Writing your report

A very brief introduction to scientific writing

Flavio Giobergia
Elena Baralis

Data science lab: process and methods

Scientific writing (in a slide)

- Scientific writing is the technical writing used to communicate your work to others
- Scientific communication *requires* clarity and concision
- Scientific writing should address a research question, hypotheses, experiments, results and discussion

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Technical writing to communicate your work

- Technical writing is the writing found in:
  - Textbooks
  - Scientific papers
  - Technical reports

- Communicating your work means:
  - Stating a “question” and an “answer”
  - Explaining the rationale behind the answer
  - Giving the means for (independent) replication

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Clarity & concision

- Clarity
  - *Does it make sense to the reader?*
  - Use precise words and sentences
    - There should be no room for ambiguities
    - Be objective!

- Concision
  - A wordy sentence is a confusing sentence
  - A picture is *sometimes* worth a thousand words
  - Meeting page quotas is not beneficial to anyone

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Scientific writing (in another slide)

- Thoroughly understand your sources
  - And make sure your sources are peer reviewed!
  - Google Scholar can help you find and navigate sources
- Support everything with evidence, and distinguish fact from possibility
- Know your audience
- Never make your readers work harder than they have to

From "Scientific Writing, Style & Structure", University Writing Center, Texas A&M University

Writing your report

- Writing choices
  - Words
  - Sentences
- Supports
  - Lists
  - Images
  - Tables
  - ~~Code~~
- Structure
  - Paragraphs
  - Sections (IMRaD!)

Writing choices

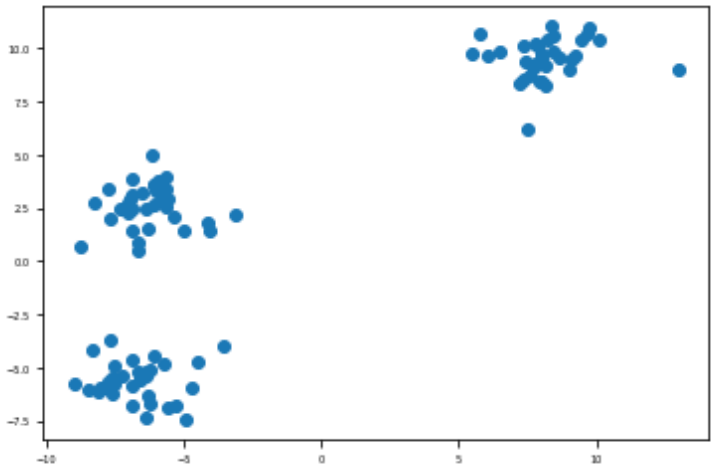
- Avoid needless complexity
  - No redundancy and gratuitous verbosity
  - Keep sentences short
    - One sentence ⇔ one clause (ideally!)
    - Reduce compound sentences
    - Resort to lists, images, tables
- Use formal English
  - No contracted forms
    - Wouldn't, didn't, it'll, … → would not, did not, it will, …
  - No informal terms (or slang!)
    - Tons of, totally, … → large quantities of, completely, …
- Passive vs Active voice

Supports (lists)

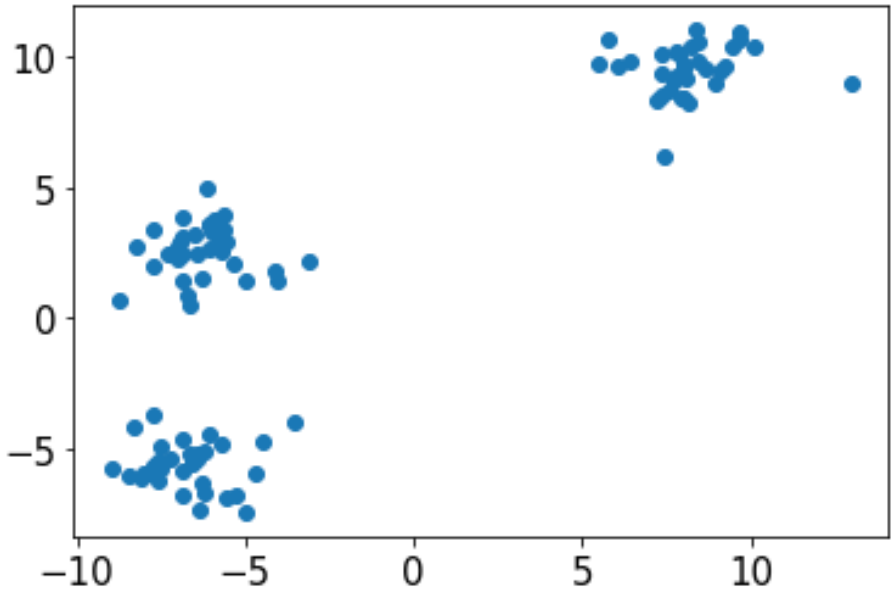
- Anything that:
  1. Lets you write less words
  2. Helps you convey ideas more easily
  3. Makes the reading experience more pleasing
- Lists can be a great way of achieving 1, 2 and 3
  - A support can be anything that can help you achieve one (or more) of the following three goals. One, it lets you write less words, because it is structured in a way that forces the adoption of few (or no) words. Second, it helps convey an idea more easily, because sometimes giving a few key concepts and letting the reader figure out the rest is better than explaining every single aspect of something in an overly verbose (and a bit patronizing) way. Finally, it makes the reading experience more pleasing, avoiding walls of text that would otherwise bore the reader greatly. This is a self-evident slide, by the way.

Supports (images)

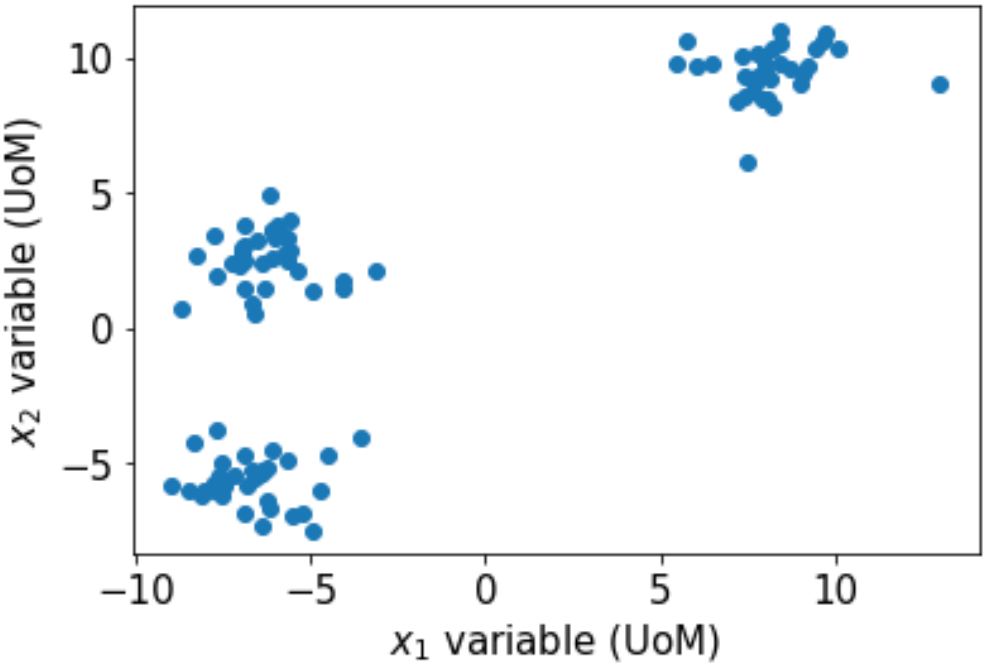
- Images (e.g. plots, diagrams) are great, if presented correctly
  - But awful, otherwise
- The figure below shows everything that can go wrong with a plot
  - Incidentally, this is what 90% of figures in reports look like



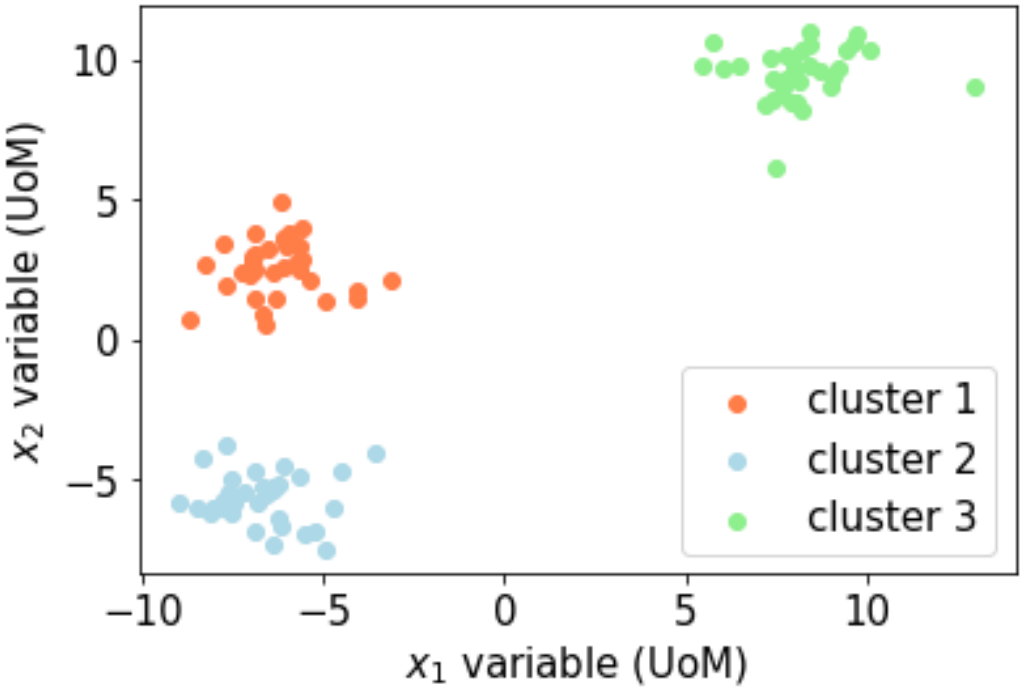
Step 1: make it readable



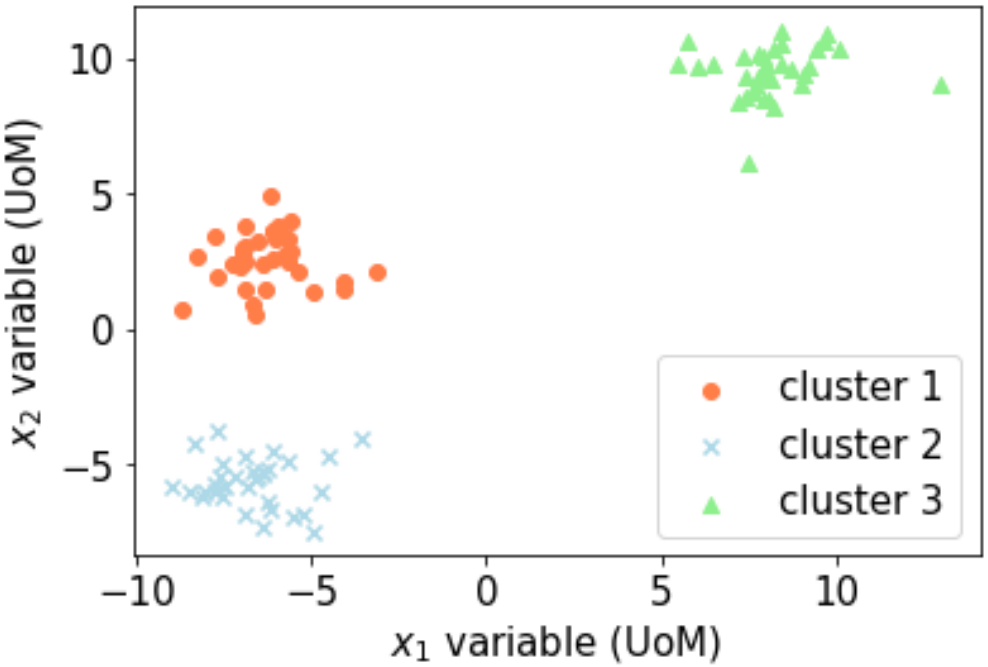
Step 2: add labels and units of measurement



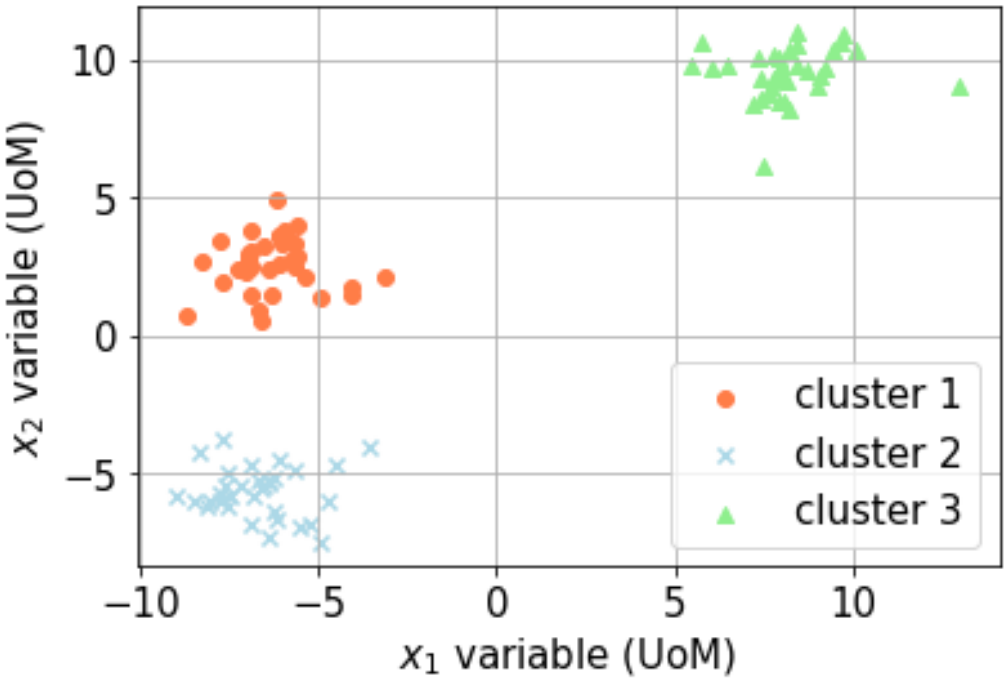
Step 3: add some colors!



Step 4: make it color blind and B/W friendly

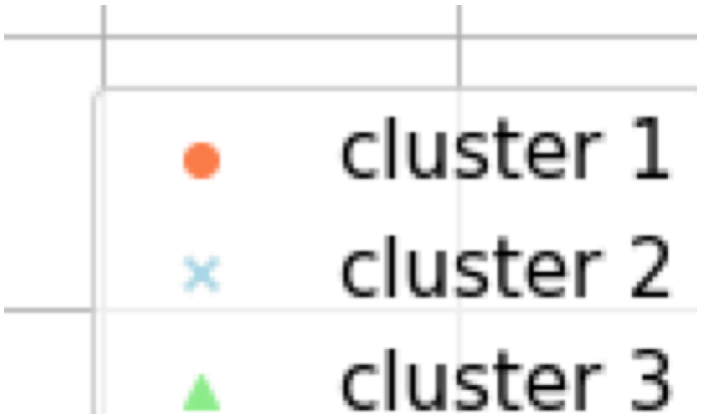


Protip 1: add a grid

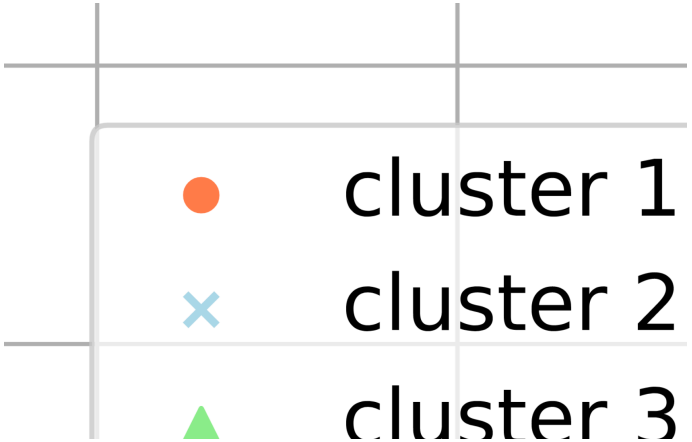


Protip 2: export vector images

bitmap

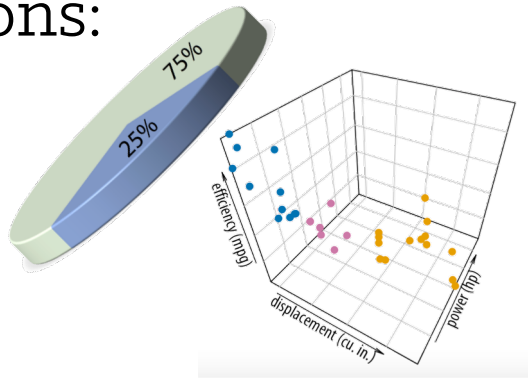


vector



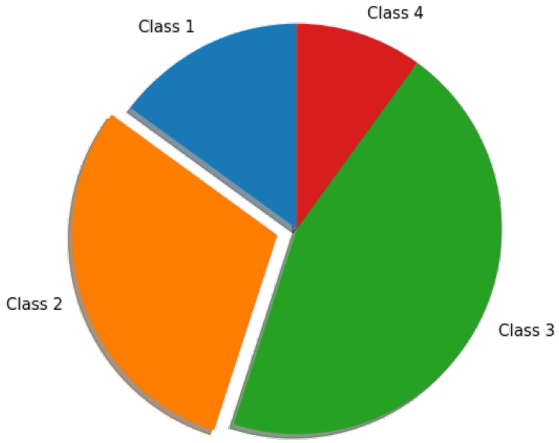
Supports (images) – cont'd

- Avoid "bad" visualizations:
  - Pie charts
  - Gratuitous 3D plots
  - …



Fundamentals of Data Visualization
https://clauswilke.com/dataviz/

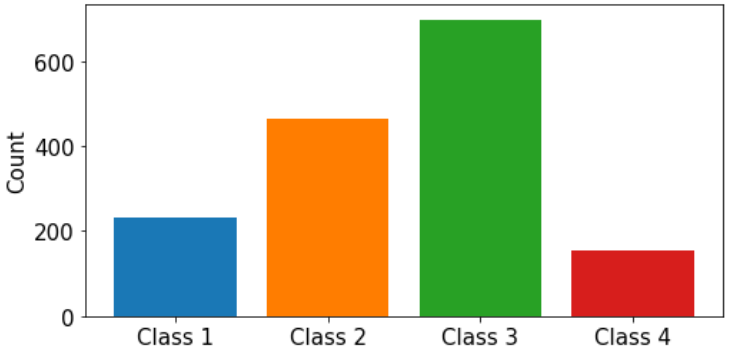
- One more example
  - What's wrong with this plot?
    - Short answer: everything



"Cosmetic decoration, which frequently distorts the data, will never salvage an underlying lack of content."
— Edward Tufte

Long answer: these are better alternatives

- Bar charts



- Tables

Class	Count
Class 1	232
Class 2	465
Class 3	698
Class 4	155

Supports (tables)

- We use tables:
  - If we want to show accurate comparisons
  - If we want to show data that is
    - Long
    - Multidimensional
    - Hierarchical
  - When it makes sense
- A nice tables generator for LaTeX (and more!)
  - https://www.tablesgenerator.com/

Category	Class	Cardinality	Color	SVM		Random Forest	
				Precision	Recall	Precision	Recall
Even	Class 2	465	Orange	0.911	0.943	0.812	0.849
	Class 4	155	Red	0.823	0.955	0.88	0.912
Odd	Class 1	232	Blue	0.815	0.901	0.873	**0.987**
	Class 3	698	Green	**0.967**	**0.974**	**0.897**	0.945

Don’t forget to caption!

- Add meaningful captions to your tables/figures
- In LaTeX, stuff may get moved around
  - Caption + Content should be “self-contained”
  - Adding a caption makes it easier for the reader to follow
- Always address in the text the contents you add

Supports (~~code~~)

- Your Python code does **not** belong to the report
- The raw output of your Python code does **not** belong to the report
- Describe algorithms
  - Visually
  - With words
- There are some rare exceptions to adding code
  - If **necessary**, use pseudocode

```
QUICKSORT (A, p, r)
 if p < r
   q = PARTITION(A, p, r)
   QUICKSORT(A, p, q-1)
   QUICKSORT(A, q+1, r)
 end if
```

```
PARTITION (A, p, r)
 x = A[r]
 i = p - 1
 for j = p, …, r – 1
  if A[j] ≤ x
    i = i + 1
    swap A[i], A[j]
  end if
 end for
 swap A[i+1], A[r]
 return i + 1
```

Structure

- Paragraphs
  - One paragraph ⇔ One important concept
    - 1:N and N:1 are not effective!
- Sections – IMRaD!
  - Introduction
    - Present your problem
  - Methods
    - Present your solution
  - Results, and
    - Apply your solution to your problem
  - Discussion
    - Did that work?
- + Abstract

Introduction (Problem overview)

- What problem do you have?
- Explore the data
  - What's interesting?
  - What's worth mentioning?
  - What requires careful handling?
- Visual aids may be particularly useful here
  - Data distributions
  - Visualization of some points
  - Summary tables

Method (Proposed approach)

- How do you propose you solve your problem?

- Keep it structured
  - Preprocessing
    - What steps did you take to prepare the data? Why?
  - Model selection
    - What models did you use? Why?
  - Hyperparameters tuning
    - Which hyperparameters did you focus on?
    - How did you tune them?

Results

- What happens when you apply your solution to your problem?
- What configurations of *Algorithms* × *Parameters* did you select?
- Let's talk performance:
  - Validation performance
  - Public score performance
- How good is your solution?
  - Vs. random guess?
  - Vs. a naïve solution?
  - Vs. others in the leaderboard?

Discussion

- What conclusions can you draw based on what happened when you applied your solution to your problem?
- What went well?
- What could you improve?
  - Other possible approaches
  - Limitations found
- Considerations on the problem

Abstract

- 2-3 sentences that describe your work
- Should give the reader an idea of the paper
- Should be self-contained
- (hopefully) appealing
  - But avoid clickbaits!