

# Scientific and technical writing

*Content, Structure, Editing,  
Formatting*

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Elguedj

GM-3-S1-PST – Year 2024/2025

## ► Opening

- Motivations for this course
- S&T writing: motivations
- Outline

## ► Content & Structure: IMRaD

## ► Editing and formatting

## ► Closing

Piled Higher and Deeper by Jorge Cham

www.phdcomics.com



title: "I am a writing god!" - originally published 1/29/2003

# PST: Scientific and Technical Project

## Two-fold objective

### Project: two technical supervisors

try and apply the scientific method to an open problem (no evident closed solution, as opposed to problems treated in tutorials)

### Scientific Writing: A. Platzer (assistant professor), DOC'INSA

report about your work and findings following scientific writing conventions

- ▶ 5×2 H lectures + 2H tutorial only → introduction, then a reference for the rest of your curriculum

# Lecture introduction (1/3)

## Motivation

- ▶ Report and defense = large part of how you are evaluated in your curriculum
- ➔ Provide you with the tools for efficient and relevant scientific and technical (S&T) writing and presentation

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title: "Write write write write write" - originally published 1/18/2017

# Lecture introduction (2/3)

## Themes

- 1 Content & structure
- 2 Form

## Teaching methods

- Slides / Q&A
- Group exercises

## Timetable

3 × 2 H lectures:

- |                         |                                      |
|-------------------------|--------------------------------------|
| 1 <sup>st</sup> lecture | Theme 1                              |
| 2 <sup>nd</sup> lecture | Theme 2 (editing, writing equations) |
| 3 <sup>rd</sup> lecture | Theme 2 (images formatting)          |

# Lecture introduction (3/3)

## Assessment: PST report

### Assessment grids on Moodle

- ▶ points on the technical part
- ▶ points on the literature review

## Resources after the course?

- ▶ Your personal notes
- ▶ Moodle page: **Rédaction Scientifique** (in Génie Mécanique/Divers)
- ▶ A new website:  
<https://jcolmars.froggit.page/rs-docs/>
- ▶ contact me by email, consult assessment grids



ACCUEIL

Rédaction scientifique



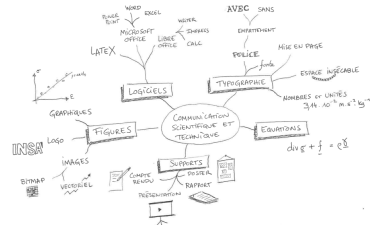
# Q&A

## Why write?

- ▶ To inform, present your findings, leave a record of the work done.
- ▶ To **convince** your audience of the importance of your work, to **convey** a message
- ▶ But also to **think**! Writing things down forces you to organize your thoughts.

⚠ Do not neglect handwriting!

- ▶ Handwriting notes
- ▶ Mind maps, outline of your document
- ▶ Storyboard



# Q&A

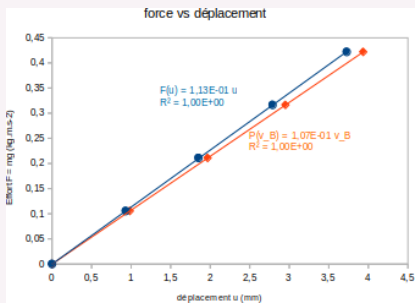
## Why write “beautiful” documents?

- ▶ To conform to customs and **standards**.
- ▶ To **enjoy**! And therefore make people want to read.
- ▶ To facilitate transmission, to convince of the **authenticity** of the results.

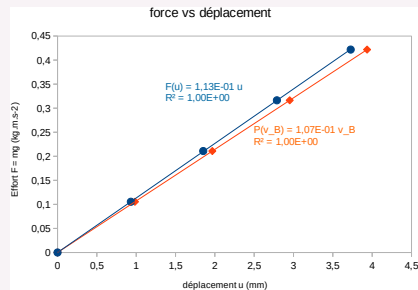


# Q&A

## Why write “beautiful” documents?



(a) A graph that appears stolen from somewhere else.



(b) A graph you produced yourself.

Figure 1: Convince with quality figures.

# Let us dive in

The course is divided into two main parts, with a **common goal : quality!**

## Content & structure (today)

- ▶ Content and structure of a S&T document

## Form (in december)

- ▶ Layout/format of your document

## ► Opening

## ► Content & Structure: IMRaD

- What is IMRaD?
- The different parts
- Summary

## ► Editing and formatting

## ► Closing

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# Content & Structure

## 2-in-1 recipe

### IMRaD: english for...

- 1 **I**ntroduction
- 2 **M**ethods
- 3 **R**esults  
and
- 4 **D**iscussion

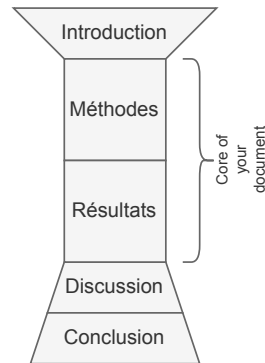


Figure 2: The shape of a S&T document <sup>1</sup>

<sup>1</sup>Glasman-Deal. *Science Research Writing for Non-Native Speakers of English*. London ; Hackensack, NJ, 2010.

# IMRaD: the only valid scientific outline

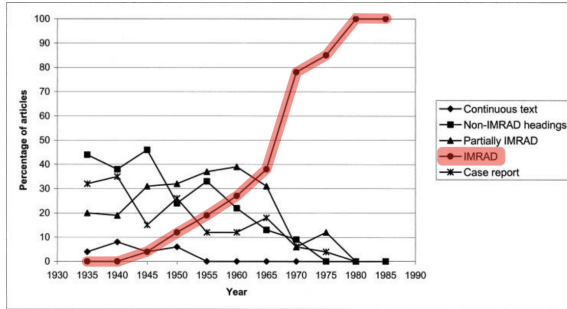


Figure 3: Text organization of published articles in the *British Medical Journal* from 1935 to 1985 (n=341) <sup>2</sup>

To adopt for good!

- ▶ Organizes your thoughts
- ▶ Reproduces the scientific approach

<sup>2</sup>Sollaci & Pereira. The introduction, methods, results, and discussion (IMRAD) structure: a fifty-year survey. *Journal of the medical library association* 92.3 (2004).

# In details: IMRaDC

- 0 Title page
- 1 **I**ntroduction
- 2 **M**ethods
- 3 **R**esults  
**and**
- 4 **D**iscussion
- 5 **C**onclusion
- 6 Acknowledgments<sup>3</sup>
- 7 References

→ Why?

→ How?

→ What?

→ And so ?

→ To sum up?

---

<sup>3</sup> could also appear right before the Introduction.

# The different parts: outline

- ▶ Title page
- ▶ Introduction
- ▶ Methods
- ▶ Results
- ▶ Discussion
- ▶ Conclusion
- ▶ Acknowledgments
- ▶ References

# Title page

## Content

**Title** short and explicit

**Authors** ordered by amount of “work done”/contribution

**(Abstract)**  $\simeq$  200 words which summarize the objective(s), the methods(s) and major findings(s).

## Example<sup>4</sup>

Response of a carbon-black filled SBR under large strain cyclic uniaxial tension

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<sup>c</sup>Manufacture Française des pneumatiques Michelin, C.E.R.L. Ladoix, 63040 Clermont-Ferrand, France

### ARTICLE INFO

#### Article history:

Received 5 February 2010

Received in revised form 18 May 2010

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Available online 11 June 2010

#### Keywords:

Cyclic stress/strain curve

Cyclic softening

Rubber

Stress amplitude

Strain-softening

### ABSTRACT

A carbon-black filled SBR was submitted to various uniaxial tension cyclic tests in order to study its cyclic softening. Stress-softening and stretch creep were monitored during stretch-control tests and ratcheting tests, respectively. The material softening induced by cyclic loadings appeared to depend on the maximum loading applied. The cyclic amplitude or equivalently the cyclic energy did not affect the material softening. The latter experimental result draws our attention since it contrasts with former results of the literature obtained on natural rubbers and butyl rubbers.

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<sup>4</sup>Brieu et al. Response of a carbon-black filled sbr under large strain cyclic uniaxial tension. *International Journal of Fatigue* 32.12 (2010). URL: <https://www.sciencedirect.com/science/article/pii/S0142112310001386>.



# Introduction

## Content<sup>5</sup>

### 1 Context and general motivation

- Establish the importance of your field
- Provide background facts / information
- Define the terminology in the title/key words
- Present the problem area

### 2 State of the art on the problem

- What is known?
- What is left to do?

### 3 Objectives of the study

- Briefly present the objectives of your work (fill the gap in current research, improve a product)
- Precisely describe the **problem** you are addressing
- Present your **hypotheses**

### 4 Document outline/presentation

- Briefly tease your methods, main results (without too much *spoill*)
- Give the **outline** (can do both at the same time)

<sup>5</sup>Each numbered item can correspond to a paragraph.

# Methods/Methodology

## Objectives: precision and exhaustivity

The Methodology should contain sufficient detail for readers to **replicate** the work done and obtain similar results.

## Content

- 1 Briefly introduce your methodology
  - Provide an overview of what you used
  - Relate it to the purpose of your work
- 2 Specifically and precisely describe materials & methods
  - Precisely describe the equipments/materials/software programs/tools/theory you used (cf. **check-lists**)
  - Justify choices made
- 3 Indicate where problems occurred, if necessary

# Results

Objective: convey the message!

All the results, and nothing but the results.

## Guidelines

- ▶ **Raw** data, yet *formatted*
  - graphs, schematics, annotated pictures
  - tables, statistics
- ▶ **Comment the results** with descriptive comments only, not explanatory
- ▶ Order the report of results
  - from the simplest/most obvious to the most complicated/complex one
  - from the most general aspects to the most specific ones

# Results

How to comment them?

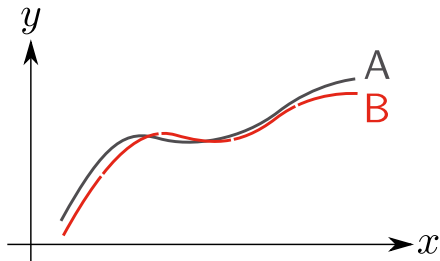


Figure 4: Evolution of  $y$  over  $x$

- not enough “Fig 4 shows the evolution of  $y$  as a function of  $x$ , for both A and B series.”
- descriptive “As can be seen in Fig 4, the two curves are very similar/different.”
- explanatory “In Fig 4, curve A is above B because...”

## Why comment them?

Results do not speak for themselves: you need to indicate what there is to see!

# Results

## Type of descriptive comments

- sequence** order and time sequence of what you found  
“Crack initiation appears after  $n$  loading cycles.”
- frequency** how often your result occur  
“Regardless of the initial guess, the algorithm never convergences.”
- quantity** give precise figures for the evolution of a specific quantity  
“Process A gives twice the roughness of process B.”
- correlation<sup>6</sup>** show the relationship between two results/quantities  
“The load and the displacement are proportional.”

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<sup>6</sup>Warning! Correlation and causality are two different things..!

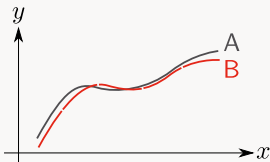
# Discussion

The most important... yet the most difficult section to write 😊

## Objective: analyze the results

Try and provide explanations, justifications for your findings.

### Example



Explain *why* A and B curves are similar/different.

### Guidelines

- ▶ Describe the general principles issued from the results
- ▶ Do they satisfy assumptions?
- ▶ Do they agree or not with literature?
- ▶ Explain the discrepancies/limitations. Can they be overcome?

# Conclusion

## Objective: concision and conviction

Show how you answered the question asked in the Introduction (problem) and summarize your key findings.

## Remark

Discussion and Conclusion are sometimes merged into one section.

## Content

- 1 **Summarize** all sections Introduction, Methods, Results and Discussion:  
“To address problem  $I$ , we followed methodology  $M$  to obtain *key* result(s)  $R$ , which shows  $P$  principle(s), or contradict with  $C$ .”
- 2 Refine **implication** of the results
- 3 Suggest future work, **perspectives**, *realistically*: indicate what needs to be done in the short, medium and long terms.

# Acknowledgments

## Objective

Thank people who helped but are not listed as co-authors:

- ▶ Financial support,
- ▶ Technical support,
- ▶ Moral support.

## Example

*Remerciements.* Les auteurs tiennent à remercier le LABEX MANUTECH-SISE (ANR-10-LABX-0075) de l'Université de Lyon dans le cadre du programme « Investissements d'Avenir » (ANR-11-IDEX-0007) géré par l'Agence Nationale de Recherche Française (ANR). Les auteurs remercient également S. SaoJoao, M. Mondon et G. Blanc de l'École des Mines de Saint-Étienne pour leurs aides sur la préparation des échantillons et leur caractérisation microstructurale. Ils tiennent aussi à remercier le CLYM (Centre LYonnais de Microscopie, <http://clym.insa-lyon.fr>) pour avoir donné accès au FIB/SEM (Zeiss NVision 40) et à N. Blanchard, A. Descamps-Mandine, Th. Douillard, et B. Van De Moortèle pour leur soutien technique. CLYM est soutenu par le CNRS, le Grand Lyon et le Conseil Régional Rhône-Alpes (France).



# References

## Content

A list of all references cited in the text (no reference if no citation!)

## Format

For instance with **Zotero**  
→ **DocINSA lectures & tutorial**

## Golden rule

**CITE YOUR REFERENCES**

## Example

### Références

- [1] H.W. Zhang, Z.K. Hei, G. Liu, J. Lu, K. Lu, *Acta Mater.* **51** (2003) 1871-1881
- [2] M. Korzynski, *Int. J. Machine Tools Manuf.* **47** (2007) 1956-1964
- [3] M.M. El-Khabeery, M. Fattouh, *Int. J. Machine Tools Manuf.* **29** (1989) 391-401
- [4] G. Kermouche, *Matériaux & Techniques* **101** (2013) 308
- [5] K. Lu, J. Lu, *Mater. Sci. Eng. A* **375-377** (2004) 38-45
- [6] N.R. Tao, Z.B. Wang, W.P. Tong, M.L. Sui, J. Lu, K. Lu, *Acta Mater.* **50** (2002) 4603-4616
- [7] P. Bazarnik, Y. Huang, M. Lewandowska, T.G. Langdon, *Mater. Sci. Eng. A* **626** (2015) 9-15

# References

Citations appear in (almost) all sections

- Introduction** Description of context/state of the art:  
“This application has been extensively studied in the past few years [1, 3-7].”
- Methods** Other works that inspired you to elaborate the methodology:  
“The model used herein comes from a previous study [1].”
- Results** Unless very specific cases, **no citation here**: you report *your own results*.
- Discussion** Mapping (dis/agreement) to literature:  
“Our findings are similar to those presented in [1], which confirms that.../ which can be explained by...”
- Conclusion** Some references can appear if your methodology or your results can be clearly compared to literature standards: “Unlike what the authors in [1] suggested, our findings show that...”

# IMRaDC: summary

## In a nutshell...

**Introduction** What was the problem?

**Methods** How did you address it?

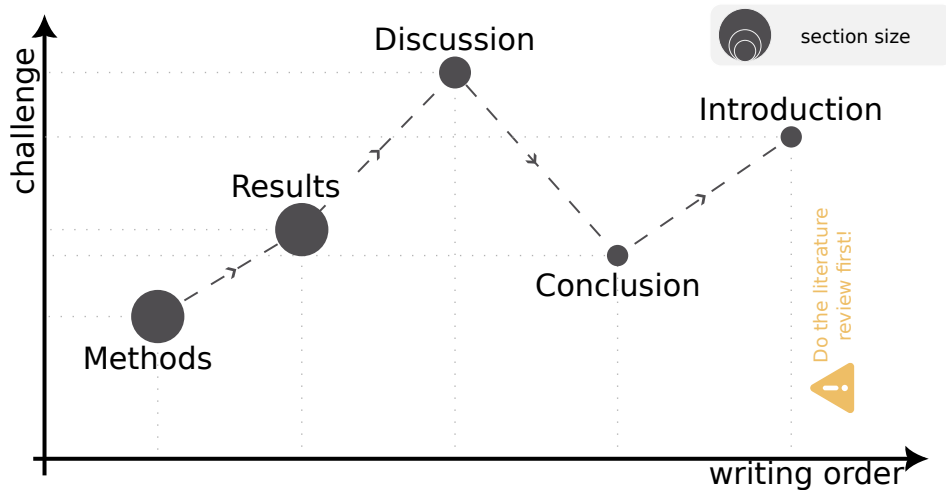
**Results** What did you obtain?

**Discussion** Why? What does it demonstrate?

**Conclusion** What should we learn from it? What else could be done?

 OK but... how do I start ? 

# Writing order vs difficulty



# Content & Structure: summary

What do you need? What should you know?

## IMRaDC: 2-in-1 formula

You “just” need to fill in the different sections.

## 3<sup>rd</sup> year student knows how to...

“Perfectly” write **M**ethods et **R**esults sections

**Methods** *Rigorously* describe

- ▶ an experiment, a process
- ▶ an analytical or numerical model
- ▶ a set of specifications

**Results** *Compile* results to convey a message.

# Content & Structure: summary

What do you need? What should you know?

## IMRaDC: 2-in-1 formula

You “just” need to fill in the different sections.

→ text, page layout

## 3<sup>rd</sup> year student knows how to...

“Perfectly” write **M**ethods et **R**esults sections

### Methods

*Rigorously* describe

- ▶ an experiment, a process
- ▶ an analytical or numerical model
- ▶ a set of specifications

→ pictures/schematics  
→ equations/(code)  
→ tables

### Results

*Compile* results to convey a message.

→ figures/tables

► Opening

► Content & Structure: IMRaD

► Editing and formatting

- Formatting documents
- Equations
- Images

► Closing

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## Wikipedia definition : page layout

Page layout [...] is the graphic **arrangement of information content in a given space** (sheet of paper, comic strip, web page, etc.).

It follows the work of collecting and composing the content [...] and often precedes the work of printing [...].

It aims to represent the content (text, images, animations, etc.) in a hierarchical and harmonious way (balance of zones, colors and spaces, contrasts), in order to facilitate a multi-level reading experience, with a constant concern for **ergonomics**.

Translated from French with DeepL.com (free version)





\_\_\_\_\_

\_\_\_\_\_

Plain text is different from **formatted text**, where style information is included; from **structured text**, where structural parts of the document such as paragraphs, sections, and the like are identified; and from **binary files** [...].

Plain text without markup

When we code, we write plain text...

# Plain text

## Advantages

accessibility, portability, sustainability

## What You See Is What You Mean (WYSIWYM)

When we exchange text, what matters is the meaning (the content described by the words). We exchange characters using computers.

## Characters encoding

- ▶ **ASCII** encodes numbers from 0 to 9, 26 Latin alphabet letters (lower and upper case), a few mathematical symbols and punctuation.
- ▶ **UTF-8** extension is used by over 95% of web pages.

# Plain text and markup

## Content vs. layout

- ▶ **Content:** plain text, words
- ▶ **Layout:** graphical representation of the message, formatted and structured, with style and other objects (images, tables, equations, etc.)

→ How can we encode page layout?

# Markup languages

Markup languages use **tags** to create formatted text by defining **elements**.

**HTML** Tags are used to delimit the start and end of elements in the markup.

- ▶ tags `<h1></h1>` delimits a level 1 header
- ▶ tags `<p></p>` delimits a paragraph

**Markdown** Lightweight markup language which uses symbols to define elements

- ▶ hash symbol `#` indicates header level (`#` header 1, `##` header 2, etc.)
- ▶ dash symbol `–` indicates a list item

**L<sup>A</sup>T<sub>E</sub>X** Elements are defined by commands and environments

- ▶ environment `\begin{document}... \end{document}` delimit the beginning and the end of the document
- ▶ command `\section` defines a new section (level 1 header).

# Markup language and styles

## Page layout encoding

- ▶ each piece of text is attributed a **role**: paragraphs, section headers, title, etc.  
→ graphical homogeneity, rigorous and repeatable
- ▶ this is done through **tags** or any markup equivalent
- ▶ editing software interprets the tags to attribute a **style** and a **position** to each piece of text

## Example: HTML and CSS

CSS language turn HTML tags into styles (font size, color, etc.).

# Office software

## What You See Is What You Get (WYSIWYG $\neq$ WYSIWYM)

In an office software (word processor such as Microsoft Word, Mac Pages or LibreOffice Writer), **text appears formatted** as you type.

What happens?

- ▶ Applying a style in Word is like putting markup tags with your mouse instead of using code
- ▶ Word does actually use tags, but it is hidden from you: try and unzip a .docx file...



\_\_\_\_\_

Whether you are  
typing plain text in WYSIWYM markup languages  
or using WYSIWYG word processors:

## think “tags”

## think structuring

\_\_\_\_\_

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- ▶ Word (reports, articles, etc.)
- ▶ Excel (graphs, data analysis)
- ▶ Power Point (presentation, posters, and some many other things...)

1. *Journal of the American Medical Association*, 2000; 284: 2689-2695.



Compatible with Microsoft Office (in principle).  
The other way around is not sure...

Alternatives : WPS Office (30 \$), Collabora, OnlyOffice, Open365, etc.).

\_\_\_\_\_

What you use...



- ▶ Reports (labs or projects)
- ▶ Lecture notes
- ▶ Community work

## What you could use instead...



Firstname Surname :

- ▶ ID: fsurname@insa-lyon.fr
- ▶ pwd: \*\*\*\*\*

# Markdown



cheat sheet

- ▶ Plain text files with \*.md extension
- ▶ Interpreted by an appropriate reader
- ▶ Easily convertible to \*.html or \*.pdf

## Local installation



Typora

## Collaborative and online



Markolla: INSA HedgeDoc server

# Markdown

```
1 # Titre 1
2
3 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Suspendisse a leo porttitor, luctus nibh sed, interdum nulla.
  Curabitur ante ante, efficitur eu arcu ut, egestas vehicula mi. Maecenas suscipit condimentum consectetur. Nulla vel dolor
  dui. Quisque gravida dictum ipsum, in luctus nulla tincidunt id. Vivamus sodales ipsum in volutpat imperdiet.
4
5 - liste 1
6 - liste 2
7
8 ## Sous-titre 1.1
```

## Titre 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Suspendisse a leo porttitor, luctus nibh sed, interdum nulla. Curabitur ante ante, efficitur eu arcu ut, egestas vehicula mi. Maecenas suscipit condimentum consectetur. Nulla vel dolor dui. Quisque gravida dictum ipsum, in luctus nulla tincidunt id. Vivamus sodales ipsum in volutpat imperdiet.

- liste 1
- liste 2

### Sous-titre 1.1

# L<sup>A</sup>T<sub>E</sub>X

## A reference for Scientific Writing

### L<sup>A</sup>T<sub>E</sub>X

L<sup>A</sup>T<sub>E</sub>X is a language (not a software).

- ▶ **Free**, large user community,
- ▶ Focus on the content (WYSIWYM)
- ▶ Compilation of the code renders page layout according to built-in (or personalized) styles

## Previous slide L<sup>A</sup>T<sub>E</sub>X code

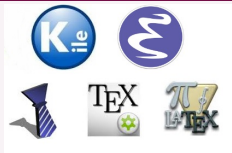
```
\frametitle{\LaTeX}
\framesubtitle{A reference for Scientific Writing}

\begin{block}{\LaTeX}
  \LaTeX{} is a language (not a software).
  \begin{itemize}
    \item \alert{Free}, large user community,
    \item Focus on the content (WYSIWYM)
    \item Compilation of the code renders page layout according to built-in (or pe
  \end{itemize}
\end{block}
```

# L<sup>A</sup>T<sub>E</sub>X

## A reference for Scientific Writing

### Requirements



That are multiple solutions to “make L<sup>A</sup>T<sub>E</sub>X”. You need

- ▶ A text editor
- ▶ A link to L<sup>A</sup>T<sub>E</sub>Xcode compiler programs

### Local installation



- ▶ L<sup>A</sup>T<sub>E</sub>X distribution: MikTex (Windows or MacOS), TexLive (Linux, MacOS)
- ▶ All-in-one editor: TexMaker

### Online and collaborative



- ▶ Overleaf
- ▶ no installation, great tutorials



# Suggested cover/title page

In order of appearance:

- ▶ complete title of the project
- ▶ as subtitle:
  - course label
  - type of report (lab, internship, project)
- ▶ your name
- ▶ name of the company
- ▶ name of your supervisors (in the company or in at school)
- ▶ the **date** of writing

and somewhere, if you like, **unaltered, high-quality logos**

# Standard page

Use headers and footers.

For instance

- ▶ header
  - (short) title
  - authors
- ▶ footer
  - page number
  - (logos)

## Difficulty

Word & co ★

L<sup>A</sup>T<sub>E</sub>X ★★

\_\_\_\_\_

## Split your text into sections/sub-sections/etc.

- ▶ Explicit section names (par ex. IMReDC)
- ▶ Number **all** sections levels
- ▶ Attribute a **style** to each section

Word & co  $\star(\star)$

L<sup>A</sup>T<sub>E</sub>X -

# Document structure

## Rule

Split your text into paragraphs

- ▶ e.g, 1 paragraph/item of IMRAD “contents”
- ▶ 1 paragraph  $\neq$  1 sentence
- ▶ 1 paragraph has a beginning and an end: must **develop** an idea

## Difficulty

Word & co -

L<sup>A</sup>T<sub>E</sub>X -

## Emphasize relevant information

Emensis itaque difficultatibus multis et nive obrutis callibus plurimis ubi prope Rauracum ventum est ad supercilia fluminis Rheni, resistente multitudine Alamanna pontem suspendere navium conpage Romani vi nimia vetabantur ritu grandinis undique convolantibus telis, et cum id impossibile videretur, imperator cogitationibus magnis attonitus, quid ambigebat.

### Visually prioritise information

- ▶ using lists
- ▶ using text blocks (with parcimony)

Alios autem dicere aiunt multo etiam inhumanius (quem locum breviter paulo ante perstrinxi) praesidii adiumentique causa, non benevolentiae neque caritatis, amicitias esse expetendas; itaque, ut quisque minimum firmitatis haberet minimumque virium, ita amicitias appetere maxime.

# To Justify or not to Justify Text?

## Justified text

Justified text fills the whole column width on paper. Spaces between words are then not regular. Text appears uniform, more formal (e.g. newspaper columns, novels).

## Left aligned

Left aligned text is freer. It suits well for short lines because justifying would stretch space between words, making it harder to read for people with disabilities.



Every non-text element (figure, schematic, table, piece of code, equations) must be given

- and must be referred to and commented in the text.

Word & co ★★

L<sup>A</sup>T<sub>E</sub>X ★

# Non-text elements

## Example

Think about using tables, especially for **synthesizing** short numerical results

| Quantity        | Notation | Value           | Unit | Reference              |
|-----------------|----------|-----------------|------|------------------------|
| Young's modulus | $E$      | $72,3 \pm 0,4$  | GPa  | <i>voir courbe ...</i> |
| Poisson's ratio | $\nu$    | $0,28 \pm 0,01$ |      | <i>voir courbe ...</i> |

**Table 1:** Aluminum properties from an uniaxial tensile test.

In Table 1, results are listed with a precise number of significant digits (related to the precision of the measure) and with an error interval.



# Final draft

Before sharing: proofread! Check **spelling and grammar** (yourself or ask someone else).

## 3 Commands :

- 1 Share your document in PDF \*.pdf
- 2 Give an explicit, unambiguous filename
- 3 Avoid accent or space in the filename

Exemple :

JDoe\_GM-3-PST\_report.pdf

Please, avoid any of:

- ▶ rapport projet 1.docx
- ▶ prÃ©sentation.pptx
- ▶ projet version finale v2.odp

# Equations

Key-part of scientific writing for engineers

It is a crucial part of scientific documents...

Yet, in students reports they come in many forms !

- ▶ Equations within the text,
- ▶ (Ugly) screenshots,
- ▶ Random size symbols,
- ▶ etc.

Writing equations, a basic skill?

Any engineer should be able to perfectly write equations with (and without) a computer.

# What you should not do

de poisson à partir du coefficient directeur de la droite via la relation :  $\epsilon_T = -\nu \times \epsilon_L$   
 Il est également possible de déterminer le module de Young grâce à la formule suivante :  
 $\sigma_L = E \times \epsilon_L$

Figure 5: From 3 GM report

La charge maximale applicable est :

$$F_{\max \text{ elastique acier}} = Rel_{\text{acier}} \times S$$

$$F_{\max \text{ elastique acier}} = 200 * 24.33 * 2.96 = 14403 \text{ l}$$

Figure 6: From another 3 GM report

# Equations layout and variables description

## Example

Heat transfer equation reads:

$$\rho c_p \frac{\partial \theta}{\partial t} = -\operatorname{div}(\vec{q}) + r \quad , \quad (1)$$

where  $\rho$  is the material's density,  $c_p$  the specific heat,  $\theta$  the temperature,  $\vec{q}$  the flux vector, and  $r$  the heat source.

When the problem is stationary, equation (1) simplifies to:

$$-\operatorname{div}(\vec{q}) + r = 0 \quad .$$

→ Maths is just another language, it should flow with the rest.

# Writing equations

with  $\text{\LaTeX}$

$\text{\LaTeX}$  rendering of an equation:

$$\rho c_p \frac{\partial \theta}{\partial t} = -\operatorname{div}(\vec{q}) + r$$

Obtain from the following code:

```
\rho c_p \frac{\partial \theta}{\partial t} = -\operatorname{div}(\vec{q}) + r
```

You make think

What is this? How can you read/type this?

# Word / Power Point

## Microsoft Office equation editor (the least worst)

- ▶ Keyboard shortcut: alt+=
- ▶ Lot of functions accessible with code (similar to  $\text{\LaTeX}$ )
- ▶ Easy to write text, equations, text again.

$$\rho c_p \frac{\partial \theta}{\partial t} = -\text{div}(\vec{q}) + r$$

# LibreOffice Writer

## Insert/Object/Formula

- ▶ built-in equation editor (Writer/Impress)
- ▶ specific syntax<sup>7</sup>
- ▶ online documentation

$$\rho c_p \frac{\partial \theta}{\partial t} = -\nabla \cdot q + s$$

## TexMaths extension

- ▶ use  $\text{\LaTeX}$  syntax
- ▶ equations are rendered as (editable) images

$$\rho c_p \frac{\partial \theta}{\partial t} = -\text{div}(\vec{q}) + r$$

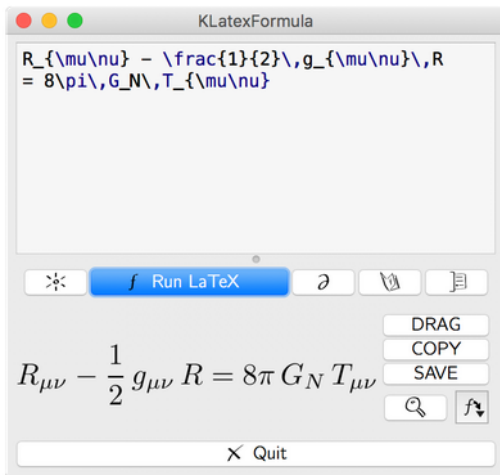
<sup>7</sup>Hard to understand and use, never managed to write the divergence operator correctly.

# KLaTeX

## Cross-platform solution

### KLatexFormula

- ▶ Test your  $\text{\LaTeX}$  syntax quickly
- ▶ Copy/Save/Drag your equation to multiple output formats





# Markdown

## example in Typora

Markdown uses  $\text{\LaTeX}$  syntax for equations.

```
$$  
1 \rho c_p \frac{\partial \theta}{\partial t} = -\mathrm{div}\{\mathrm{\left(\vec{q}\right)}\} + r |  
$$
```

Maths ✓

$$\rho c_p \frac{\partial \theta}{\partial t} = -\mathrm{div}(\vec{q}) + r \quad (1)$$

# HTML

## What about web pages?

### Example: Wikipedia

Obtention de l'équation [ [modifier](#) | [modifier le code](#) ]

 Article détaillé : Équation de conservation.

On peut définir une loi de conservation pour une **variable extensive**  $\phi$  entraînée à la vitesse  $\mathbf{V}$  et comportant un terme de production volumique  $S$  par :

$$\frac{\partial \phi}{\partial t} + \nabla \cdot (\phi \mathbf{V}) = S$$

```
1 <p>On peut définir une loi de conservation pour une <a href="/wiki/Extensivité%20et_intensivité%20(physique)"
  title="Extensivité et intensivité (physique)">variable extensive</a> <span class="mwe-math-element"><span class="mwe-math-
  mathml-inline mwe-math-mathml-a11y" style="display: none;"><math xmlns="http://www.w3.org/1998/Math/MathML" alttext="
  {\displaystyle \phi }">
2   ...
3 <annotation encoding="application/x-tex">{\displaystyle {\frac {\partial \phi }{\partial t}}+\nabla \cdot (\phi \mathbf {V}
  )=S}</annotation>
4
```

html

\_\_\_\_\_



- 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

# Application

de poisson à partir du coefficient directeur de la droite via la relation :  $\epsilon_T = -\nu \times \epsilon_L$   
 Il est également possible de déterminer le module de Young grâce à la formule suivante :

$$\sigma_L = E \times \epsilon_L$$

## Exercice

- ▶ Lister tout ce qui ne va pas
- ▶ Réécrire cette équation proprement dans l'éditeur de votre choix.

# Remise en forme

de poisson à partir du coefficient directeur de la droite via la relation :  $\epsilon_T = -\nu \times \epsilon_L$   
 Il est également possible de déterminer le module de Young grâce à la formule suivante :

$$\sigma_L = E \times \epsilon_L$$

## Corrigé

[...] le coefficient de Poisson  $\nu$  à partir de la définition suivante :

$$\epsilon_T = -\nu \epsilon_L$$

avec  $\epsilon_T$  et  $\epsilon_L$  les déformations transversale et longitudinale respectivement. Le module d'Young  $E$  est ensuite calculé grâce à la relation de comportement :

$$\sigma_L = E \epsilon_L$$

où  $\sigma_L$  représente la contrainte longitudinale.

# Application

La charge maximale applicable est :

$$F_{\max \text{ elastique acier}} = Rel_{\text{acier}} \times S$$

$$F_{\max \text{ elastique acier}} = 200 * 24.33 * 2.96 = 14403 \text{ l}$$

## Exercice

- ▶ Lister tout ce qui ne va pas
- ▶ Réécrire cette équation proprement dans l'éditeur de votre choix.

## Corrigé

$$F_{\max}^a = R_e^a S \quad ,$$
$$F_{\max}^a = 200,00 \times 24,33 \times 2,96 = 14\,403,00 \text{ N} \quad .$$

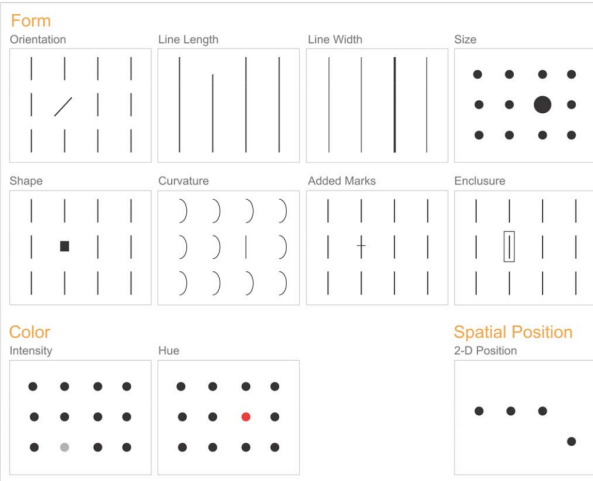
## Outline

- ▶ Formatting documents
- ▶ Equations
- ▶ Images
  - ▶ Introduction
  - ▶ Rules for graphs
  - ▶ Image theory
  - ▶ Exercise

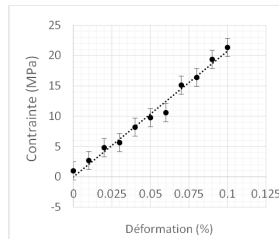
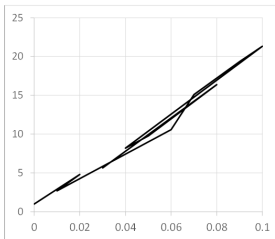
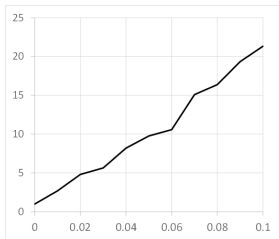
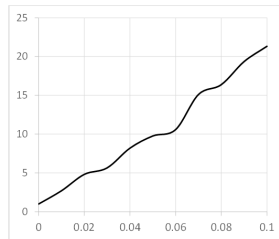
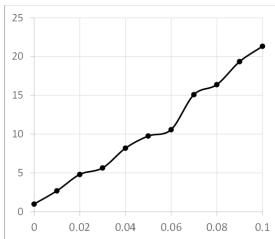
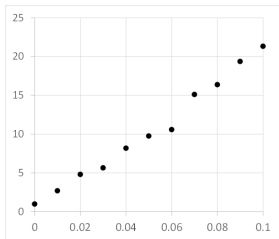




Where do they end up? Which type of document?



# Formatting a graph



\_\_\_\_\_



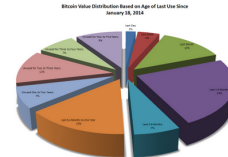
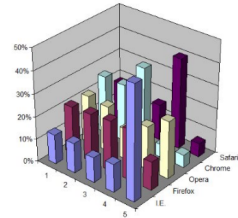
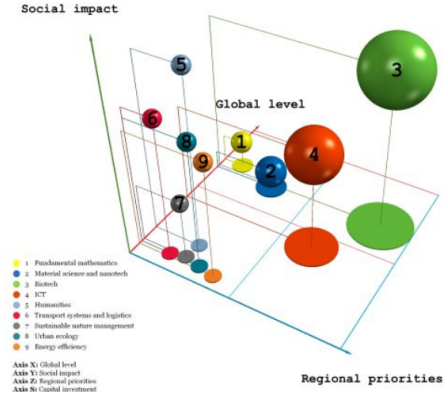
- 



▶

# 3D graphs...

...are forbidden (and horrible)!



From <http://livingqlikview.com/the-9-worst-data-visualizations-ever-created/>

\_\_\_\_\_

The type of graph/chart directly influences the message you convey!  
Find inspiration here: [The Data Visualisation Catalogue](#)  
But **avoid pie charts**, please.

Even a perfectly crafted graph does not speak for itself!

- ▶ Provide a legend and a number to reference it in the text
- ▶ Add a descriptive comment (cf. IMRaD/Results part)

# Vector vs. raster/bitmap graphics

## Raster/bitmap = pixels map

“In computer graphics and digital photography, a raster graphic represents a two-dimensional picture as a **rectangular matrix or grid of pixels**[...]. A raster image is technically characterized by the width and height of the image in pixels and by the number of bits per pixel.” (Wikipedia)

Its resolution is given by the number of pixels by length unit (DPI, PPI) and a color is associated to each pixel.

File formats: DMP, GIF, TIFF, PNG, JPEG.

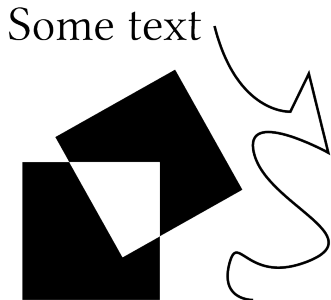


File formats: SVG, EPS, PDF, (EMF), AI.

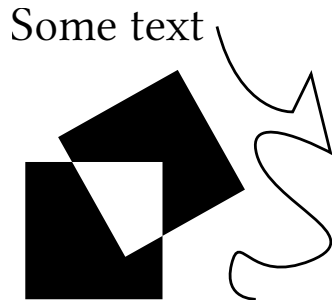


# Vector vs. raster/bitmap graphics

## Example



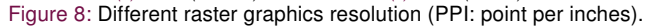
(a) Raster



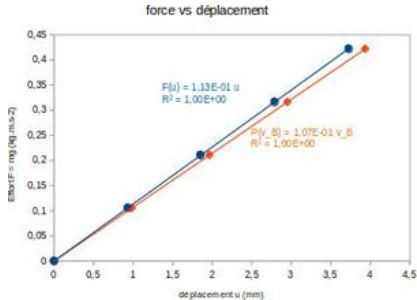
(b) Vector

Figure 7: Vector vs. raster graphics, generated with Inkscape.

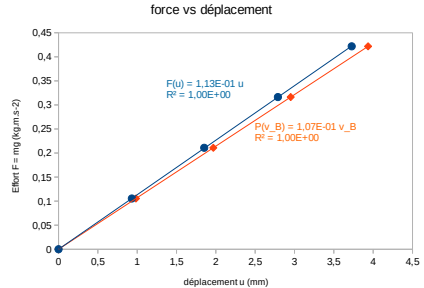
## Example



# Vector vs. raster/bitmap graphics



(a) Raster format (JPEG)



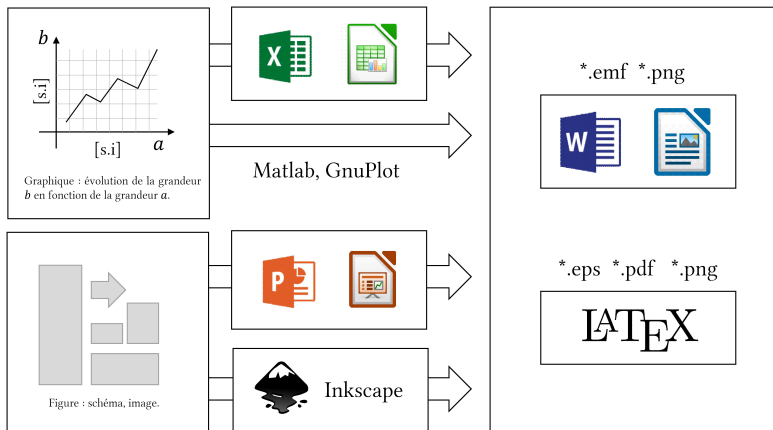
(b) Vector format (PDF)

Figure 9: When you create a graph/chart, it is a vector graphics object, do not degrade its quality later on!



Figure 10: Photo of a biaxial tensile machine [LaMCoS].

# From graphics editing to their integration in a document.



\*.emf : Enhanced Meta File, magic format of Windows, handling both raster and vector graphics.

# Summary

## Keep in mind

- ▶ Raster / vector formats → use them appropriately
- ▶ Graphics language (visualization)
- ▶ Always comment your figures

## Export: do it right



## From the graph to final PDF document (MS Office)

- Other solutions: LibreOffice, LaTeX, etc.

## Drawing challenge

- ▶ Experimental setups
  - tensile test specimen
  - camera
- ▶ theoretical curve
  - which ever theoretical curve  $y = f(x)$  you like
  - add explanations on the graph (domain, remarkable elements, etc.)
- ▶ free drawing
  - INSA's rhino
  - ...



- Opening
- Content & Structure: IMRaD
- Editing and formatting
- Closing

Piled Higher and Deeper by Jorge Cham

www.phdcomics.com



title: "I am a writing god!" - originally published 1/29/2003

# What about oral presentations?

Refer to the dedicated lecture on the [Moodle page](#) (FR)

> Génie Mécanique / Divers / Rédaction Scientifique / Présentation orale

# What about posters?

You will present your work in a **poster** session, on February 7. The poster must have **A1 format**. **Use the template** provided on the **Moodle page**

> Génie Mécanique / Divers / Rédaction Scientifique / Templates /

Modèle pour posters // Poster templates

Modèle de poster en A1 pour GM-3-PST  
Poster template for GM-3-PST (poster session, A1 format)

Modèle PowerPoint : utilisez un autre logiciel à vos risques et périls, en repartant de la trame proposée.  
PowerPoint template: use another software at your own risks, start from the proposed canevas.



Modèle poster A1 PowerPoint // PowerPoint template for A1 poster

## Advice

- ▶ Make choices: not everything will fit on the poster
- ▶ Everything else applies: IMRaD structure, nice editing and formatting.

# Take home messages

- ▶ IMRaD for structure and content
- ▶ Markup tags and **styles** to format text
- ▶ Formatting **equations** and **figures** (never take a screenshot again!)

# For the future

You must practice!

- ▶ (Almost) Everything is on **Moodle** or the **Website**
- ▶ ask for help, feedback, and review

# Crédits

Ce cours est grandement inspiré

- ▶ du cours donné en PST depuis qqs années, fait par Julien Colmars, Auriane Platzer et Thomas Elguedj (INSA Lyon - GM)
- ▶ du cours “Rédaction d’un rapport/Présentation scientifique et technique” donné par Erwan Verron (Centrale Nantes)
- ▶ du cours “How to write and publish your paper” de G. Hess-Fernandez (École des Docteurs, Bretagne Loire), lui-même basé sur le livre de Glasman et Deal<sup>8</sup>

Nous remercions également D. Tumbajoy-Spinel et ses collègues<sup>9</sup> d’avoir fourni un si bon exemple d’article *en français* respectant IMRaD.

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<sup>8</sup>Glasman-Deal. *Science Research Writing for Non-Native Speakers of English*. London ; Hackensack, NJ, 2010.

<sup>9</sup>Tumbajoy-Spinel, D. et al. Identification des propriétés mécaniques des surfaces tribologiquement transformées (tts) à partir des essais de nano-indentation et micro-compression de piliers. *Matériaux & Techniques* 103.3 (2015). url: <https://doi.org/10.1051/mattech/2015020>.