Monitored Quiz Today

Please access the Modules page of AnimoSpace.

TOPIC

Perception and Color

ACCESS CODE

7YT9FJYH1

Time limit: **15 minutes**

Quiz closes at **6:20 PM**

Python Visualization Basics

From notebooks → web-ready charts: SVG/HTML outputs, interactive graphics, and modern chart components.

Marc Reyes

Professional Lecturer · marc.reyes@dlsu.edu.ph
DATA101 — De La Salle University

Today’s Plan

01 · WEB OUTPUTS

HTML, CSS, SVG

What the browser actually renders.

02 · PYTHON WORKFLOW

Notebook → chart → export

Reproducible visuals you can ship.

03 · MODERN COMPONENTS

Scales, marks, guides

A reusable mental model.

04 · INTERACTIVITY

Selections + tooltips

When interactivity is worth it.

Learning Outcomes

WEB

Explain SVG vs PNG vs HTML

And choose the right export format.

PYTHON

Build a reproducible chart workflow

Data → transforms → plot → export.

DESIGN

Name modern chart components

Scales, axes, marks, guides, interactions.

PRACTICE

Write code that produces legible outputs

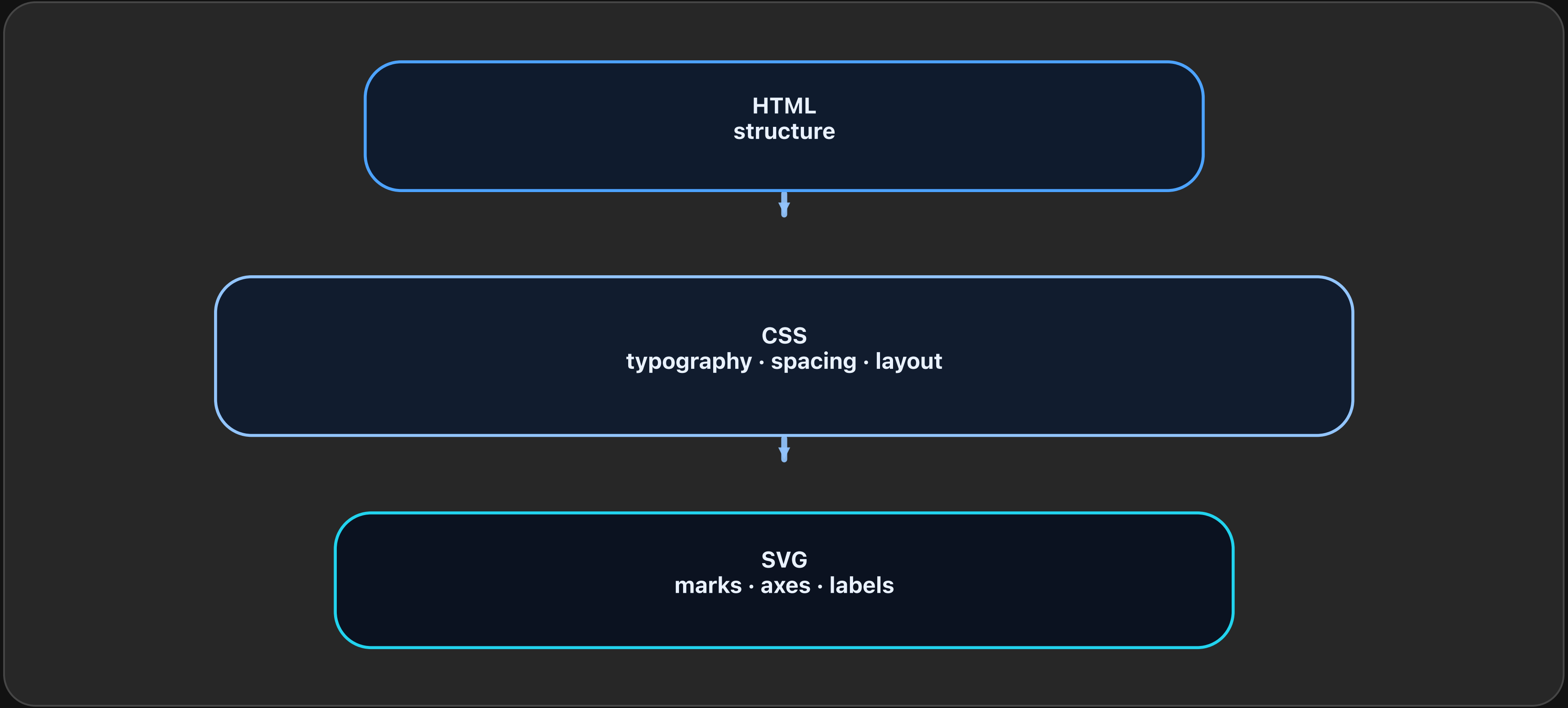
Readable on slides, PDFs, and web pages.

PART 1 · WEB OUTPUTS

What the browser understands

HTML + CSS + SVG as the delivery layer for charts

The Web Output Stack (for Charts)



HTML
structure

CSS
typography · spacing · layout

SVG
marks · axes · labels

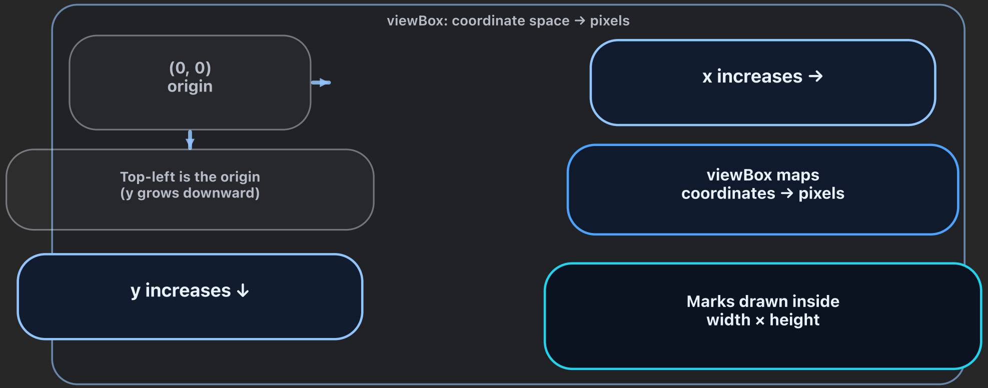
SVG: The “Native” Format of Many Charts

WHY SVG

- Scales crisply (great for slides and PDFs)
- Text remains selectable and searchable
- Shapes are editable (Illustrator/Figma)

WHEN NOT SVG

- Huge point clouds (file size)
- Complex maps with many paths
- Photographic backgrounds



CSS: The Hidden Part of “Professional”

CSS CONTROLS

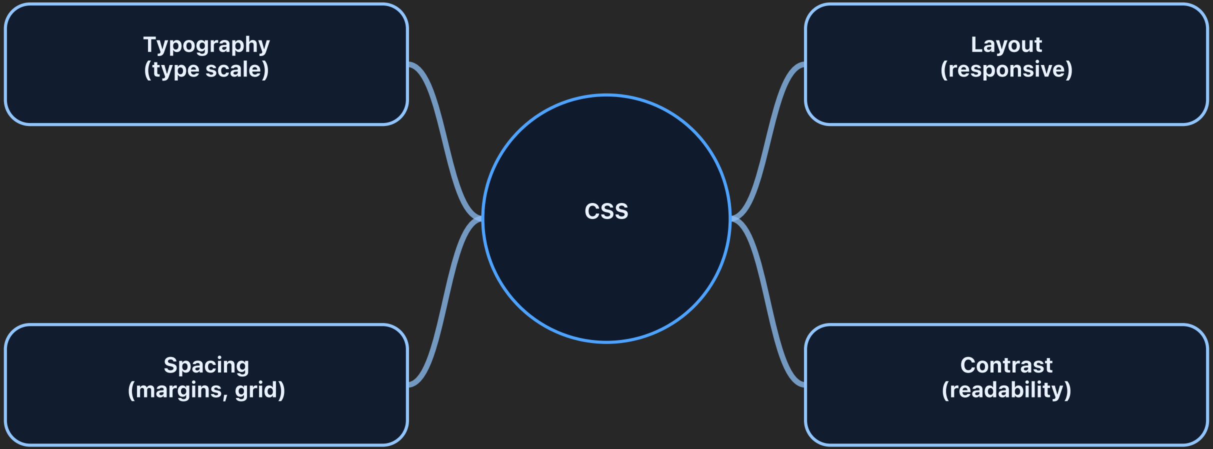
Hierarchy + spacing + readability

Font sizes, line heights, margins, contrast.

CHART IMPLICATION

Your chart lives inside a layout

So it must be responsive and legible.



CSS

Typography (type scale)

Spacing (margins, grid)

Layout (responsive)

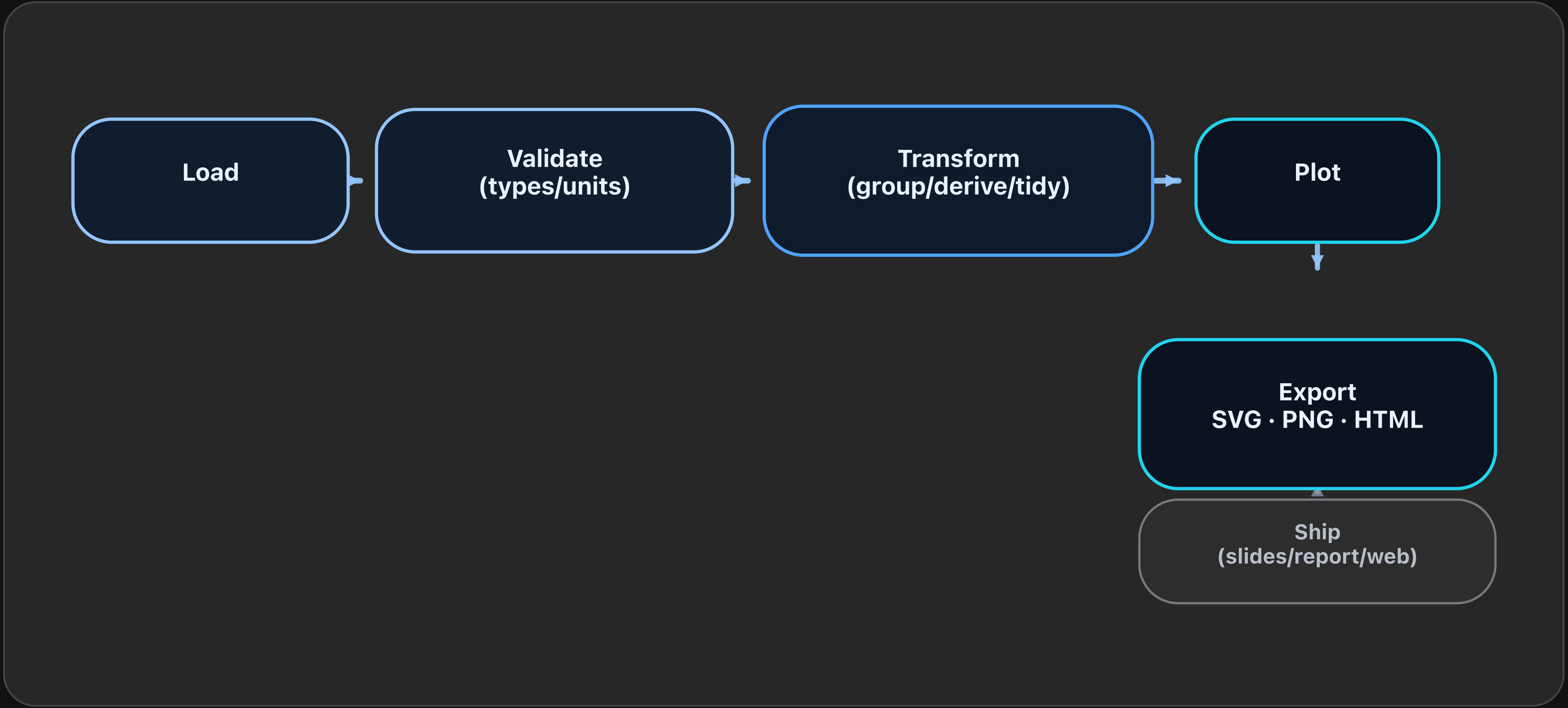
Contrast (readability)

PART 2 · PYTHON WORKFLOW

Notebook → chart → export

Reproducible visuals you can ship

A Repeatable Python Visualization Pipeline



Load

Validate
(types/units)

Transform
(group/derive/tidy)

Plot

Export
SVG · PNG · HTML

Ship
(slides/report/web)

Pandas as the “Chart Data Engine”

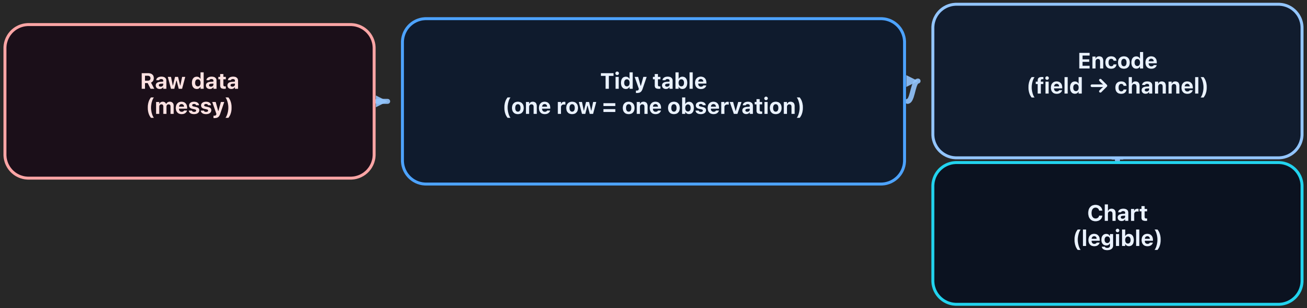
COMMON TRANSFORMS

- `groupby` + aggregate
- derive rates and deltas
- `melt` / tidy reshape
- sort for ranking

WHY IT MATTERS

Most chart bugs are data bugs

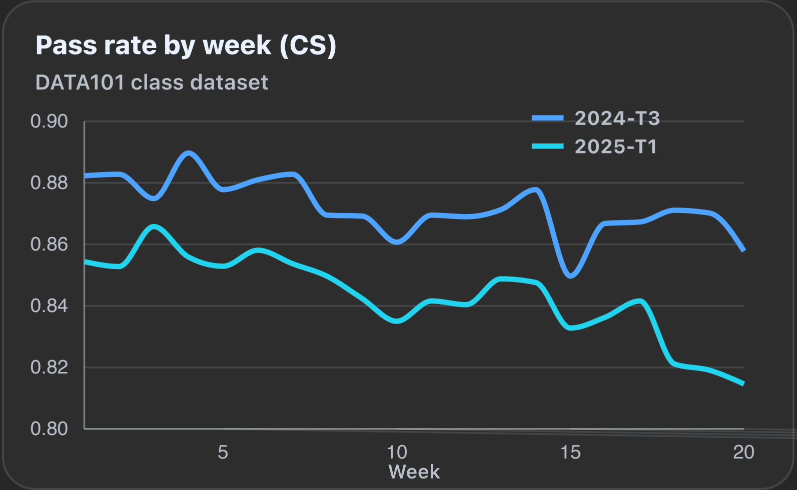
Wrong denominator, wrong unit, wrong grain.



Concrete D3 examples (class dataset)

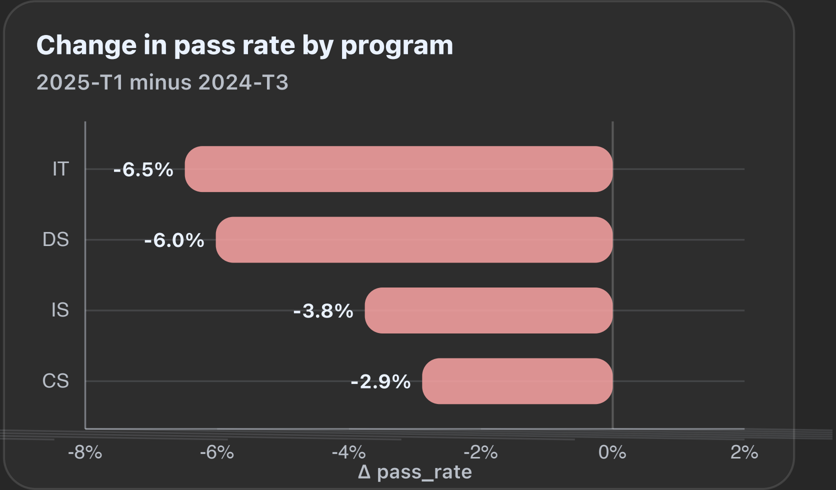
REAL DATA

These charts use the DATA101 class CSV (same dataset used in the guided activity).



Pass rate by week (CS)

DATA101 class dataset



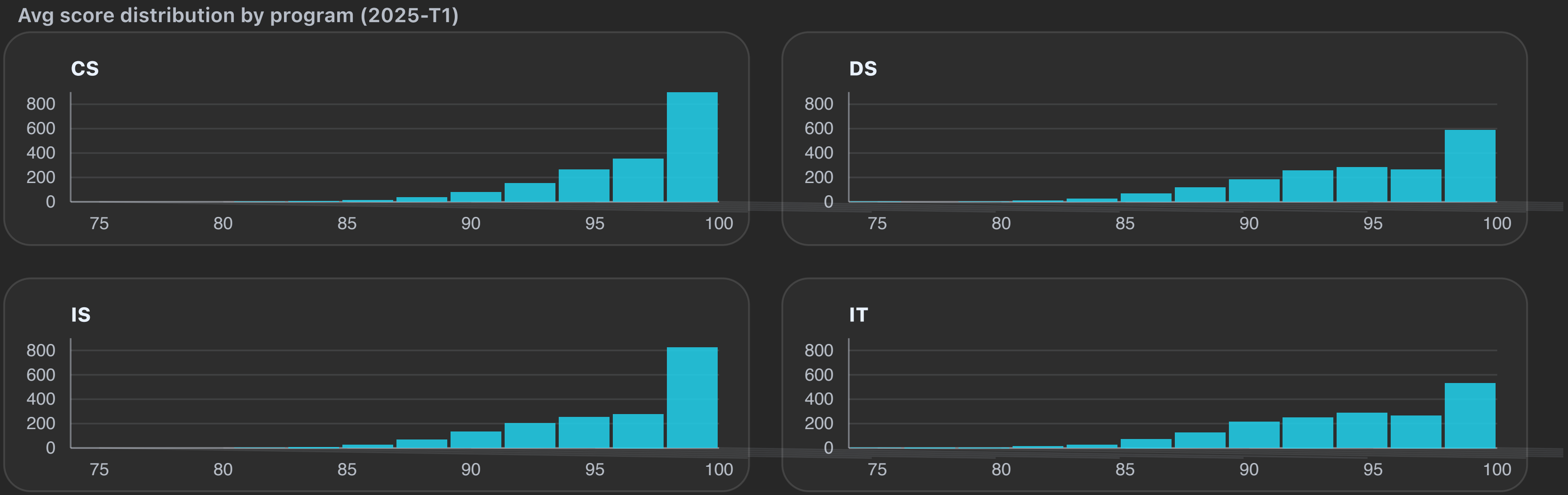
Change in pass rate by program

2025-T1 minus 2024-T3

Concrete D3 example: distributions (real data)

REAL DISTRIBUTION

Avg score histograms per program (shared scales, same bins).



Demo A: Chart-ready tables (rates + deltas)

GOAL

Turn counts into comparable measures

- Counts → rate (pass_rate)
- Rate over time → delta (change)
- One row = one observation (tidy)

PROFESSIONAL HABIT

Write the table before the chart

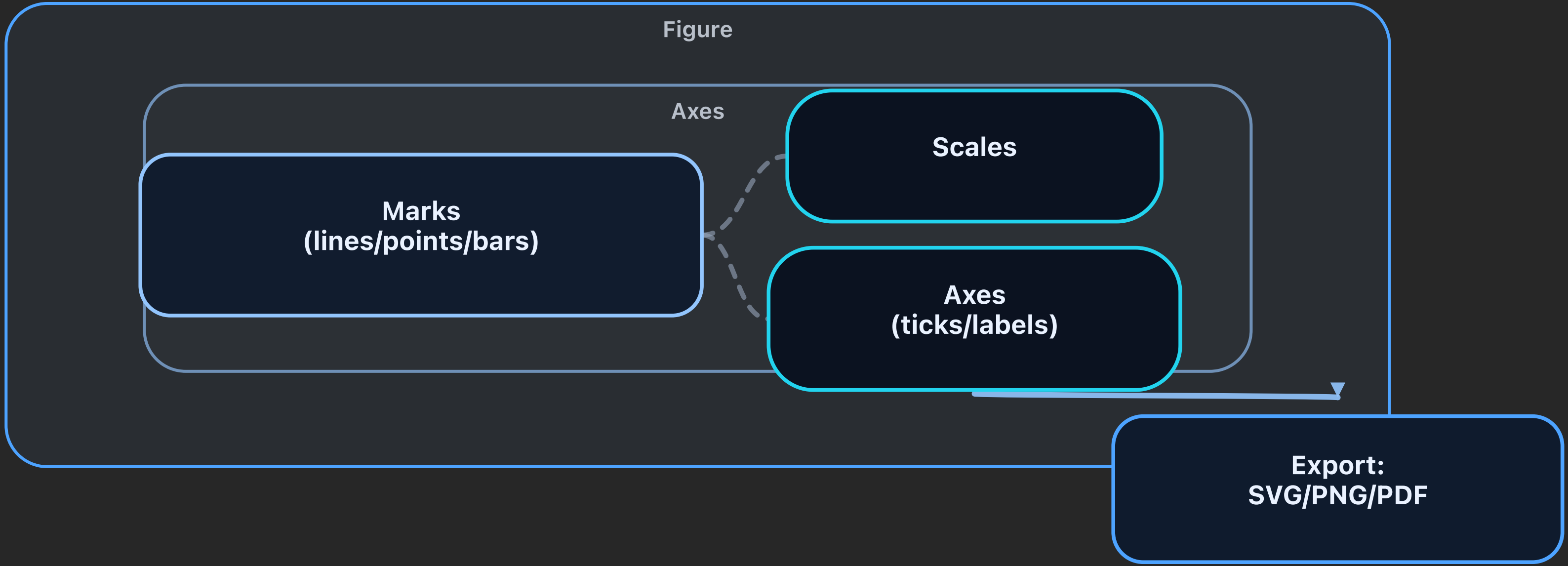
If the table is wrong, the chart will be wrong—no matter how polished it looks.

program	week	n_pass	n_students	pass_rate	delta
A	1	70	100	0.7	—
A	2	62	100	0.62	-0.08
B	1	90	120	0.75	—
B	2	88	120	0.733	-0.017
C	1	40	50	0.8	—
C	2	44	50	0.88	0.08

Code Demo A — Run

```python
import pandas as pd

df = pd.DataFrame(
    {
        "program": ["A", "A", "B", "B", "C", "C"],
        "week": [1, 2, 1, 2, 1, 2],
        "n_pass": [70, 62, 90, 88, 40, 44],
        "n_students": [100, 100, 120, 120, 50, 50],
    }
)

df["pass_rate"] = df["n_pass"] / df["n_students"]

weekly = df.sort_values(["program", "week"]).assign(
    delta=lambda d: d.groupby("program")["pass_rate"].diff()
)

print(weekly.to_string(index=False))
```

Matplotlib: The “Artist” Model (Mental Map)



Demo B: Matplotlib → SVG export (web-ready)

WHY SVG

Crisp + editable + searchable

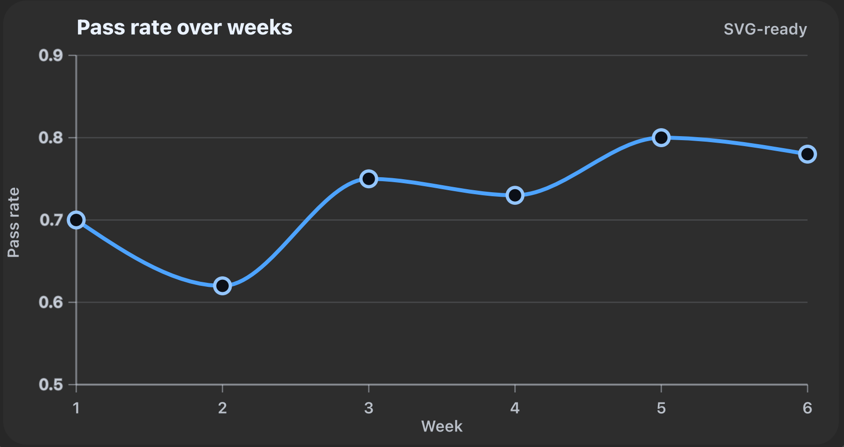
- Perfect for slides + PDF export
- Shapes editable in Figma/Illustrator
- Text stays selectable (accessibility + search)

HABIT

Export intentionally (don’t screenshot)

RENDERED RESULT (ILLUSTRATION)

Your SVG will scale crisply in slides.



Code Demo B — Run

```python
import io

import matplotlib.pyplot as plt
import numpy as np

x = np.arange(1, 7)
y = np.array([0.70, 0.62, 0.75, 0.73, 0.80, 0.78])

fig, ax = plt.subplots(figsize=(7.2, 3.2))
ax.plot(x, y, marker="o", linewidth=2)
ax.set_title("Pass rate over weeks")
ax.set_xlabel("Week")
ax.set_ylabel("Pass rate")
ax.set_ylim(0.5, 0.9)
ax.grid(True, alpha=0.25)
fig.tight_layout()

buf = io.StringIO()
fig.savefig(buf, format="svg")
svg = buf.getvalue()

print("SVG chars:", len(svg))
print("Starts with:", svg.splitlines()[0][:72] + "…")
```

Seaborn: Statistics Defaults + Cleaner Styles

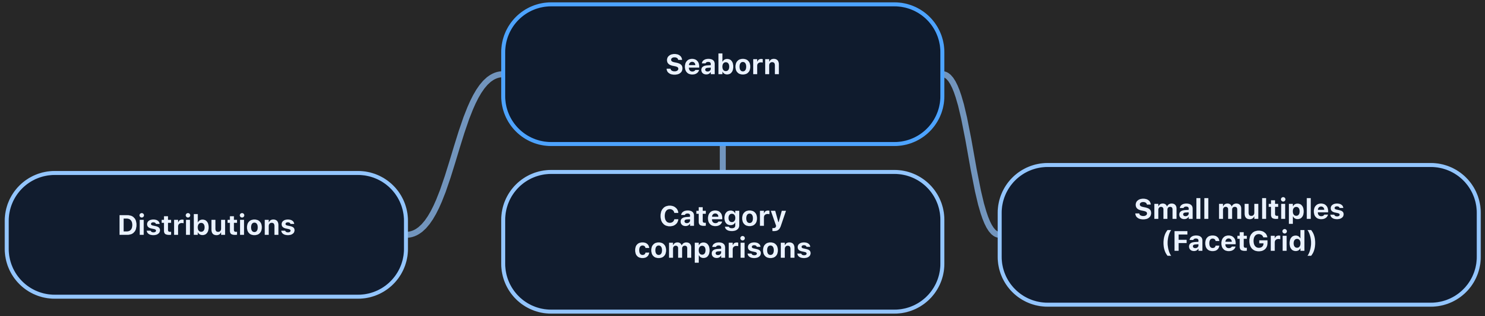
WHAT IT ADDS

- Statistical plots (distributions, categories)
- Reasonable default aesthetics
- Easy small multiples (`FacetGrid`)

COMMON TRAP

Pretty defaults ≠ correct story

Always check units, bins, and baselines.



Code Demo C: Faceted Histograms

RUNNABLE NEXT SLIDE

Generate data + summarize spread

We'll compute stats and histogram bin counts (what a faceted histogram is actually drawing).

WHAT TO LOOK FOR

- Panels share axes (fair comparison)
- Shape shows variance (not just the mean)
- Bins + scale are design decisions

Code Demo C — Run

```python
import numpy as np
import pandas as pd

rng = np.random.default_rng(7)
program = np.repeat(list("ABC"), 250)
score = np.concatenate(
    [
        rng.normal(76, 6, 250),
        rng.normal(76, 14, 250),
        rng.normal(70, 8, 250),
    ]
)
df = pd.DataFrame({"program": program, "score": score})

summary = df.groupby("program")["score"].agg(["mean", "std", "min", "max"]).round(2)
print("Summary stats (mean can be similar while spread differs):")
print(summary.to_string())

bins = np.linspace(df["score"].min(), df["score"].max(), 19)
counts = (
    df.assign(bin=pd.cut(df["score"], bins=bins, include_lowest=True))
    .groupby(["program", "bin"])
    .size()
```

Code Demo C (Output): Small Multiples Reveal Spread

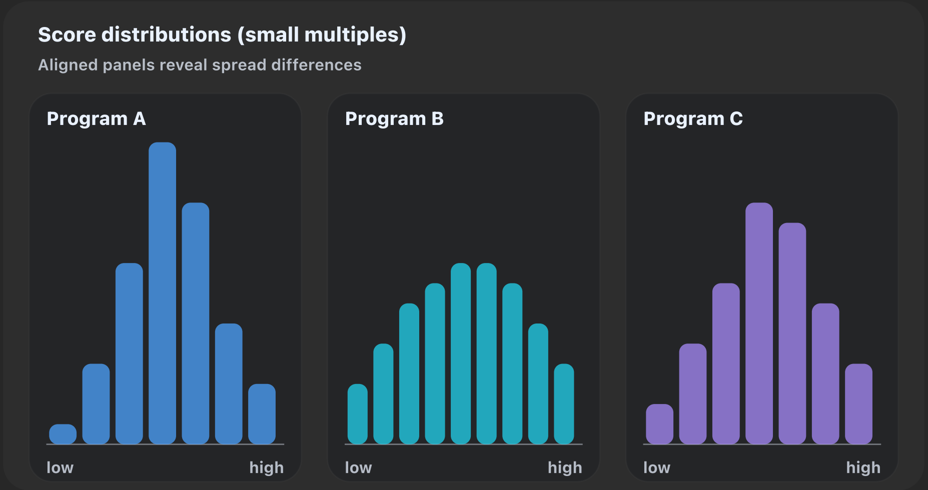
INTERPRETATION

Same mean, different risk

- Wider distributions imply more extreme outcomes
- Aligned panels make differences obvious
- Label bins and units when you publish

WHY THIS WORKS

Small multiples outsource less work to the viewer: same axes, same units, clean comparison.


Score distributions (small multiples)

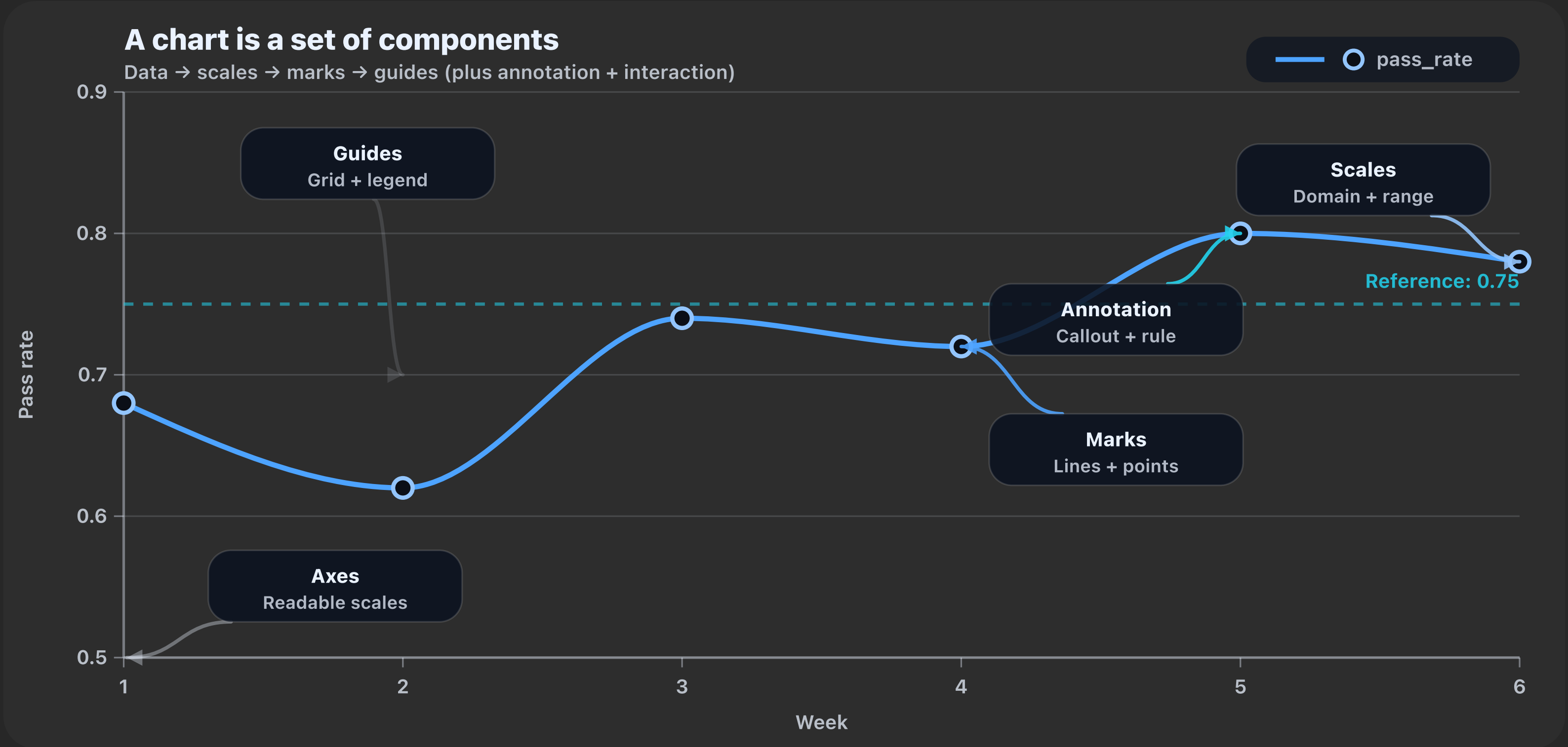
Aligned panels reveal spread differences

PART 3 · MODERN COMPONENTS

Think in chart parts

Build charts like reusable UI components

The Modern Chart Component Checklist



“D3 Concepts” in a Python World

CORE IDEA

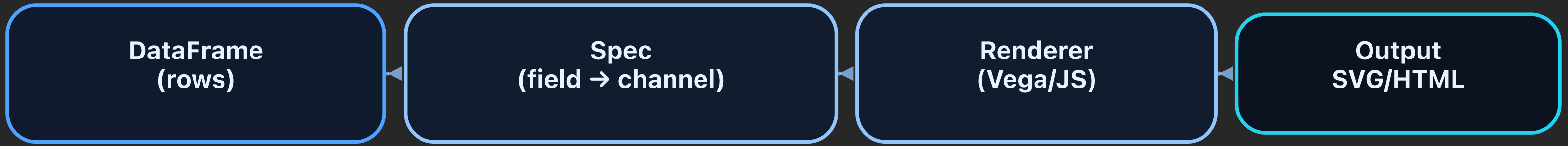
Data ↔ marks mapping

Bind rows to marks; encode columns to channels.

PYTHON ANALOGY

DataFrame → spec → renderer

Altair/Plotly generate web renderers.



Code Demo D: Altair Encodings

GRAMMAR-STYLE VISUALIZATION

Field → channel mappings

A spec is a contract between data and marks. You can critique it before any pixels are rendered.

WHAT TO WATCH

- Domains are explicit (comparison-friendly)
- Color encodes category, not magnitude
- Tooltip adds detail without clutter

Code Demo D — Run

```python
import json

import pandas as pd

df = pd.DataFrame(
    {
        "x": [1, 2, 3, 4, 5, 6],
        "y": [0.70, 0.62, 0.75, 0.73, 0.80, 0.78],
        "term": ["baseline"] * 3 + ["current"] * 3,
    }
)

spec = {
    "mark": {"type": "circle", "size": 110},
    "encoding": {
        "x": {"field": "x", "type": "quantitative"},
        "y": {"field": "y", "type": "quantitative", "scale": {"domain": [0.5, 0.9]}},
        "color": {"field": "term", "type": "nominal"},
        "tooltip": [{"field": "x"}, {"field": "y"}, {"field": "term"}],
    },
}

print("First 3 rows:")
```

Code Demo D (Output): Encoded Scatter + Tooltip

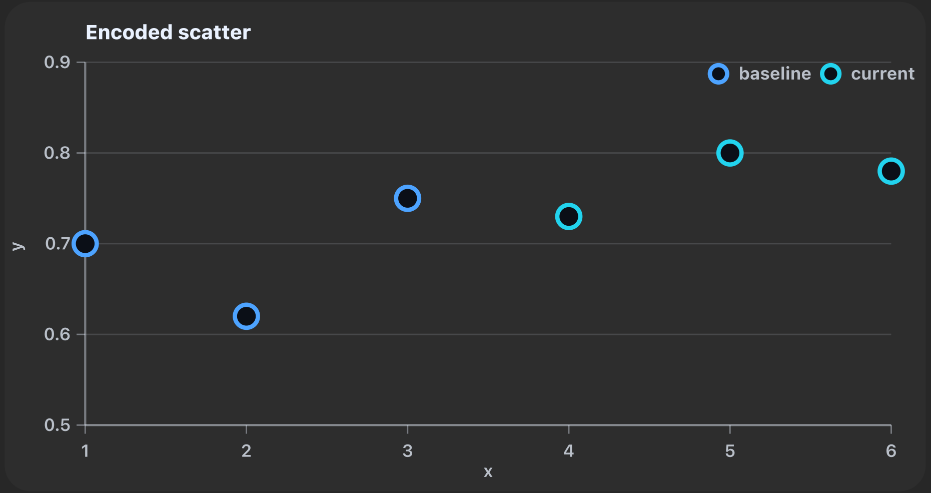
DESIGN NOTE

Encoding is a contract

- Quantitative → position/scale
- Categorical → hue/grouping
- Set domains when comparisons matter

RENDERED RESULT

Legend + axes carry the structure; tooltip adds detail without clutter.



PART 4 · INTERACTIVITY

Interactivity with purpose

Tooltips, selection, filtering, and readable dashboards

Tooltips Are “Details on Demand”

GOOD TOOLTIP

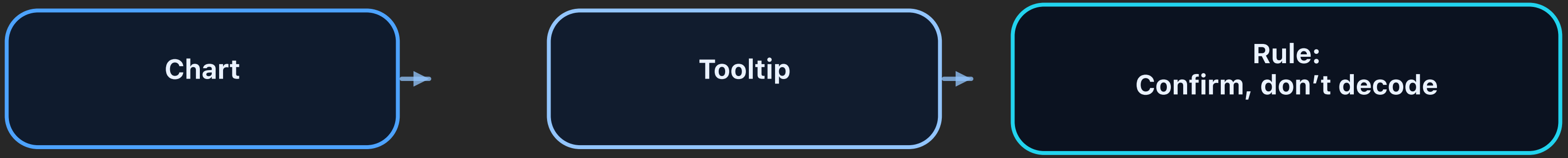
Confirms values

Units, exact numbers, IDs for traceability.

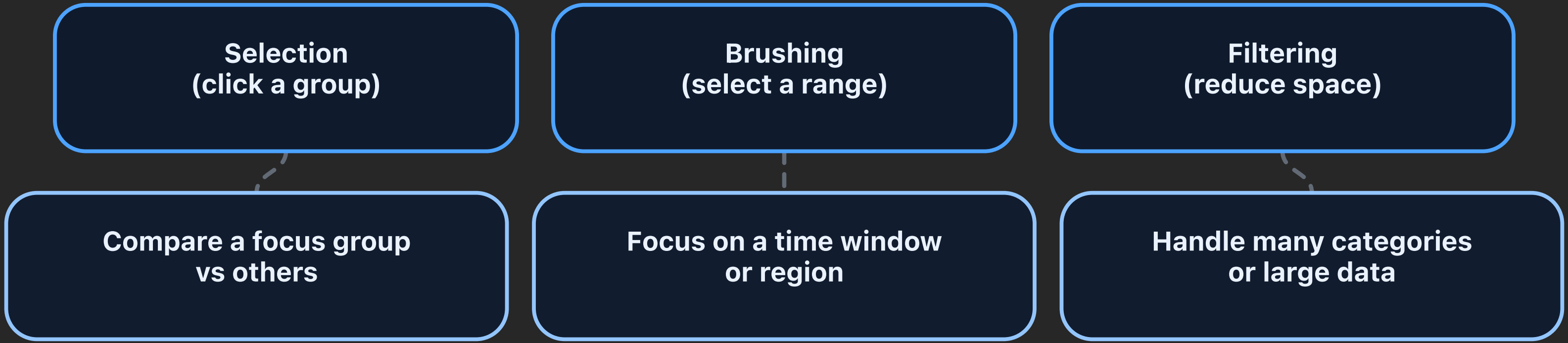
BAD TOOLTIP

Replaces the chart

If you need to hover everything, redesign.



Selections, Brushing, and Filtering (Task-Driven)



Selection
(click a group)

Compare a focus group
vs others

Brushing
(select a range)

Focus on a time window
or region

Filtering
(reduce space)

Handle many categories
or large data

Demo E: Interactive HTML artifacts

WHEN TO USE HTML

Interactivity supports a task

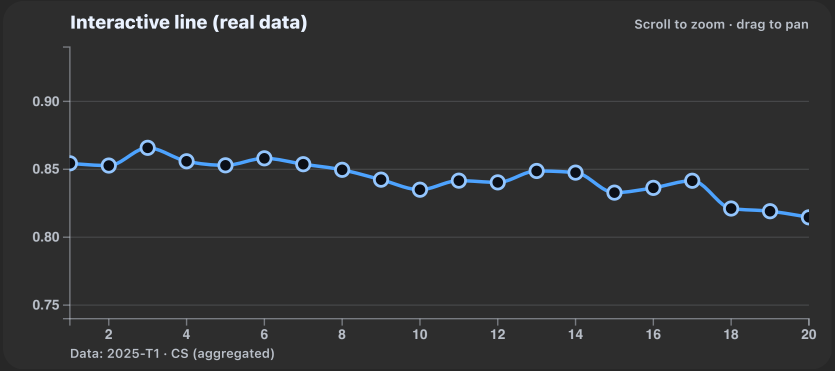
- Hover to confirm exact values
- Zoom/pan for dense time series
- Highlight/filter to compare groups

DELIVERABLE

A single HTML file you can share

RENDERED RESULT (ILLUSTRATION)

Hover + zoom are built in.



Interactive line (real data)

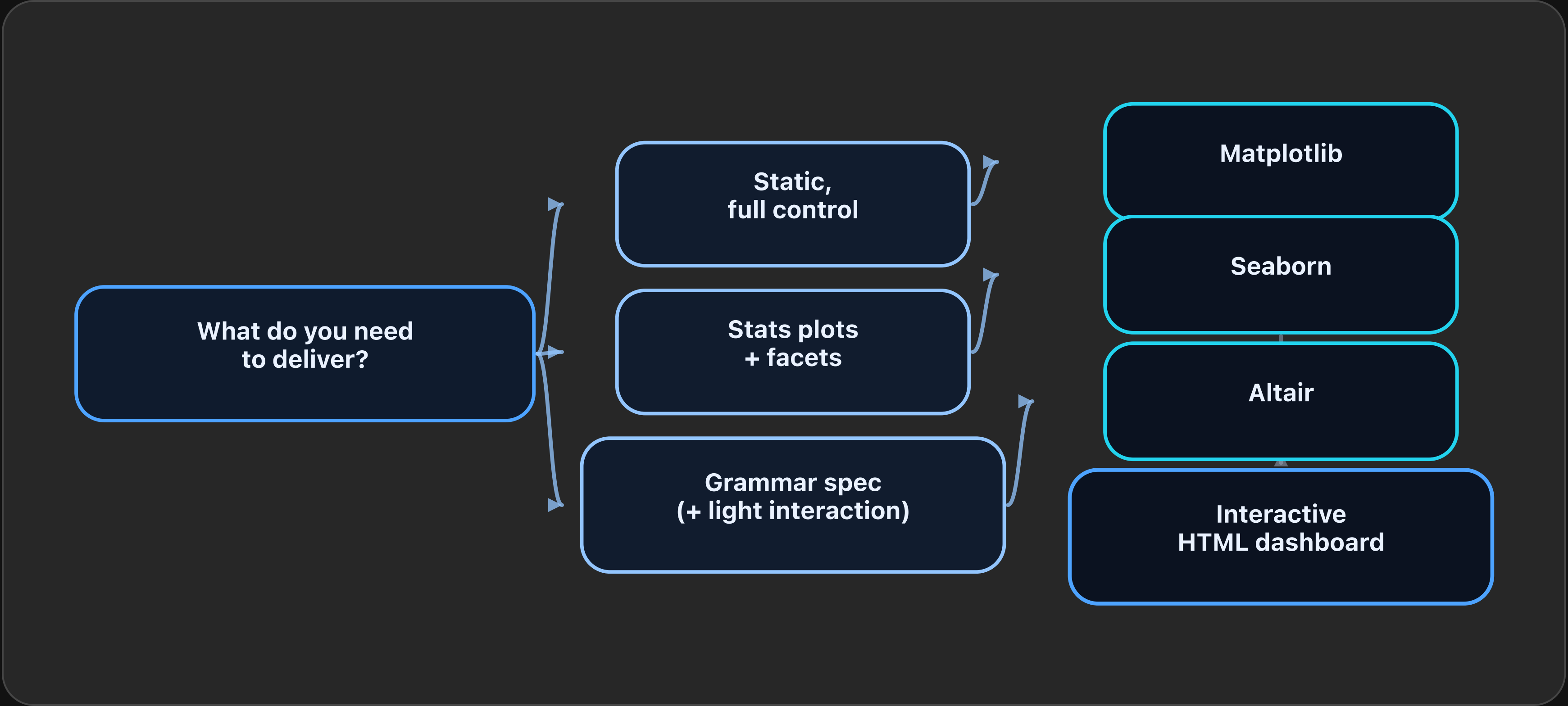
Scroll to zoom · drag to pan

Data: 2025-T1 · CS (aggregated)

Code Demo E — Run

```python
import pandas as pd

df = pd.DataFrame(
    {"week": [1, 2, 3, 4, 5, 6], "pass_rate": [0.70, 0.62, 0.75, 0.73, 0.80, 0.78]}
)

width, height = 720, 320
pad_l, pad_r, pad_t, pad_b = 56, 18, 22, 44

xmin, xmax = df["week"].min(), df["week"].max()
ymin, ymax = 0.5, 0.9


def sx(x: float) -> float:
    return pad_l + (x - xmin) / (xmax - xmin) * (width - pad_l - pad_r)


def sy(y: float) -> float:
    return pad_t + (1 - (y - ymin) / (ymax - ymin)) * (height - pad_t - pad_b)


pts = [(sx(r.week), sy(r.pass_rate)) for r in df.itertuples(index=False)]
path = "M " + " L ".join(f"{x:.1f},{y:.1f}" for x, y in pts)
```

Choosing the Right Tool (A Practical Heuristic)



What do you need to deliver?
Static, full control
Stats plots + facets
Grammar spec (+ light interaction)
Matplotlib
Seaborn
Altair
Interactive HTML dashboard

Export Formats: What You Hand In (and Why)

SVG

Slides + print

Crisp, editable, searchable.

PNG

Fixed images

Good for dense marks; stable layout.

HTML

Interactive

Tooltips, zoom, filters.

RULE

Choose format based on *use case*, not preference.

Micro-Checklist: “Looks Professional” in Practice

TYPOGRAPHY

- Readable title (claim or task)
- Axis labels with units
- Limited tick density

GRAPHICS

- Aligned scales for comparisons
- Legend only if necessary
- One clear emphasis (not rainbow)

DATA

- Rates vs counts handled
- Missingness shown explicitly
- Aggregation explained

EXPORT

- SVG/PNG/HTML matches use case
- Consistent sizing across figures
- Works on dark backgrounds

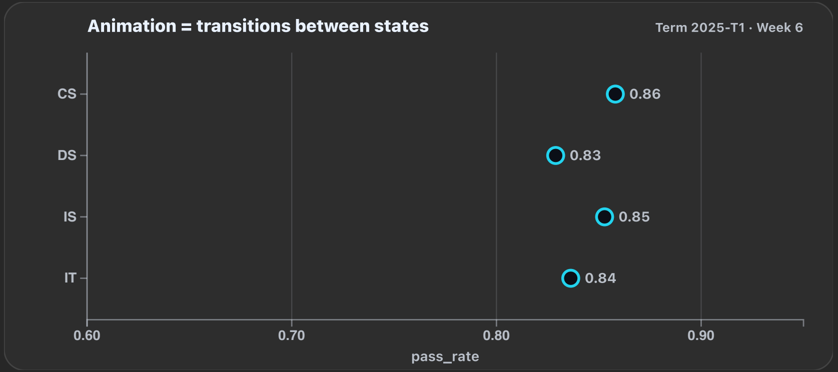
Bonus: Animations (when they help)

D3 DEMO (AUTO-ADVANCING)

Same data, same scale — watch the marks move.

USE ANIMATION WHEN

- The task is to **see change over time**
- You keep a **fixed scale** (so frames are comparable)
- You also provide a **static alternative** for precise comparison



PYTHON OPTION

Plotly animations

A single HTML file with frames + controls.

Practice (In Class): Make One Chart, Three Exports

TASK

Create one chart and export it as SVG, PNG, and HTML.

Then explain which format you would submit for: slides, a PDF report, and an interactive critique.

1

Pick a simple dataset

10–200 rows.

2

Include units + baseline

If relevant.

3

Justify your export choices

Write 2–3 sentences.

PART 5 · PRACTICE

Python-first visualization craft

Make charts that ship: readable, accessible, reusable.

Styling is a constraint, not decoration

PROFESSIONAL HABIT

Use one theme across charts

Typography, sizes, gridlines, colors.

WHY IT MATTERS

Consistency builds trust

Viewers stop re-learning your chart style each slide.

DESIGN RULE

Make the data loud. Keep the scaffolding quiet.

Live Python: A consistent Matplotlib style

WHAT YOU'RE BUILDING

A tiny "style system"

- Figure size is intentional (export-ready)
- Typography is consistent
- Gridlines are subtle

RULE

Make the data loud. Keep scaffolding quiet.

WHAT TO NOTICE

- Font sizes are intentional
- Gridlines are subtle
- Labels are complete (units when needed)

Live Python — Run

```python
import io

import matplotlib.pyplot as plt
import numpy as np

plt.rcParams.update({"figure.dpi": 120, "font.size": 12})

x = np.arange(1, 9)
y = np.array([72, 71, 74, 76, 75, 78, 80, 79])

fig, ax = plt.subplots(figsize=(7.2, 2.8))
ax.plot(x, y, marker="o", linewidth=2)
ax.set_title("Consistent style: readable by default")
ax.set_xlabel("Week")
ax.set_ylabel("Score")
ax.grid(True, alpha=0.25)
fig.tight_layout()

buf = io.StringIO()
fig.savefig(buf, format="svg")
svg = buf.getvalue()
print("SVG length:", len(svg))
print("Starts with:", svg.splitlines()[0][:72] + "…")
```

Color is a data encoding (not a theme)

MATCH MEANING

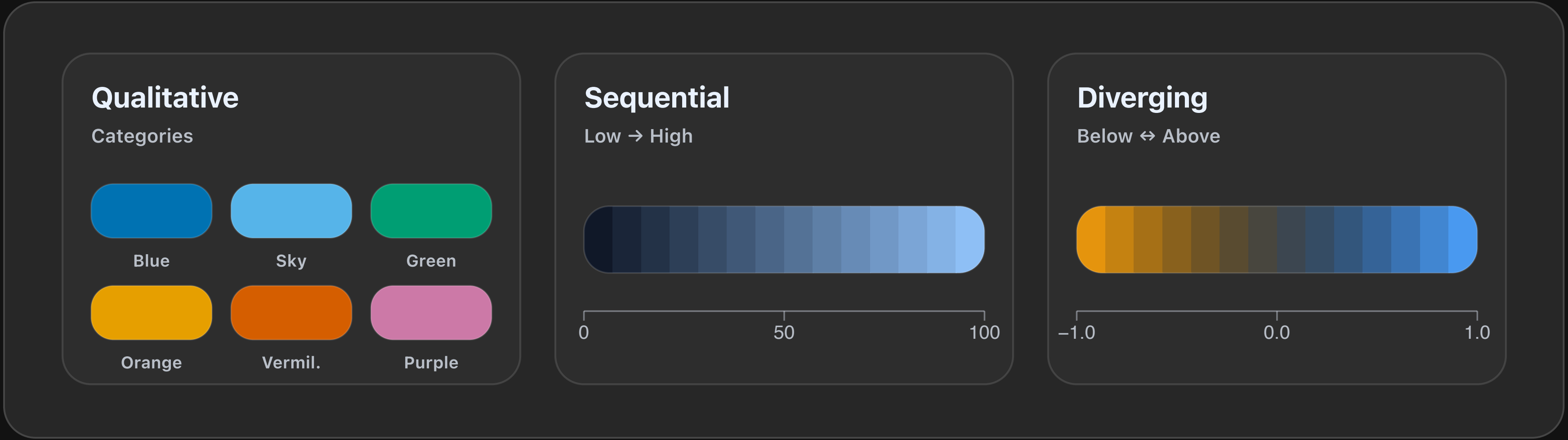
Type → palette

Categorical, ordered magnitude, baseline differences.

COMMON FAILURE

Pretty ≠ interpretable

If the scale is wrong, the chart is wrong.



Qualitative

Categories

Sequential

Low → High

Diverging

Below ↔ Above

Matplotlib colormaps: choose by semantics

SEQUENTIAL

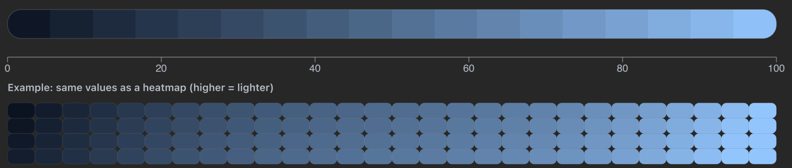
Magnitude: low → high

Use lightness ramps so order is visible.

DIVERGING

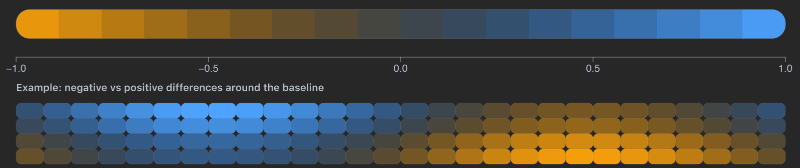
Difference: below ↔ above baseline

Only when the midpoint is meaningful.



Lightness ramp (ordered magnitude)

Example: same values as a heatmap (higher = lighter)



Centered midpoint (baseline = 0)

Example: negative vs positive differences around the baseline

Live Python: sampling colors from a colormap

CONCEPT

Colormaps are functions

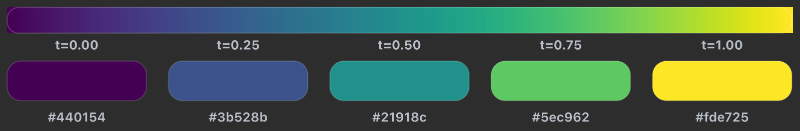
You can sample them, test them, and keep them consistent across many charts.

WHY THIS MATTERS

Colormaps are functions. You can sample them, test them, and keep them consistent across plots.

Colormap = function (t → color)

Example: Viridis (sequential, order visible via lightness)



Tip: choose palettes by semantics (categorical vs sequential vs diverging), then sample consistently.

Live Python — Run

```python
import matplotlib.cm as cm

cmap = cm.get_cmap("viridis")
samples = [cmap(i / 4) for i in range(5)]

for i, rgba in enumerate(samples):
    print(i, tuple(round(x, 3) for x in rgba))
```

Accessibility basics for color

DO

Add redundancy

Labels, position, shape—don’t rely on color alone.

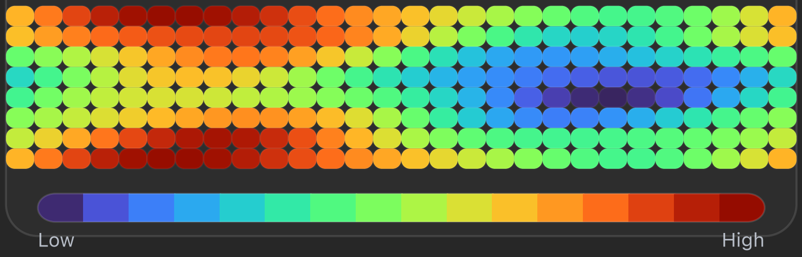
AVOID

Red/green-only meaning

Many viewers cannot reliably distinguish it.

Rainbow-like

Creates false boundaries



Perceptual

Order visible in lightness

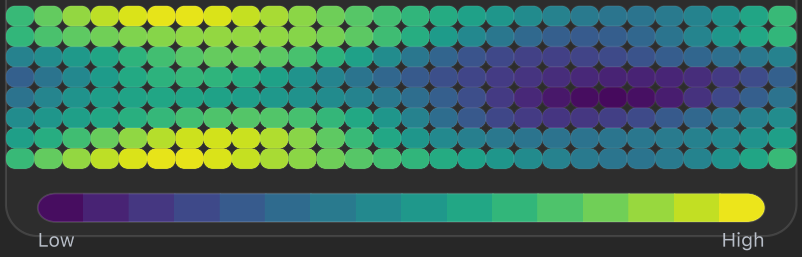


Chart components as reusable code

INPUT

DataFrame

Types + units + grain.

PROCESS

Transform + encode

Compute chart-ready columns.

OUTPUT

Figure object

Exportable + consistent.

If your chart can’t be wrapped as a function, it won’t scale to a project.

Live Python: a reusable chart function (template)

HOW TO USE IT

Turn repeated chart decisions into parameters (titles, fields, scales, annotations).

PATTERN

A “chart component” mindset

Turn repeated chart decisions into parameters (fields, scales, annotations, export).

Live Python — Run

```python
from dataclasses import dataclass


@dataclass
class ChartSpec:
    title: str
    x: str
    y: str


def describe_chart(spec: ChartSpec) -> str:
    return f"{spec.title} | x={spec.x} | y={spec.y}"


print(describe_chart(ChartSpec("Pass rate trend", "week", "pass_rate")))
```

Layout matters (even in notebooks)

GOOD LAYOUT

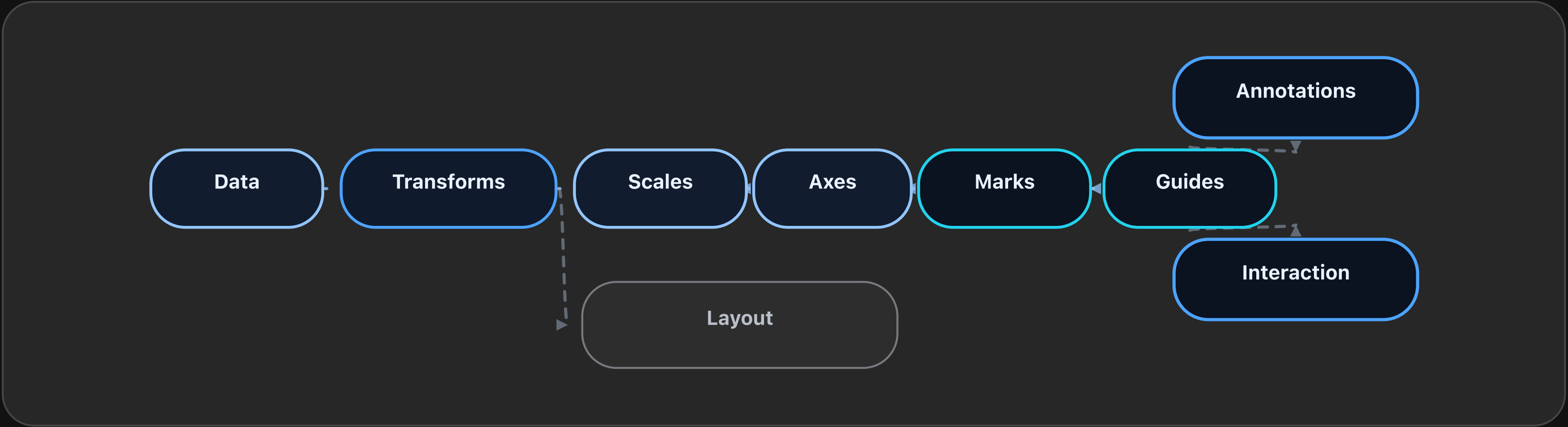
Aligned comparisons

Shared scales; predictable reading order.

BAD LAYOUT

Legend hunting

Too many colors; misaligned axes; crowded labels.



Performance: reduce complexity before you draw

WHEN DATA IS LARGE

Aggregate or bin

Histograms, hexbin, summaries.

WHEN DATA IS DENSE

Sample or faceting

Downsample; split into panels.

If you draw every point, you are encoding latency.

Publishing checklist (before you export)

TEXT

- Readable title + labels
- Units included
- Consistent font sizes

SCALES

- Baselines correct
- Domains chosen intentionally
- Comparisons are aligned

COLOR

- Meaning matches palette
- Contrast is sufficient
- No color-only decoding

EXPORT

- SVG for vector (slides)
- PNG for raster (photos)
- HTML for interaction

Mini exercise (in-class)

PROMPT

Turn one messy table into a chart-ready table.

Then choose a single chart and justify it in 4 sentences.

DELIVERABLE

A tidy table + one exported figure (SVG or PNG).

JUSTIFICATION

Task → transform → encoding → why it’s readable.

Export formats: choose the right artifact

SVG

Slides + print

- Crisp at any zoom
- Searchable/selectable text
- Editable in Figma/Illustrator

Use when marks + labels must stay sharp.

PNG

Screens + photos

- Reliable everywhere
- Good for raster layers (maps)
- Predictable file size

Use when you have imagery or heavy density.

HTML

Interaction

- Tooltips + selections
- Responsive layouts
- Shareable dashboards

Use when interaction supports a task.

RULE OF THUMB

If it needs to be read, prefer `SVG`. If it needs to be explored, prefer `HTML`. If it's an image, prefer `PNG`.

Web-ready exports: what “done” looks like

SHIP WITH CONTEXT

- A one-sentence caption (what + why)
- Units + time window + data source
- A note for missing data / caveats

A chart without context is a decoration.

SHIP WITH STRUCTURE

- Consistent title sizing
- Aligned margins across figures
- Filenames: `topic_metric_scope_date.svg`

The “professional” look is mostly layout discipline.

EXPORT

Save at intended size (don’t “resize later”).

CHECK

Open the file and verify labels/units are intact.

EMBED

Place it into the final layout (slides, PDF, web page).

Accessibility basics (for charts you publish)

LEGIBILITY

- Contrast passes “squint test”
- Text is large enough at 100% zoom
- Direct labels when possible

ROBUSTNESS

- No color-only meaning
- Patterns/markers for redundancy
- Clear “no data” encoding

PROFESSIONAL HABIT

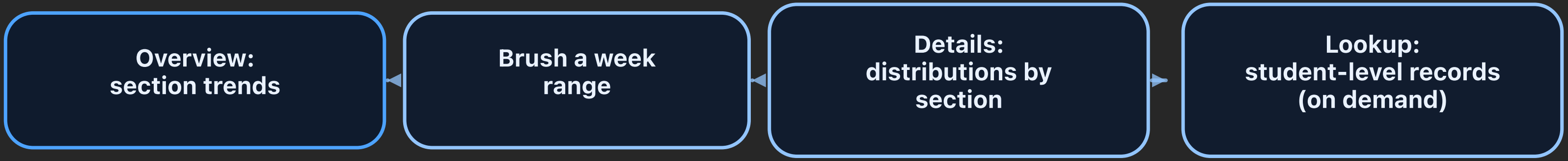
Assume your chart will be viewed in bad conditions.

Low brightness, projector washout, grayscale print, or viewers with color-vision differences.

Case study: from overview to actionable detail

WHY THIS PATTERN WORKS

Start broad (see trends), then narrow (choose a range), then inspect (compare distributions), then lookup only when necessary.



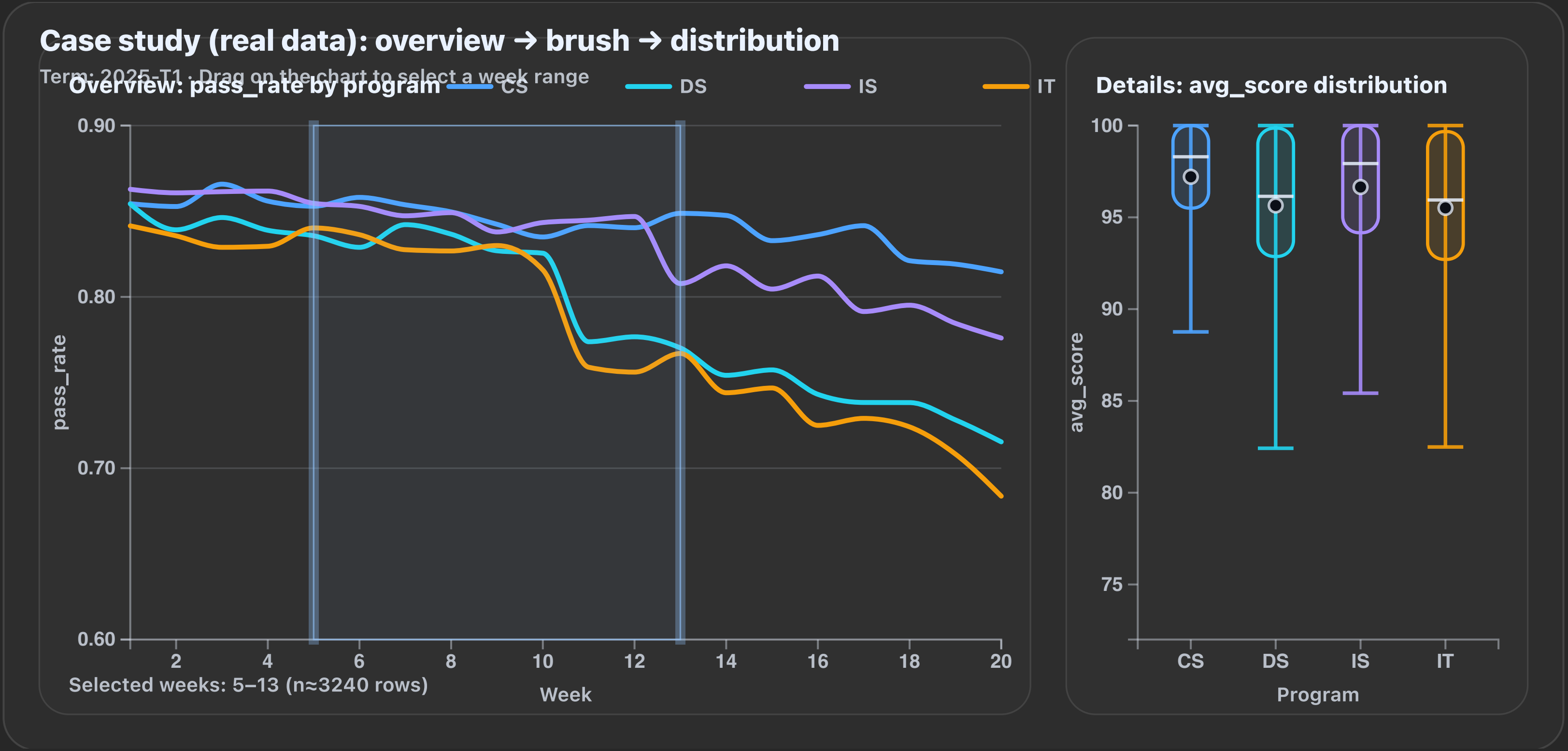
Overview:
section trends

Brush a week
range

Details:
distributions by
section

Lookup:
student-level records
(on demand)

Case study (interactive demo): brush → distribution



Case study (real data): overview → brush → distribution

Term: 2025-T1 · Drag on the chart to select a week range

Selected weeks: 5–13 (n≈3240 rows)

Common export bugs (and quick fixes)

BUG

Tiny text in the final file

It looked fine in the notebook, then became unreadable.

FIX

Set figure size + font sizes explicitly before export.

BUG

Cropping / clipped labels

Axis labels or legends get cut off.

FIX

Use `tight_layout()` / constrained layout and verify the file.

BUG

Misleading scales after export

Domains/baselines changed across charts.

FIX

Lock domains for comparisons; label units; avoid implicit defaults.

RULE

Always open the exported file and proofread it like a report.

Exit ticket (2 minutes)

1

What is your dataset’s “grain” after your transform?

Example: one row = program × week.

2

Which channel is doing the “hard work”?

Position? Length? Lightness? (Name it.)

3

What did you export, and why that format?

SVG vs PNG vs HTML.

4

One improvement you would make next iteration

Labeling, domain, transform, or layout.

Key Takeaways

WEB OUTPUTS

SVG/HTML are common “final forms”

Export for the medium you ship to.

PYTHON WORKFLOW

Data → transforms → chart → export

Re-run it tomorrow and get the same result.

MODERN COMPONENTS

Scales, marks, axes, guides, interaction

Name the parts to design and debug faster.

INTERACTIVITY

Only “professional” when it supports a task

Tooltips confirm; charts should still read.

References (Recommended)

Matplotlib documentation

Figure/Axes model, export formats, styling

https://matplotlib.org/stable/

Altair documentation

Grammar of graphics + interactive selections

https://altair-viz.github.io/

Plotly documentation

Interactive charts + HTML export

https://plotly.com/python/

Wickham (2014)

Tidy data as a foundation for chart-ready tables

https://doi.org/10.18637/jss.v059.i10