# Technical writing and Doing research: an experience

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# Technical writing

- Type of papers
  - Research article
  - Survey
  - Technical report
  - Report
- Organize your paper
  - Sections, subsections
  - Introduction
  - Preliminaries/problem statement
  - Body/main results
  - Discussion/conclusion
- Do a rough sketch of what you want to do

# Technical writing

- Introduction
  - An idea about what is going to follow in the paper
  - Related earlier works
  - How important is the work presented
  - Short description of section-wise split-up of the content
  - Notation
- Preliminaries/problem formulation
  - Background
  - Launchpad for the rest of the paper
  - Important to know how much background is necessary

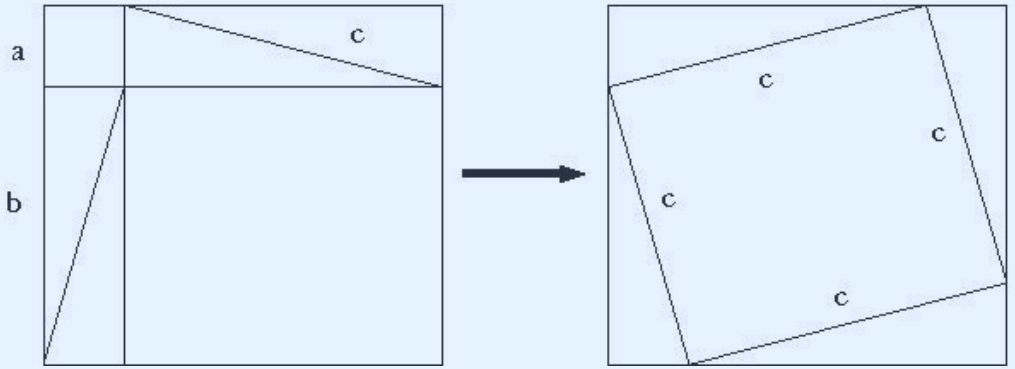
# Technical writing

- Main results
  - Theorems, lemmata, propositions
  - Remarks

**Theorem:** In a right-angled triangle with sides *a*, *b*,and hypotenuse *c*, the following holds

$$a^2+b^2=c^2$$

**Lemma:** In a square the following rearrangements can be done




**Proof of theorem:** With small calculation and the above Lemma, the Theorem follows.

**Remark:** This is how Indians proved it. Euclid's proof, however, was different.

# Technical writing

- Conclusion
  - Summary of the results
  - Contribution
  - Scope of future work
- Writing an abstract
  - Every article should contain an abstract at the beginning
  - Deceptively difficult

    ``The present letter is a very long one, simply because I had no leisure to make it shorter."

    - Blaise Pascal

  - Short, crisp, and to the point - *succinct*
- Keywords

# Technical writing

- Some important tips
  - Use *sweet* short sentences
  - Clarity
  - Sometimes use two sentences to explain the same thing: ``in other words''
  - Even highly technical papers should, ideally, not be monotonous
  - Doing good research, finding out new results is not enough – presentation is *equally* important
  - Read, modify, read, modify, read, modify, ...
  - Always run a spell-check at the end

# Technical writing

- Citation and referencing
  - Absoultely important
  - Citation does not mean *lifting*
  - One cannot just ctrl+c ctrl+v
  - There are standard rules about style of citation
    Some are alphabetical, some are in the order of appearance in the main text
  - References list also has standard rules

    [PW02] H.K. Pillai and J.C. Willems. Lossless and dissipative distributed systems, *SIAM Journal on Control and Optimization*, 40(5):1406-1430, 2002.

    [Won79] W.M. Wonham. *Linear Multivariable Control: a Geometric Approach*, Springer-Verlag, 1979

    Latex and bibtex does a great job

# Doing research

``Research is what I'm doing when I don't know what I'm doing."
- Werner von Braun

- Didn't have much of an idea of what I was supposed to do in M.Tech project
- Did a seminar with Professor Madhu Belur
- Didn't understand a single word of what I was reading!

$$A^T P + PA + KBR^{-1} B^T K + C^T C \geq 0$$

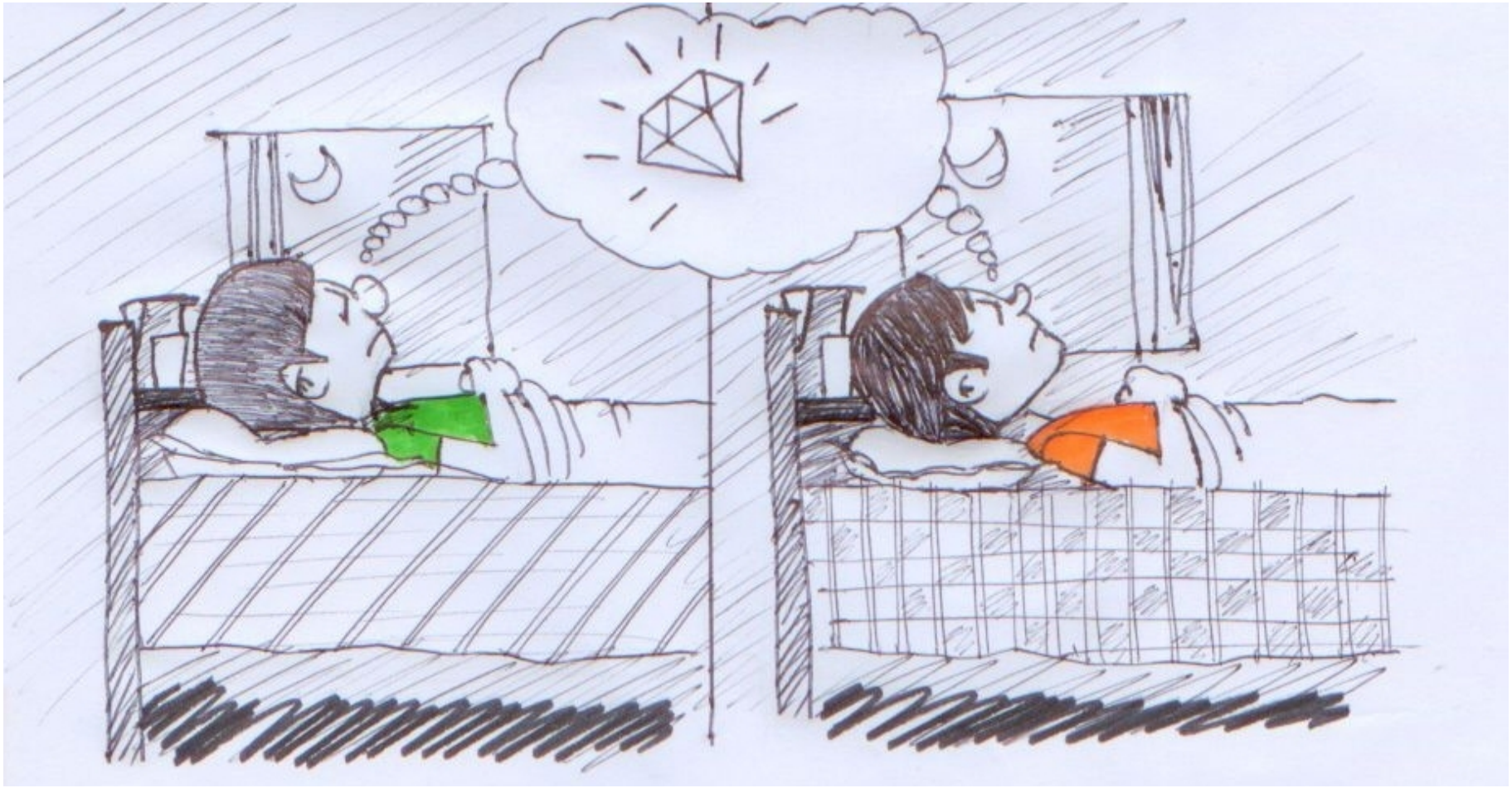
- With the help of Professor Belur and my courses and introductory books on similar topics I got to build a basic idea of what is going on – the weird matrix inequality started to make sense

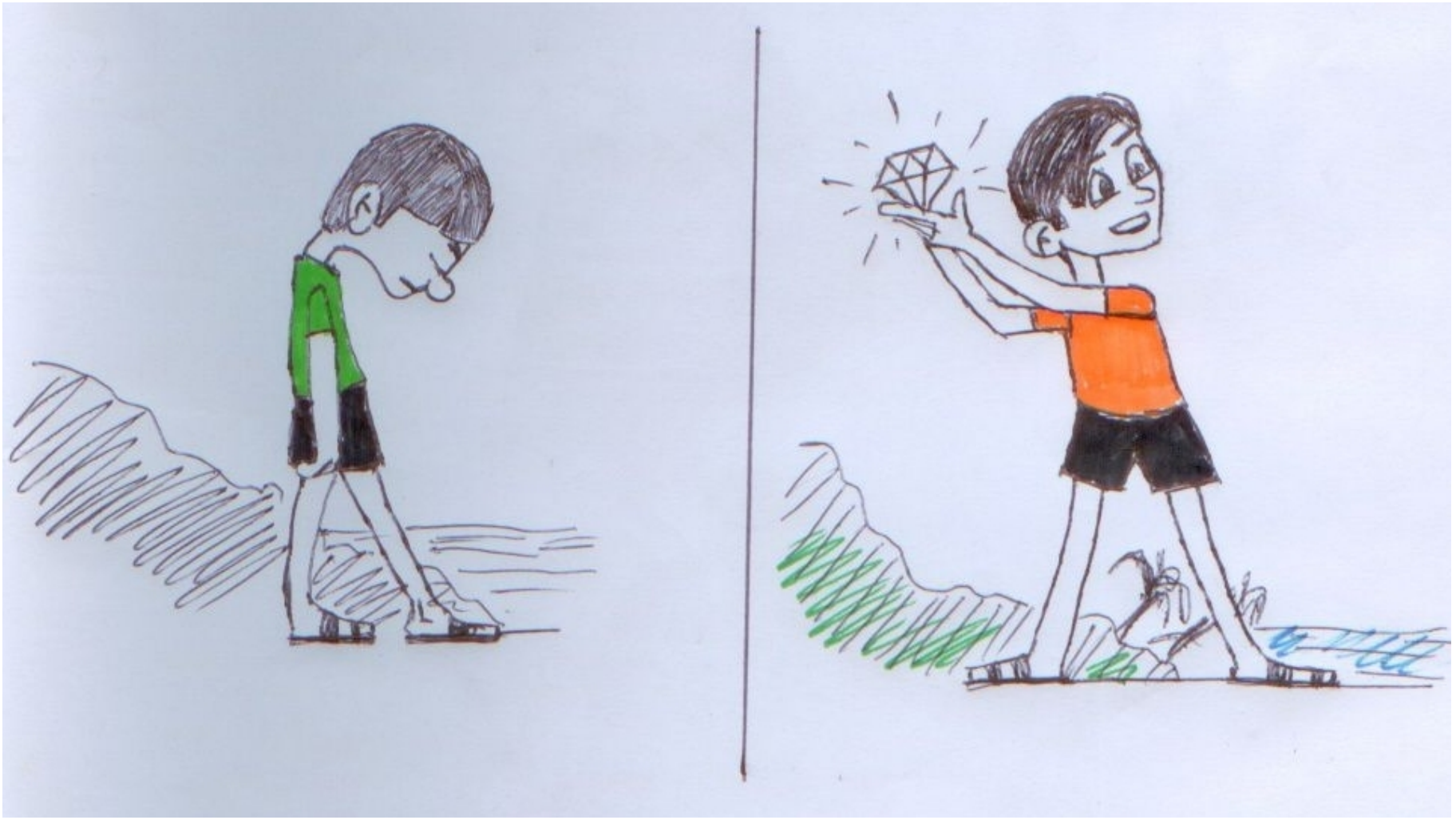
# Doing research

- Started working on a project similar to this
  Sir had given me some directions, I took the one that had some connections with my seminar topic
- The problem was called ``problems at optimality''
- The topic was broad, some works had been done earlier
- Once again, had a set back at the start
- Realized that *dissipativity of uncontrollable systems* is one crucial thing that is common, but largely unexplored
- We started working on it, but nothing came up – I used to have nightmares about equations!
- But one day when I was lying on my bed trying to take a nap, absolutely hopeless about the problem, it came to me – plain and clear – it was so freaking obvious
- I called up Sir. We chased it for the next few months and formulated an almost comprehensive theory of dissipativity of uncontrollable systems

# Doing research

- Have an open mind
- Don't get fixated onto something that you may think is your passion, your life's dream – it's DANGEROUS!!!
- Don't expect your advisor will give you a concrete problem and will solve it for you
  Most of the times finding a problem turns out to be the most difficult part of research
- Often astonishing new results come out while we are chasing after something completely different
  The major part of modern commutative algebra was developed in a quest for solving Fermat's Last Theorem, which remained unsolved for more than 300 years
- Course works
- Getting your hands dirty





# THANK YOU!