Techniques for Scientific Writing and Associated Softwares

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Outline

Strategies for scientific communication

- Discussion on the objectives to be achieved before the PhD defense
- Efficiently using conferences and journals
- General instructions for paper writing
- How to write a short (conference-type) article
- How to write a journal article
- How to write the PhD thesis
- How to design slides
- How to make a poster
- The PhD defense

Softwares for scientific writing

- Applied session on paper writing
- Applied session on figure drawings
- Slide/poster preparation
- Poster defense / Slide presentation

The 12-point Checklist

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- generating new ideas
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- great written and oral communication skills

The bad examples

Some countries/universities pressure researchers to success

- quantity favored over quality:
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    $\Rightarrow$ You end up only going for “All Star” sessions
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  - production of clearly wrong results (at least $1/3$ of submitted conference papers are wrong)
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- a PhD thesis is very short: do not waste your time!
  - Typical PhD work-time: from 8am to 6pm + book reading at night + work during weekends
  - Reserve 6 months for PhD dissertation. Many advantages:
    - you need to find a consistent outline for the dissertation (often work broken down in pieces)
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- the PhD student is "officially" only half-responsible of his success/failure
  - Students may forget they must work hard (a minimum work gives you your diploma)
  - Competition for job starts AFTER the PhD

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IMPORTANT ADVICE: Create your own webpage/Scholar account early on! And add a picture!

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Equally valid within the lab: go to seminars of both senior and junior scientists! **Be curious!**

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- Never publish anything based on conjectures or proposing conjectures! Especially so if the conjecture is likely not to hold.

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General instructions for paper writing

Simplicity, clarity and reproducibility

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  - People often do not understand why these articles are rejected since they are correct.
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- **PLAGIARISM !!**: Beyond unacceptable, must be reported! May imply blacklisting or life banishment!
  $\Rightarrow$ Even self-plagiarism is banned!

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- **Readers of long papers might get tired:** make sure long papers deserve to be so long! Overwriting a paper annoys readers who won't read it.

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- second-level reading: detailed organization is clear, well sectioned, using clear “environments”.

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  $\rightarrow$ Results may be introduced in a separate "Main Results" section prior to the methods, especially in math papers. This avoids the main result to be found on page 53 and helps the reader to know where the paper is getting at.

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     $\Rightarrow$ The conclusion should mirror the introduction but **targeting the (now) aware reader**.
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The IMRAD format (2)

"Introduction, Method, Results, And Discussion"

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     $\Rightarrow$ Alphabetical ordering or appearance ordering.

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- choose appropriate wording
  - avoid common uninformative/waste words, e.g. “use”: never use use
  - avoid all possible confusions, e.g. “ECG of a monkey using . . . ” (who uses what?), “Data Augmentation for Speech Recognition for Under-resourced Languages” (two targets?)
  - use natural keywords!
    $\Rightarrow$ Some important information (e.g. practical application of the main math result) may never be spotted in search engines.

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- Researchers are very sensitive to references:
  - recall that H-index is the international evaluation of a researcher
  - references acknowledge the work of people before you
  - avoid open criticism of bad articles (do not reference them!)
  - avoid criticism of old articles (your ideas often come from a modern look at them)
  - make an exhaustive analysis of the literature in order not to miss any actors
  - when not referencing an article, make sure the paper excludes it naturally (reviewers may be annoyed by that)

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- Don't enforce good results, be honest
  - Avoid showing only corner case scenarios, this will be spotted!
  - Don't hide alternative techniques that work better.
  - Sometimes, papers justifying that a technique is bad are good papers.
  - Often, plots are a support for proven results. They don't stand themselves as proofs.

Question every table with large number of zeros

Temp [°C]	Growth in 48 h [mm]
-50	0
-40	0
-30	0
-20	0
-10	0
0	0
10	0
20	7
30	8
40	1
50	0
60	0
70	0
80	0
90	0
100	0

Table: Effect of temperature on growth of oak seedlings

Not all numerical data must be put in a table

Temp [°C]	No. of expt	Aeration of growth medium	Growth
24	5	+	78
24	5	-	0

Table: Effect of aeration on growth of *Streptomyces coelicolor*

Nocillin	K Penicillin
5/35 (14)	9/34 (26)

Table: Bacteriological failure rates

When to use tables?

- If repetitive data must be presented
- If few determinations $\Rightarrow$ data in text
- Put table (column) into words if reasonable
- Question every table with large number of zeros
- Give only significant data

Good Table

Parameters for downlink transmission scheme

Bandwidth [MHz]	f_S **[MHz]**	**FFT size**	**# occupied SC**
2.5	3.84	256	151
5.0	7.68	512	301
10.0	15.36	1024	601
15.0	23.04	1536	901
20.0	30.72	2048	1201

Table: Parameters for downlink transmission scheme

How to arrange tabular material

- Like elements should read down not across
- Words in a column are lined up left
- Number lined up right (or at decimal point)
- Vertical rules are normally not used
- Avoid double rules
- Avoid exponents in table headings
- Follow the journal's instructions

How to design effective graphs (1)

When to use a graph

If data shows pronounced trends

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- Each graph should be as simple as possible
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- Group graphs together if they are most meaningful displayed together
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- Ensure self-containedness of graphs/caption for **first reading pass!**

How to design effective graphs (2)

Symbols and legend

- Use standard symbols ○ △ □ ● ▲ ■
- Use different symbols or different types of connecting line (e.g. dashed, dotted, etc.)
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  $\Rightarrow$ not visible when printed black&white
- Use appropriate line width, size

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- Ensure consistency of display with the rest of the document!
- Don't shrink/distort images, don't make ugly low-resolution copy-paste!

Example: Bad Graph

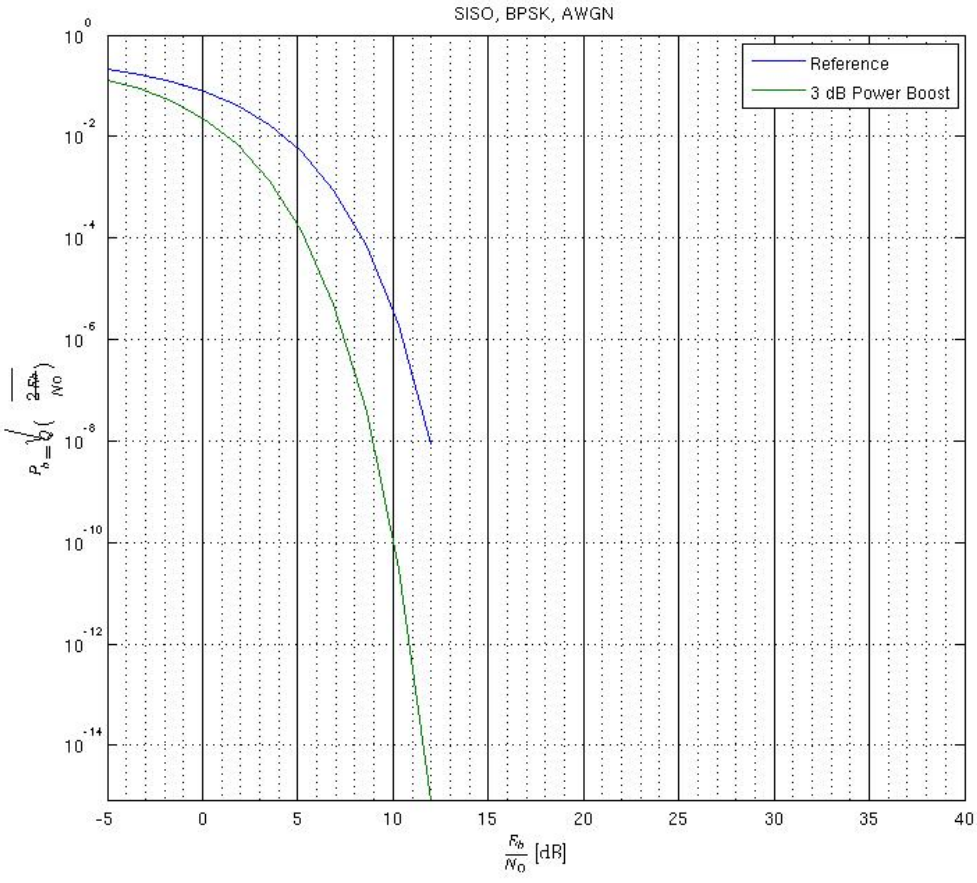
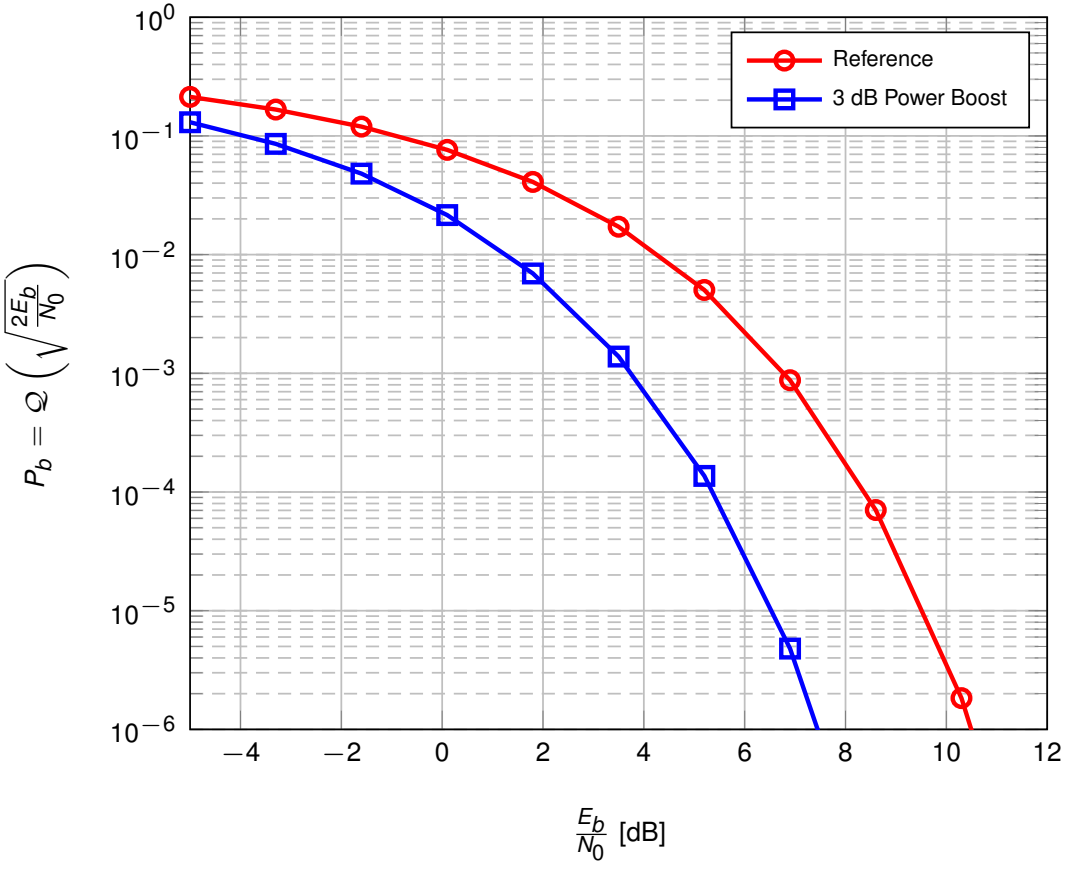


Figure: BER vs. SNR, BPSK, AWGN

Example: Good Graph



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  - only number what is referenced (unless for peer-review)
  - etc.

Some further advice

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- **Paper size**:
  - Most papers are the pinnacle of months of work, so it is tempting to overwrite them
  - Keep the paper efficient: clear and simple so to convey the information fast and reliably
  - Respect page limitations: journals adapt themselves to most practical format
  - Readers won't read too long articles
  - When proofs are long and little informative for the contribution, keep them in appendices

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- the online alternative with simultaneous user editing and auto-compiling:
  - Overleaf (multiple features, easy for beginners)
  - Plmlatex (governmental, secured)

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- Important extra packages:
  - insert new features/modules with `\usepackage{ThePackage}`
  - for plots/graphs: use `pgfplots` (fully latex compliant), don't copy-paste Matlab/Python output!
  - for drawings: use `tikz`

Strategies for scientific writing

How to write a conference article

The objectives of a conference

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- **Conveying the information on your work**:
  - These communications are ALL about conveying a message, not “publishing a paper”
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- **Opening your mind to other subjects**:
  - Often tutorials are there to discover new topics
  - Some conferences privilege very new contributions, even missing target
  - Often, the papers of interest to you were available online 6 months before.
    $\Rightarrow$ To keep in mind for your own presentations!

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  - Make a link to the long version of the article
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- Shorten sections to a minimum
  - Abstract should not exceed five lines: one sentence for context, results, (tools), interpretation.
  - Short conclusion (keep it since reviewers will jump to it)
  - Only fundamental references should stay (direct stream from history to your work), max. 10 refs.
  - When result is a single theorem, make a pedagogical explanation of the proof.
  - Keep only important graphs/tables (2 or 3 max.)

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  - Make the contribution visual and simple

- Shorten sections to a minimum
  - Abstract should not exceed five lines: one sentence for context, results, (tools), interpretation.
  - Short conclusion (keep it since reviewers will jump to it)
  - Only fundamental references should stay (direct stream from history to your work), max. 10 refs.
  - When result is a single theorem, make a pedagogical explanation of the proof.
  - Keep only important graphs/tables (2 or 3 max.)

- At the same time, avoid papers looking like unsupported claims
  - Be convincing
  - Be pedagogical (at a researcher level of course!)
    $\Rightarrow$ Many people use short papers as an entry-door to a new topic
    $\rightarrow$ Prefer sketches of proofs instead of full proofs, simplify the hypotheses, keep notations short.

Writing a conference article

A conference article conveys **practical** information in a few pages

- Short in content (can be 4-5 page long).
  $\Rightarrow$ Don't present too many things. Stick to essential results
  - Only sketches of proofs for important theorems
  - Make a link to the long version of the article
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- You need to know how to make a difference! Make the paper interesting so that at least reviewers do read them!
- As a PhD student, do not waste time on a conference paper: they barely count in your reference list.
  $\rightarrow$ Only use conferences for **communications**, not as a means for **publication**.

Strategies for scientific writing

How to write a journal article

Choosing the appropriate journal

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- Do not force a paper to be published by jumping from journal to journal.
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- be prepared to adapt the scientific "jargon" to the community of interest.
- if not exactly your field, do not miss essential references from this community.

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- **Efficiency**: keep the content simple and clear (but well commented), not long for the sake of writing a "real" contribution
  $\rightarrow$ Even a work of 2 years does not justify to be overly written.
  $\Rightarrow$ Do not try to reach the page limit, this is a stupid idea!
  $\rightarrow$ More information is often too much information.

The IMRAD format

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- **Discussion and Conclusion**:
  - Make it efficient. Smart unequivocal comments.
    $\rightarrow$ Fight against painful philosophical or empty discussions!

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Strategies for scientific writing

How to write the PhD thesis

The philosophy behind

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- 100-200 pages should not be seen as "a long document"
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- **Format**: Format is free but usually follows these rules
  - Long introduction to context and tools
    $\Rightarrow$ Good opportunity for philosophical considerations!
    $\Rightarrow$ Use this section as a tutorial on the techniques developed.
    $\Rightarrow$ Model should be general enough to cover every subsection of the work.
  - Introduction and discussion of the main results and references of own publications.
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  - Reviewed by two people from the defense jury.
    $\Rightarrow$ The more renown these people the better your appreciations but the more dangerous too!
- **Format**: Format is free but usually follows these rules
  - Long introduction to context and tools
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  - Results given in separate sections.
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    $\Rightarrow$ Resist pure copy-paste! Make notations consistent
    $\Rightarrow$ Especially work deeply on the transitions.

The rules when writing a PhD thesis

- **No real page limitation**: 50 pages is a strict minimum, 300 pages is too long.
- **In France**:
  - Should be written in French, but English with extended abstract in French ($\sim$ 30–50 pages) is allowed
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  - conclusion / perspective: Recollects the overall contribution / gives an opening to your work
    - **don't spoil this section which proves you understand your field: this is the best testimony of your real expertise!**
    - opening should be smart/dedicated to your work only. Overall opening translates lack of autonomy.

Strategies for scientific writing

How to design slides

Overall information about seminar/conference/workgroup presentations

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- Good and bad presentations:
  - A bad presentation in front of people in your field can ruin your career!
  - A good presentation, even in front of 3 people, is always beneficial.

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- Convince the whole community of your strengths
  - the community is small (everybody knows everybody else): people off your field will talk about your presentation
  - keep in mind that you need to find a position after your PhD: your presentations are building your career!

Preparing the slides

General rules:

- Keep always in mind to be simple and clear:
  - Little content in each slide
  - Few slides (maximum 1/min)
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- State-of-the-art must be well done
  - Make clear what has been done before, what's new here
    $\rightarrow$ Most people in the audience don't know the topic.
  - Correctly reference prior work
    $\rightarrow$ People in the room may work on the topic: they want to see their names!
    $\Rightarrow$ Worst case: you show off on a subject already covered by someone in the room!

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Specific preparation:

- Keep the talk/slides didactic
  - Discard all unnecessary details so not to loose track of what's important
  - Always recall again and again important points
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- Conclusion is often done but not so necessary (after 15min, everyone should remember what you said!)
- Opening / discussion of technical problems to be solved is important
  - a new proof approach is often what will be reused after you
  - people in your field must feel there is some grain to grind

Before the presentation: Checklist

- Rehearse your presentation beforehand
  - Know at least your slides' content
  - Don't rehearse too much to gain make it feel natural
    $\rightarrow$ Over-preparation and stress are visible and annoying
- Check that your slides are functioning properly
- Get to the hall ahead of the audience
- Make sure the projector is working
- Assure that your slides project
- Check the lights
- Check the microphone if you use one
- Check that pens/chalks are available if board is needed

When comes the presentation

→ How to combat stage fright:

- Prepare so you feel confident
- Do not prepare too much so you feel obsessed
- Dissipate nervous energy e.g. take walk, exercises etc.
- Beware of too much caffeine, food or water

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- Obviously, don't read notes!
- Too many ideas too quickly presented will be confusing
- Stick to most important points or results
- Don't proceed too fast, especially at beginning
- Fit the allotted time slot (plan 9 min or 9.5 min if you have 10 min)
- Speak very clearly and avoid speaking quickly
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- Beware of the "crazy pointer" behavior: slow and restricted use of it, use your hands instead!
  ⇒ Crazy pointers are very stressful, even painful!

Q&A period

- Irrelevant questions:
  - Deflect the discussion to something related you want to talk about.
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- If you lack the answer
  - Admit that you don't know (do not panic)
  - Sometimes people ask to check that you know
    $\rightarrow$ Don't make up a wrong answer.
  - Offer to provide the answer later
  - Say how to find the answer

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    - if available, use digital pen and mark your slides!
    - be very slow and precise with the mouse
      $\Rightarrow$ Nothing's more annoying than a crazy pointer/mouse!

Strategies for scientific writing

How to make a poster

Preparing the Poster

- Guidelines:
  - Follow IMRAD format
  - Use very little text
    $\Rightarrow$ most space for illustrations
  - Clear statement of purpose (abstract) at beginning, in bulleted points, not in sentences
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- Detailed content:
  - Short attention-grabbing title
  - Choose appropriate typeface
  - Use bulleted and numbered lists
  - Should be self-explanatory
  - Lots of white space is important
  - Guide the viewer (what to look at first, second, ...)
  - Poster should contain highlights

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- Show readiness to answer questions
- Take advantage of the chance for feedback/network
- Consider handouts with more details
- Have some copies of your paper or related research

Strategies for scientific writing

The PhD defense

Around the defense

- The usual procedure:
  - **2-3 months before** the defense: thesis report sent to reviewers
  - **1 month before** the defense: reviewers send their reports with change suggestions
  - **15 days before** the defense: announcement of the defense is made
  - **D-Day** of the defense: 45min presentation + unlimited Q&A session
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- Specifics of the PhD defense:
  - 5 to 7 jury members, among which 2 reviewers (chosen by PhD advisor and validated by school)
  - the 2 reviewers receive the manuscript in advance and evaluate it, write a report
  - 45min presentation is not interrupted and must fit in time
  - during Q&A, only jury members ask questions
  - after all this, the jury deliberate and write the report
  - PhD applicant is made aware of the jury deliberation
  - since 2012, there is no grade anymore

$\Rightarrow$ Do attend PhD defenses to learn about the process AND to learn about new fields (if well done which is rare!)

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  - $\Rightarrow$ Prepare so to fulfill the constraint, but don’t over-prepare!! Everybody will know you did and this is a nightmare to listen to!
    - most PhD defenses are wasted because of stress and over-preparation
    - the applicants seem not to be aware of the objective of the defense
    - $\longrightarrow$ remember that the jury read your thesis already, so they judged the work! Now they judge YOU.

Preparing the defense

The objective is to show your pedagogical skills and your mastering the topic.

- The presentation is “only” 45min
  - the objective is to give an overview of your work
  - justify that you handle the topic/have original results/add value to state-of-the-art
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  - convey a message clear to everybody: jury + audience.

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$\longrightarrow$ **The presentation**

- Make the problem statement clear and present properly what you will do:
  - take your time on this, and explain the difficulties clearly and how you addressed them
  - often, people skip this part to enter the real matter
    $\Rightarrow$ This may loose the whole audience at once!

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  - you must justify your position as a world leading expert in your research area

Content of the PhD defense (2)

$\longrightarrow$ **The Q&A session**

- Be prepared for questions
  - anticipate questions on the weakest points of your thesis
  - usually two types of questions
    - Very (overly) broad ones: they make sure you know other things than your PhD topic alone
    - Precise/technical ones: these should be easy to answer: they ensure you master the tools you use
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- It’s alright not to know things: NEVER make things up!
  - inventing answers ruins your credibility
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- Don’t remain unresponsive
  - either you propose a way to obtain the answer, give some hints/clues
  - either, after giving it long thoughts, you admit you don’t know

Softwares for scientific writing

Applied session of paper writing

The session

→ **Mutual review**,

- everyone brings an article or a draft of an article
- articles are shared and cross-reviewed:
  - the objective is to apply the learnt rules
  - the objective is to be very harsh

→ **LateX basics**,

- on computer, introduction to the basics of LateX
- basics to write conference articles / journal papers

Softwares for scientific writing

Applied session of figure drawings

The session

→ **Tables**,
- creating tables with LateX

→ **Figures**,
- getting used to PGFplots
- making Matlab and PGFplots interact

→ **Block diagrams**,
- getting hands on Tikz

→ **Drawings**,
- using Inkscape
- including LateX formulas in SVG files

Softwares for scientific writing

Slide/poster preparation

The session

→ **Preparing slides**,

- using LateX to prepare slides
- abide by the rules described in first sessions

→ **Preparing a poster**,

- using LateX to prepare a poster
- abide by the rules described in first sessions

Softwares for scientific writing

Slide/poster presentation

The session

→ **Presentation of posters and slides**

- posters will be presented in a competitive/real-life situation
- slides will be presented in a PhD-defense type with jury and Q&A

The 12-point checklist

- **For all communications:**
  1. the message is unique, clear, and well conveyed
  2. the objective/motivation (problem statement with a progression from history, through state-of-the-art, to the “before and after this work”) is crystal-clear
  3. the presentation is smartly structured according to the IMRAD format

- **Written communications:**
  1. two-level reading: first quick scan must tell the main story (clear environments, self-contained figures) / full scan must be exhaustive, reproducible, with no errors
  2. paper is self-contained, browsing is easy, all notations are defined and “simple”
  3. main results/visuals are smartly interpreted, not just described
  4. the conclusion is a smart opening with new questions, convincing continuation beyond the work: not a copy-pasted abstract!
  5. no error in syntax, grammar, spelling; appropriate language

- **Oral communications:**
  1. 2-min on first slide with only one “comprehensive” image
  2. minimal content on slides (no sentences, clear emphases, etc.)
  3. repeat again and again, browse back, use the audience visual feedback (adapt dynamically if you see your audience lost)
  4. never read notes or the slides: the slides support the talk, but **are NOT** the talk

AND NO PLAGIARISM !!