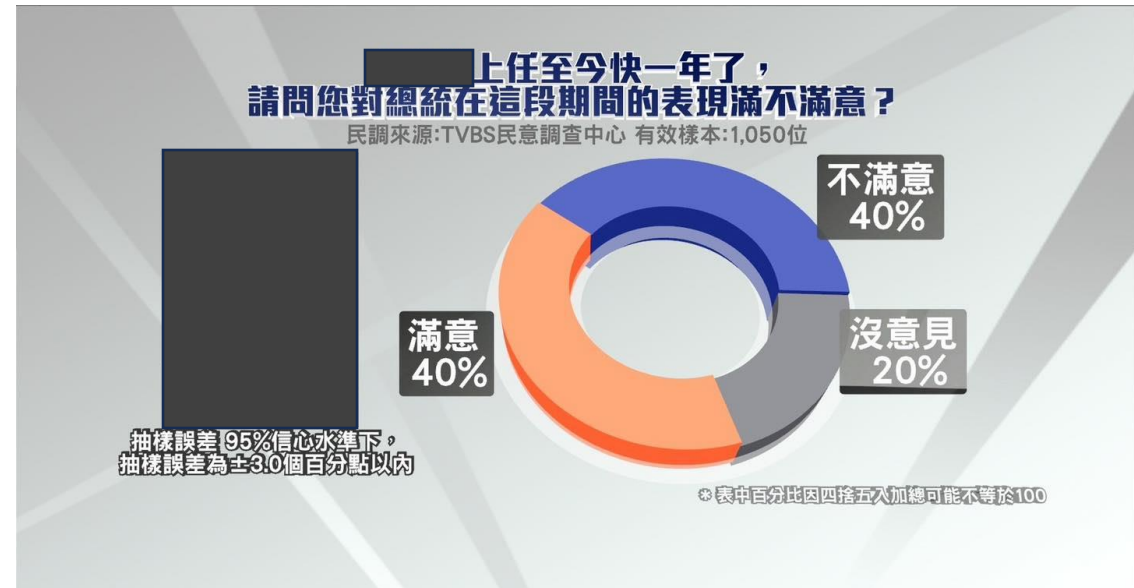
Let your data speak.



Don't just fool others with charts



[Shut up about the y-axis. It shouldn't always start at zero.](#)



— don't fool yourself either.

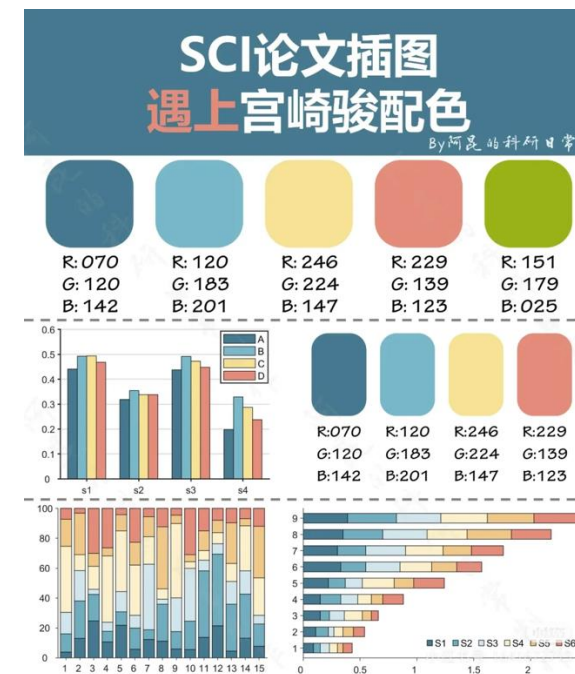
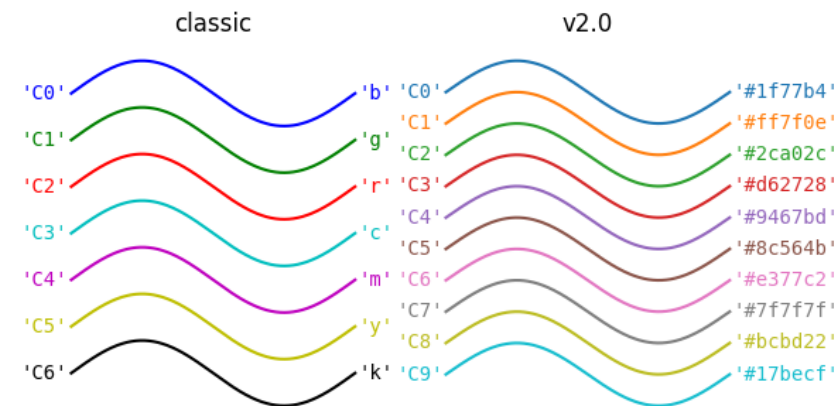
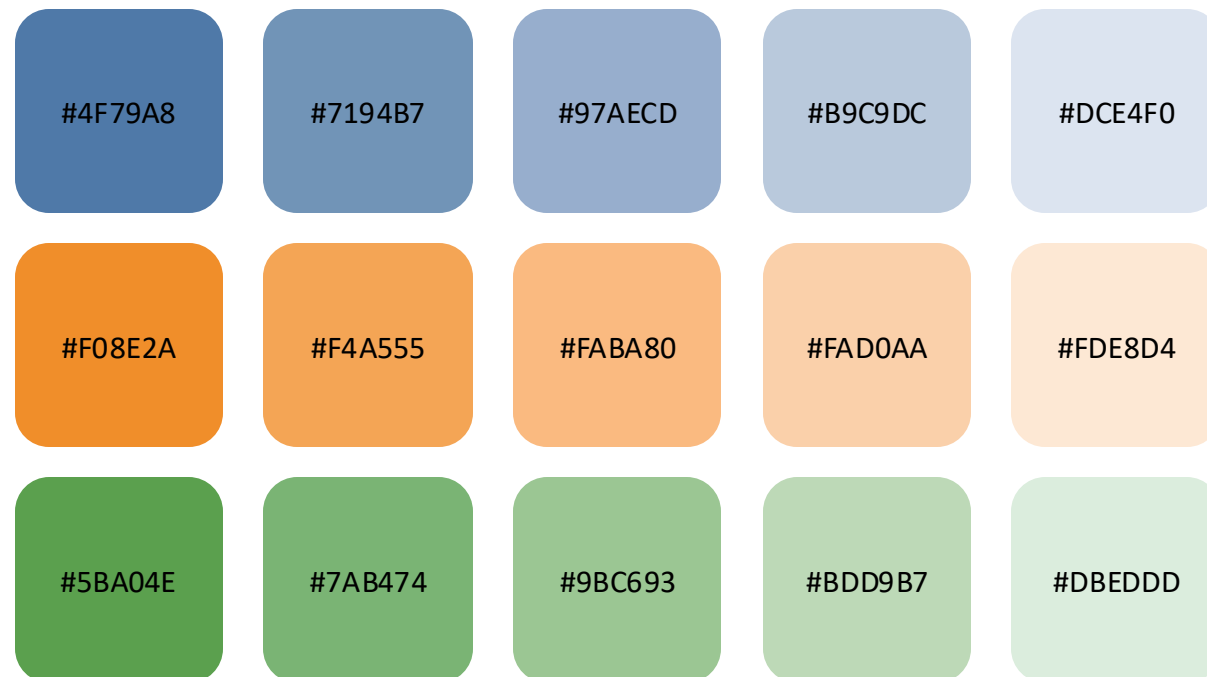


What color to use?

Simplicity is the ultimate sophistication

- **Consistency** and **Identifiable** is the principle

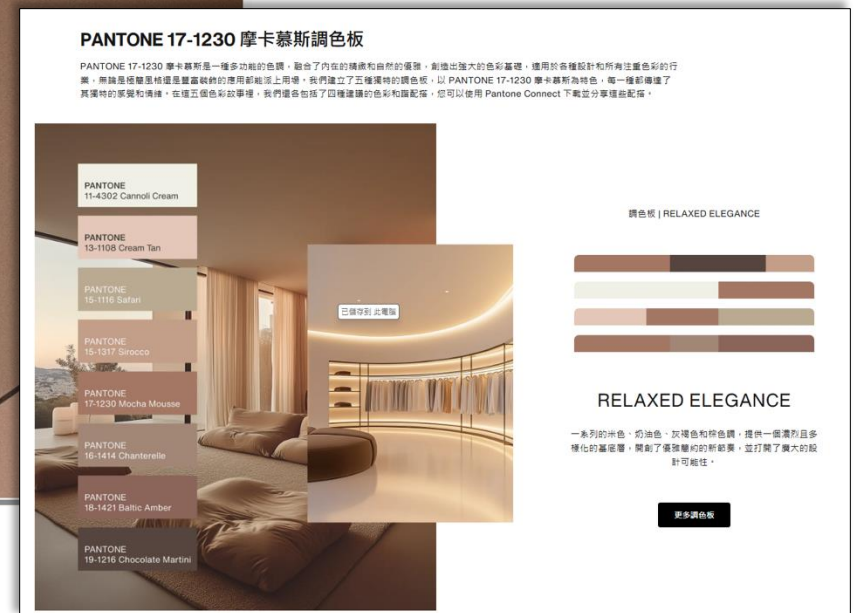
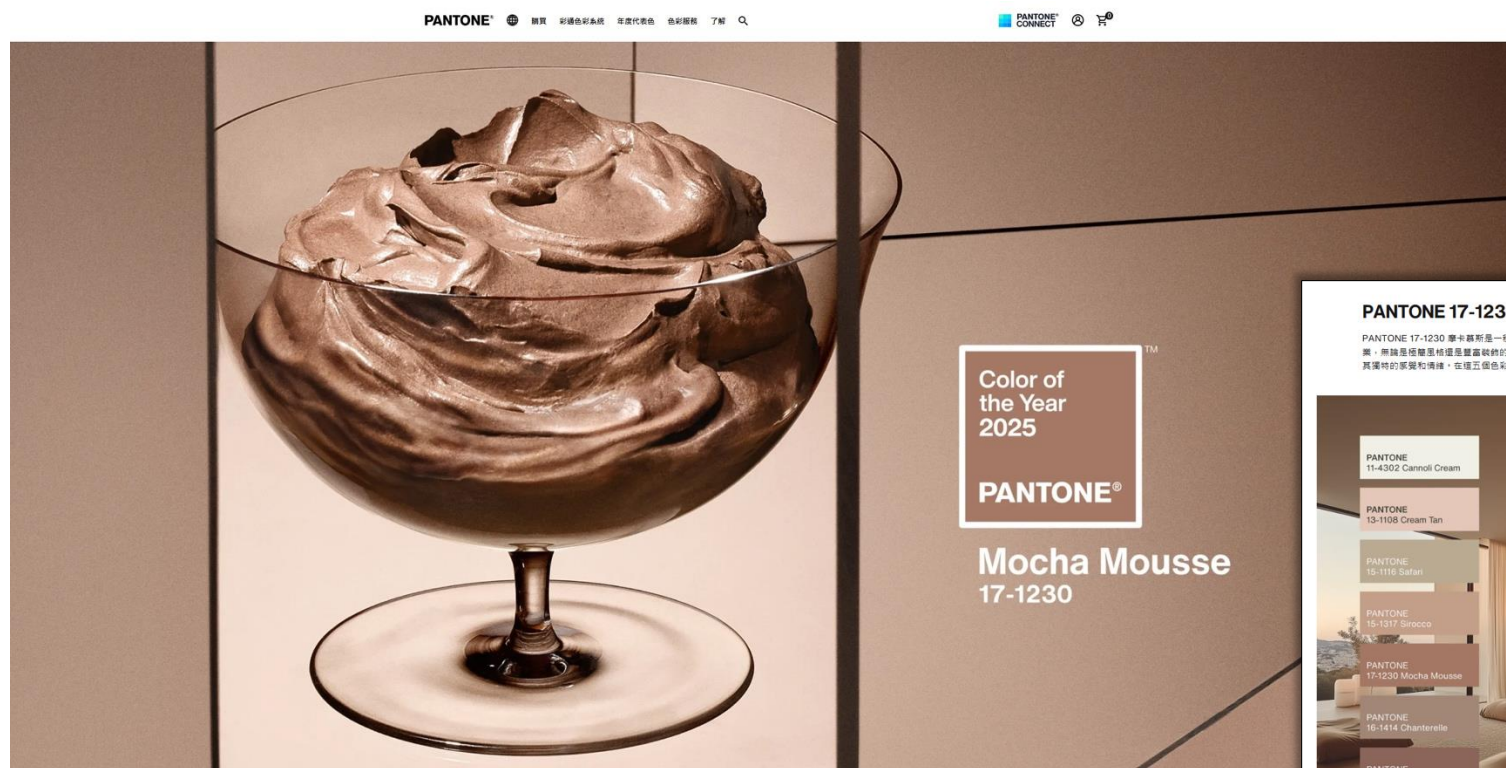
Colors





What color to use?

PANTONE®





What color to use?

#197 Umbreon

Moonlight Pokémon

Umbreon

Dex: 197 Randomize

Information Forms & Evolutions Colors

Primary #2F323F

Secondary #64647C

Accent #C49F3B

Umbreon #197

Dark Gold

Pokédex Entry

When agitated, this POKÉMON protects itself by spraying poisonous sweat from its pores.

Base Stats

HP	95
Attack	65
Defense	110
Sp. Atk	60
Sp. Def	130
Speed	65
Total	525

Color Palette Generator

Your website - inspired by Umbreon

Create beautiful color palettes inspired by your favorite Pokémon. Just enter any Pokémon's name or Pokédex number to discover its unique color scheme.

Save Palette

Learn more →

RGB

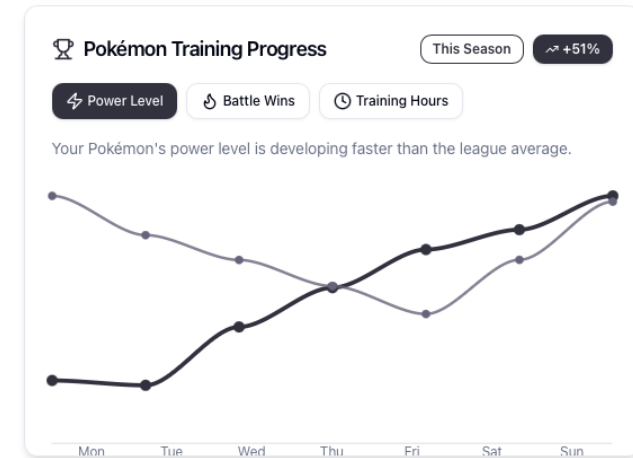
rgb(47, 50, 63)

RGB

rgb(100, 100, 124)

RGB

rgb(196, 159, 59)



Trainer Red Elite Trainer Online

Ready for our Pokemon battle?

10:00 AM

Let's do this! My team is ready. YO

10:01 AM

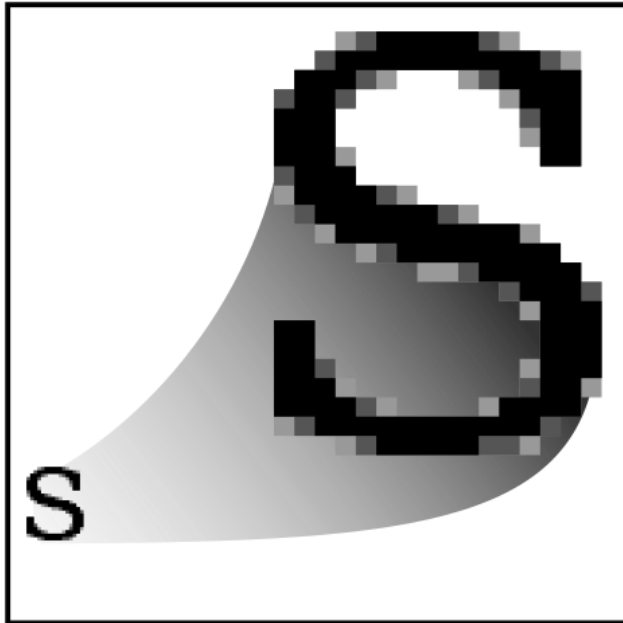
Great! I've been training my Charizard specially for this.

10:02 AM

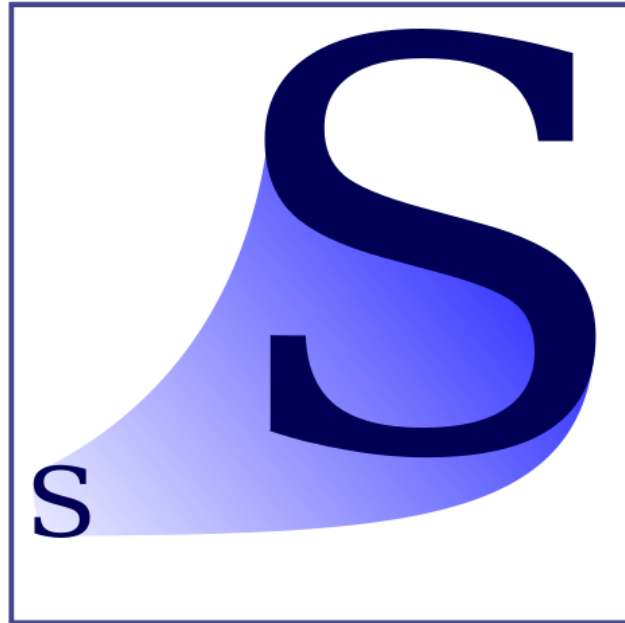
Type your message...



Save Image



Raster
GIF, JPEG, PNG



Vector
SVG

- **Raster Image**

- ✓ Format: PNG, JPG
- ✓ Dpi > 300

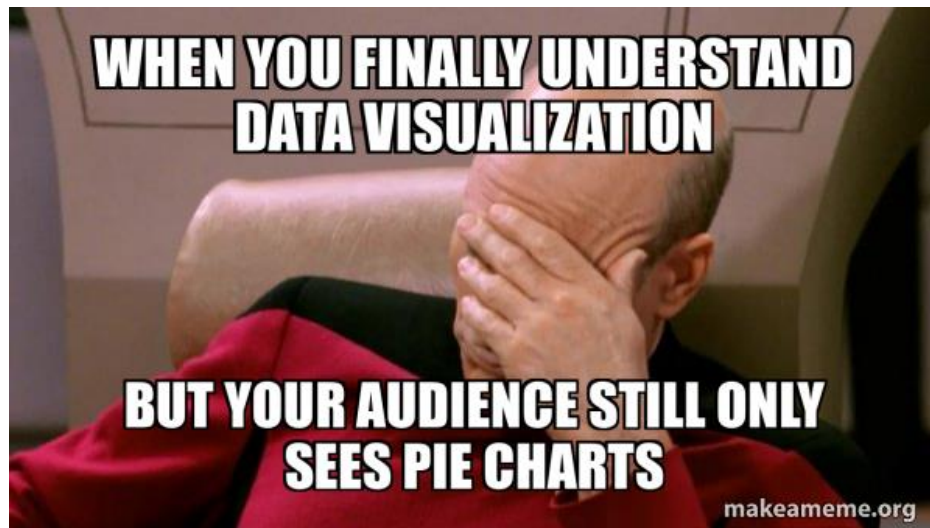
- **Vector Image**

- ✓ SVG
- ✓ Stays sharp at any scale



Conclusion

1. Communicate data in a simple and clear way
2. Use tools and methods you're familiar with
3. Follow the essential principles



THANK YOU FOR LISTENING

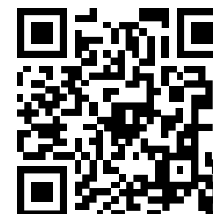


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Energy
Economics
Environment

E3 Center



¹Jun-Wei (Gary) Ding

Ph.D. Student, Dept. of Civil Engineering, National Taiwan University

Email: d13521023@ntu.edu.tw

²I-Yun (Lisa) Hsieh

Associate Professor, Dept. of Civil Engineering, National Taiwan University

Email: iyhsieh@ntu.edu.tw

