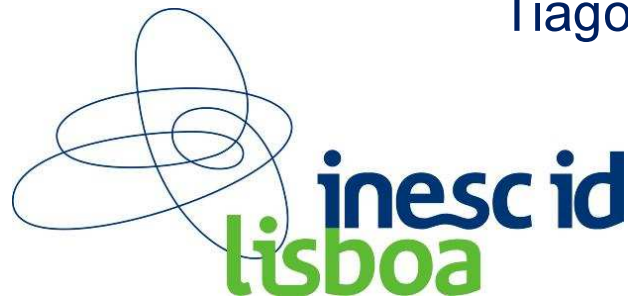


# Science and Communication

CRYPTACUS 2018 training school

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# Science and Communication

- Scientific research
- Information gathering and analysis
- Communicating with others
  - Written
  - Oral
  - ...

# Scientific research

- Seek and properly interpret the facts.  
Interesting examples:
  - Black plague, who is to blame?
    - Rats?
  - Facts:
    - Propagation rate: > 3Km/day (within 4 years all Europe was contaminated)
    - Incubation period of 20 days
    - Total amount of deaths: 25.000.000
  - Cause: Human merchants!

# Scientific research

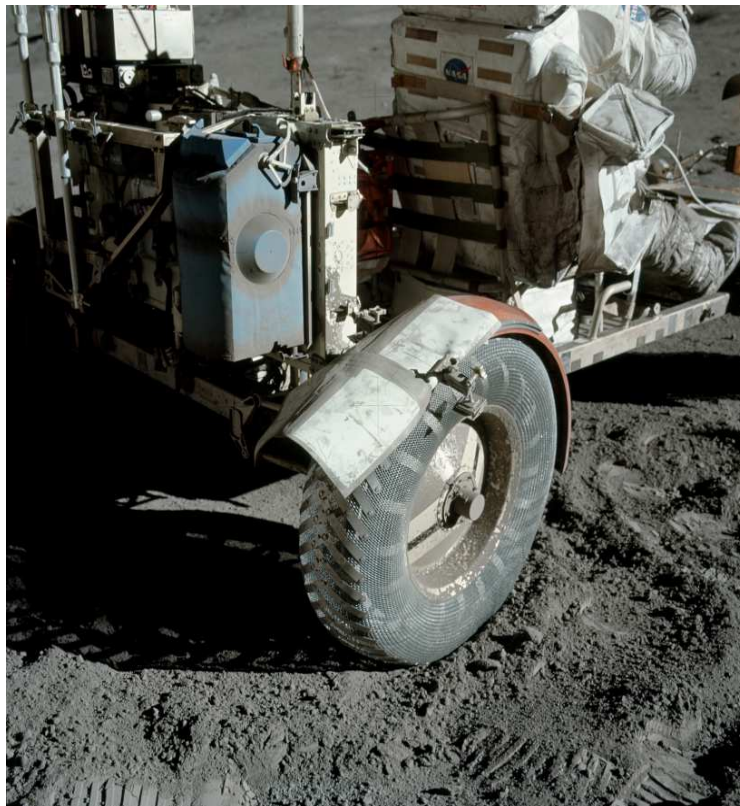
- Scientific method:
  - a method of learning about the physical universe by applying the principles of the scientific method, which includes making empirical observations, proposing hypotheses to explain those observations, and testing those hypotheses in valid and reliable ways;
  - the central theme in this methodology is the testing of hypotheses and the ability to make predictions. The overall goal of science is to better understand nature and our Universe.
  - also refers to the organized body of knowledge that results from the scientific study.
- Research:
  - to study a subject thoroughly, especially in order to discover (new) information or reach a (new) understanding

# Scientific research

- Problem with these definitions:
  - Validation/fallacies:
    - Is astronomy a science?
      - How to validate/verify the BigBang!
  - Explanation of Nature:
    - Is Physics a science?
      - What is gravity: Wave or particle?
    - Is Mathematics a science?
      - Or just a rule game/ artificial postulates (without support)!
    - Is “Social Science” a science?
      - What can we really predict? Or just explains/reports past events!
- Everything is science?

# Scientific research

What is missing in this NASA picture ?



Close-up of lunar roving vehicle at Apollo 17  
Taurus-Littrow landing site

Description: A close-up view of the lunar roving vehicle (LRV) at the Apollo 17 Taurus-Littrow landing site extravehicular activity (EVA). Note the makeshift repair arrangement on the right rear fender of the LRV. During EVA-1 a hammer got underneath the fender and a part of it was knocked off. Following a suggestion from Astronaut John W. Young in Mission Control Center at Houston, the crewmen repaired the fender early in EVA-2 using lunar maps and clamps from the optical alignment telescope lamp. Schmitt is seated in the rover. Cernan took this picture.

<http://www.hq.nasa.gov/office/pao/History/alsj/a17/AS17-137-20979HR.jpg>

# Scientific research



- What is wrong with this one?
  - AS17-140-21370.jpg

1. Too much light
2. I see aliens at the end!
3. Men never went to the moon...  
and the Earth is flat.
4. Other

Conclusion? ...

# Scientific research

## Moral and ethical questions

- **Tampering (with evidences):**

- Ethical questions.
- Peer pressure.
- What can we actually conclude from the data we have?
- We are humans! “*errare humanum est*”

*errare humanum est, sed perseverare diabolicum:*  
to err is human, but to persist (in the mistake) is diabolical.

- **Scientists are accused of promoting horrors:**

- E.g.: Nuclear weapons
  - If they would refuse to develop them they would be considered traitors!
- E.g.: Biologic weapons
  - How many treatments/therapeutic drugs resulted from these studies?
- Current attempts to perform Human cloning!?

- **Unfulfilled promises:**

Should we keep financing the research?



# Information gathering and analysis

- Available information
- Information triage
- Where to obtain the information
- Exploring the information
- Storage and usage of the information

# Information gathering and analysis

- Search for existing theories
  - Should not be something <sup>too</sup> esoteric
  - A theory should have a practical interest, but...
- What research has been performed on the topic by the scientific community?
- Which methods were used?
- Where to look for this information?
  - Indexed data bases of tutorials and papers (articles)

# Information gathering and analysis

- Perform a critical unbiased analysis of the results and methods used by others to avoid:
  - Sagging to peer trends
  - Fooled by result manipulation
  - Inadequate methods
- Do not be obsessed by:
  - The most recent results
    - Is the most recent more innovative / complete?
  - Quantitative results
    - The magic of number manipulation
  - Qualitative results
    - May lack thoroughness / rigor

# Information gathering and analysis

- What has been written about ‘The topic’
  - Under-information
    - Not enough information sometimes on obvious results
  - Over-information
    - Too many papers/works on identical topics on the same field
  - Pseudo-information
    - *Scientific* information on the media
    - Literature of science (aka popular science)
    - Wikipedia and similar sites

# Information gathering and analysis

- How to handle information:
  - Under-information
    - Exploring the under-information gaps
      - E.g. interdisciplinary search/techniques
  - Over-information
    - Search **only** for **useful** information having in mind **the goals**
      - Not always easy!
  - Pseudo-information
    - Comparative analyses of the information

# Information gathering and analysis

- Where to obtain the information:
  - Origin:
    - Libraries
      - physical or electronic
    - Reliable sources
      - [ieeexplore.ieee.org](http://ieeexplore.ieee.org), [portal.acm.org](http://portal.acm.org), ..., [b-on](http://b-on.org), and [scholar.google.com](http://scholar.google.com) !!
    - Semi-reliable sources
      - Pseudo-information
        - » Eg: internet, Wikipedia, ...
  - Support:
    - Encyclopedias, dictionaries, ...
    - Books and specialized journals
    - Scientific proceedings and conferences

# Information gathering and analysis

- Exploring the information:
  1. Select the information
    - Keywords, acronyms, authors, topics
  2. Treat the information
  3. Interpret that same information
    - Triage:
      - Start by selecting a set of documents (**Beware of literary gluttony**)
      - Successive approximations (towards the mother lode).
- Support:
  - Written word
  - Audio
  - Pictures and video
  - Others (Data loggers, ...)

# Information gathering and analysis

- Save time by reading what is relevant!
- How to explore the text/information:
  - Title and keywords
    - Does it *sound* of any interest to your work / (re)search
  - Author and institution or editor
    - Are they known?
    - Are they reliable?
  - Index
  - Abstract/Summary
    - What the paper is about
    - What is proposed/novelty
    - Key results
  - Conclusions
    - Small version of the entire paper
    - Clear and concise
  - Introduction and results section
  - And finally ... the main body of the paper
    - If more details or in-depth knowledge of the described work is needed



# Information gathering and analysis

- Storage and usage of the information:
  - Organize your bibliography
    - Sooner or later you will need to go back to it  
*“what was the name of that paper??...”*
  - Organization of references:
    - Author’s name
    - Title of the paper
    - Where and When was it published
    - Topic of the paper
    - Other relevant data

BibTeX is an useful tool to facilitate the organization and use of references. Used directly in LaTeX.

# Communicating with others

- Written communication
- Oral and visual communication
- Communicating using slides

# Written communication

- Written communication
  - Types of document
    - Reports
    - Papers
    - Thesis
  - Organization & Structure of the document
  - Writing it...

# Written communication

## Types of documents

- Reports
  - Technical
  - Project
  - Progress
- Scientific communications
  - Conferences
  - Journals
- Theses
  - Graduation
  - MSc
  - PhD
- Advertisement
  - Billboards (written communication?)
  - Magazines (scientific or not)
- Others

# Written communication

- What to transmit about the research work:
  - Goals
  - The object of the work
  - Related work
    - relation between what is proposed and what has been proposed
  - Developed work
  - Obtained results
    - Adequate analysis of the obtained results
  - Conclusions
  - Future work

# Written communication

## Target of the communication

|             | Scientific community | Public and private organizations | Media      |
|-------------|----------------------|----------------------------------|------------|
| Clarity     | +                    | ++                               | ++++       |
| Depth       | ++++                 | ++                               | +          |
| Terminology | Coded                | Semi-coded                       | Simplified |
| Structure   | Rigorous & Detailed  | Simplified                       | Appealing  |

Always: Seek the truth (Rigor) ; Have a Correct speech (Clarity)

# Written communication

- Organization of the text:
  - Goals
  - Presentation of the problem
    - Introduction to the problem
    - Back ground / State of the art
  - Research process
    - Methodology
    - Theoretical / Practical development
  - Achieved results
    - Simulations
    - Experimental results
  - Consequences of the results
    - Added value
      - Analytical analyses of the results
      - Comparison with the related state of the art
    - Future work

# Written communication

- Structure of a paper
  - Title
  - Authors information
  - Abstract (1-3%)
  - Keywords (3-5#)
  - Introduction (10-15%)
  - Main body (60-75%)
    - State of the art
    - Methodology
    - Development
  - Results (10-20%)
  - Conclusions (3-5%)
  - Acknowledgments
  - References (4-6%)
- Structure of a report/theses
  - Cover
    - Title and Author(s)/Company information
  - i. Abstract
    - May be in more than one language
    - Keywords
  - ii. Acknowledgments
  - iii. List of contents
    - Content of the report/theses
    - List of Figures and Tables
    - List of Acronyms
  - 1. Introduction
  - 2. Main body
  - 3. Conclusions
  - I. Appendix
  - Bibliography
  - Index



# Written communication

- Where to start?
  - Compose the contents table (index table)
    - Organizing the structural units
      - Chapters
      - Sections
      - Subsections
        - » Helps to structure the information
    - Structures the presentation of the work
    - Should not be rigid
      - The structure may change
        - » As fluid as the work!!
        - » Use it as a LEGO

# Written communication

- *The Title:*
  - Works as a calling card.
  - It should:
    - attract the reader
    - be in accordance with the content
    - be concise
      - One line (two at most)
      - Length also depends on the specificity of the presented work
    - be as clear/descriptive as possible
    - acronyms help, but...
- **Keywords**
  - topics / areas that are the object of the document

# Written communication

- The *Abstract/Summary*:

- *Allows to perceive the work without the need to read the whole paper*

- *Research topic*
- *Methodology & developed work*
- *Obtained results*
- *Key conclusions*

*Small version of the whole paper, focusing on the key aspects*

- *Some times each chapter has a summary of its own*

- *In big reports/theses*
- *Clear exposition of the work*
- *Improves the levels of reading*

# Written communication

- *The Abstract:*
  - A summary of the main ideas that allows to perceive the whole research work presented in the paper.
    - Most of the detail should be left out!
  - The key trick is to plan your argument in 6 sentences  
what's the topic?
    - What's the key research question?
    - Why nobody else has answered this research question?
    - What's your big new idea?
    - How did you go about doing the research?
    - What's the key impact of your research?
    - Use these questions to structure the entire thesis/paper!

# Written communication

- Results section:
  - How the results were obtained:
    - Simulation
      - Model(s) used
    - Experimental results
      - How was it measured
      - Environmental and external conditions
  - Comparison with the related work
    - Using the same criteria/conditions
      - If not possible, why and what approximations were made
  - Improve the related work by more than 5-10%
    - Giving a margin for simulation/measuring errors
- ♦ Be impartial, thorough, clear, and critical of your own work when comparing.
  - Nevertheless, you may give more focus on the positive aspects of your results!!

# Written communication

- **Introduction:**
  - Motivation for the work
  - Background
  - Proposed Work
  - Dissertation/work objectives
  - Key results
  - Paper overview/organization
    - Some author prefer not to add this, particularly in smaller documents
  - When/at which stage to finish writing it?
    - At the end
      - Only then do we have a full perspective of the developed/described work

# Written communication

- **Figures and tables:**
  - Used to illustrate concepts/results
    - One picture is worth 1000 words
  - It is a tool to achieve the goal, not the goal itself !
    - Must be referenced and explained in the text.
  - **Must have a caption**
    - Option a: Concise and clear
      - Caption = title of the picture
      - The description of the pictures goes in the text, not in the caption
    - Option b: Descriptive
      - Caption describes the image in detail. Allows the reader to get the idea without reading the text
    - Legend
      - Explain the symbols used (very concise)
  - **Avoid unnecessary complexity**
  - **Types of Figures:**
    - Graphics, diagrams, images, pictures

# Written communication

- **References:**
  - Inner text
    - chapters, sections, appendixes, figures, equations, ...
  - Bibliographic:
    - Use credible and scientific references from credible sources:
      1. peer reviewed papers (Scientific journals and conferences)
      2. published books, theses
      3. reports, internal reports, ...
      4. **‘Wikipedia like’ references are not adequate**
  - Bibliography listing:
    - By order of citation
      - Papers, reports
    - Alphabetic
      - Theses, books
    - Typically defined by the publisher



# Written communication

- What to put in appendix:
  - Complementary information
    - Important information
    - Mandatory information
    - Informative information
  - Theoretical deductions
    - To validate or prove statements in the main body
  - Others
    - Code
    - Auxiliary figures, tables, ...

Text that is not fundamental to understand the description in the main body but required to prove statements or complement the information

# Written communication

- Things to avoid:
  - Chapters with 1 or 2 pages
  - Section with few lines of text
  - Frequent use of footnotes
    - Breaks the reading flow
  - Frequent information redirection
    - See Chapter # / Section #
    - See reference ...
  - Different names/designations for the same entity
  - Distinct entities with the same name
  - Unchecked or unsubstantiated statements
    - Unproven affirmations must have a valid reference
  - Undefined concepts, acronyms, etc.
  - Incoherent concepts and relations

# Written communication

- In conclusion:
  - Be clear but specific/detailed
  - Be structured but appealing
  - Go to the point, avoid digressing

## Remember: Levels of reading/information

- » Abstract: Illustrative but short
- » Main body: detailed but long

# Written communication

- Acknowledgments
  - Give credit to those who helped accomplishing the work
    - Financial support
      - Scholarships
      - Equipment
      - Others
    - Scientific support
    - Personal support
      - In theses or in special cases

# Acknowledgments

To professor António Serralheiro for his notes on  
“Projecto/Metodologias da investigação”

# Oral and visual communication

- Communicate with:
  - Clarity
  - Confidence
  - Expressiveness
  - Empathy
- Communicate in a positive fashion
  - Maintain visual contact
    - Without staring
  - Listen to what the other people are ‘saying’
  - Have a good posture

A good communication = A good deal/transaction

# Oral and visual communication

- **Communication effectiveness:**
  - Transmit a succinct but complete message
  - Use supportive forms of communication
    - Images/animations
    - Charts / Graphic representations
    - Gestures
    - Sounds
  - **Good vocal** projection and diction
    - Speak to the audience not to the slides
  - **Adequate graphics**
    - Colors used
    - Explicit charts and diagrams
  - Make sure the **message got through**
    - Analyze the body language
    - Questions asked or *not asked*
    - ...

# Oral and visual communication

- **Body language** (examples):
  - + Hands in the hips
  - + Sincere look
  - + Smile
  - + Slightly bend forward
  - + Adequate distance from the listener
    - 1 meter > L > 1,5 meters
  - Looking down when speaking
  - Staring the other person
  - Shoulders down
  - Harms crossed
  - Hands in the pockets



# Oral and visual communication

- **Revealing hints** (examples):
  - Sweaty hands → nervous
  - Broken verbal fluidity → lack of preparation
  - Touching the earlobe → doubt / uncertainty
  - Self hand massage → lack of confidence in oneself

Beware of generalizations and assumption...
- **Improving yourself:**
  - **Practice** in front of a mirror
  - **Rehearse** with your co-workers
  - Record and playback to **analyze yourself**
  - To calm yourself : breath deep and slowly (discreetly)

# Oral and visual communication

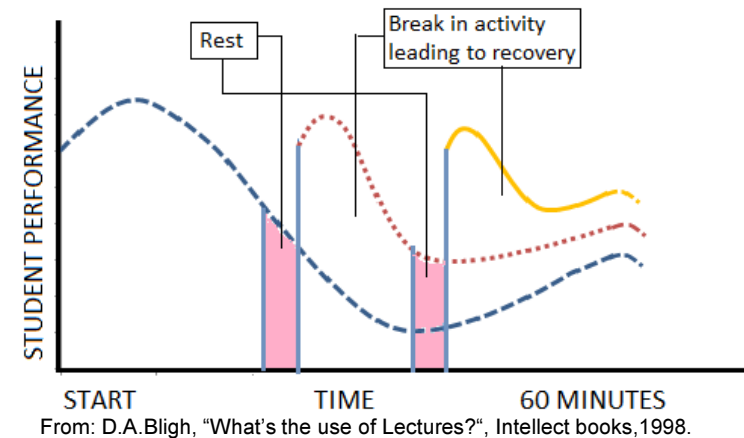
- Helpful techniques:
  - Take notes
  - Smile
    - Even on the phone
  - Be cordial
    - Get up when saluting others
    - Avoid interrupting the other peoples sentences
    - Show interest
  - Have a good posture
    - Sit up straight
    - Adequately dressed
  - If justified use communication and marketing professionals
  - Be on time
    - Or even *slightly* earlier to make sure everything is prepared

# Oral and visual communication

- **Helpful techniques:**
  - Discreetly mimic the target.
    - Dress code
    - Behavior
  - Keep an open mind to other ideas
  - Put things in writing as soon as possible:
    - Agreements
    - Promises
    - Decisions
  - Use examples
    - Beware not to lose generalization of the goal !
  - **Adjust the message and the communication medium**
    - Depending on the target
    - The objective of the communication

# Communicating using slides

- Communicating using slides:
  - Mixture between oral and visual presentation
  - Use **short meaningful** sentences
    - As if the title of what you are saying
    - Keywords
  - Use **Illustrative figures and charts**
    - With simple captions / subtitles
    - Complement them with an oral explanation
  - Use **different levels of reading**
    - Headings
    - Different letter size
    - Highlighted text/ Color text
    - ...
  - **If the audience loses track of what you are talking about, they should be able to use the slides to get back on track**
  - The attention span of the audience is limited
    - Typically 25 to 45 minutes, after this they disconnect



# Communicating using slides

- Content of the slides:
  - Do **not overload** the **slides** with information
  - Present yourself
    - specially in conferences, multiple presentation meetings
  - Describe the content of the presentations
  - Put the slide(s) overall topic on the header
  - Use your company/institute logo in each slide
    - Discrete but constant, be known
    - If appropriate also add your name
  - Number each slide
  - Finish the presentation with an conclusion
    - Achieved goals
    - Key results
    - And if adequate, with future work

# Communicating using slides

- When presenting:
  - To large audiences:
    - You may **select a few people** in the room to talk to
      - To focus your presentation
      - **Perceive if the audience** is getting the message
  - Look and talk towards the audience
    - Do **not** speak **to the floor** or the slide projection
  - Use a pointing device
    - Do not just point with your finger
  - Properly manage the available time
    - Do not finish significantly before time
    - Do not use more time than the one you have
    - Do not start fast and finish slow, nor vice-versa
  - **Adjust** your presentation **to the time** you have **available**
  - **Speak clearly** and at a controlled pace

# Communicating using slides

- In conclusion:
  - Be **clear** and illustrative
  - **Do not overload** the audience with information
    - make them desire for more information!
  - **Slides are a complement** to your verbal exposition/explanation
  - **Go to the point**, avoid digressing
  - Allow the audience to get back on track

**Remember:** Levels of reading and key points

# Final words on research and development

## Creativity & Discipline

Creativity: mostly about **breaking** rules

Discipline: mostly about **following** rules

Rules = internal consistency, mathematical correctness,  
sticking with stated assumptions