

# Mathematics Notebook

July 14, 2022



# Preface

I used to blog about mathematics and is planning to revive the work on Medium. Sadly, Medium lack support for LaTeX and it is terribly hard to type equations without scratching my head looking for Unicode characters. The easiest solution is not use Medium but Wordpress with LaTeX plug-in, like Prof. Tao's blog. However, I was also advised to use Medium as it is increasingly popular platform. So I will just type my piece here and put them on medium later, with equations added as images.



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# Chapter 1

## How to prove it?

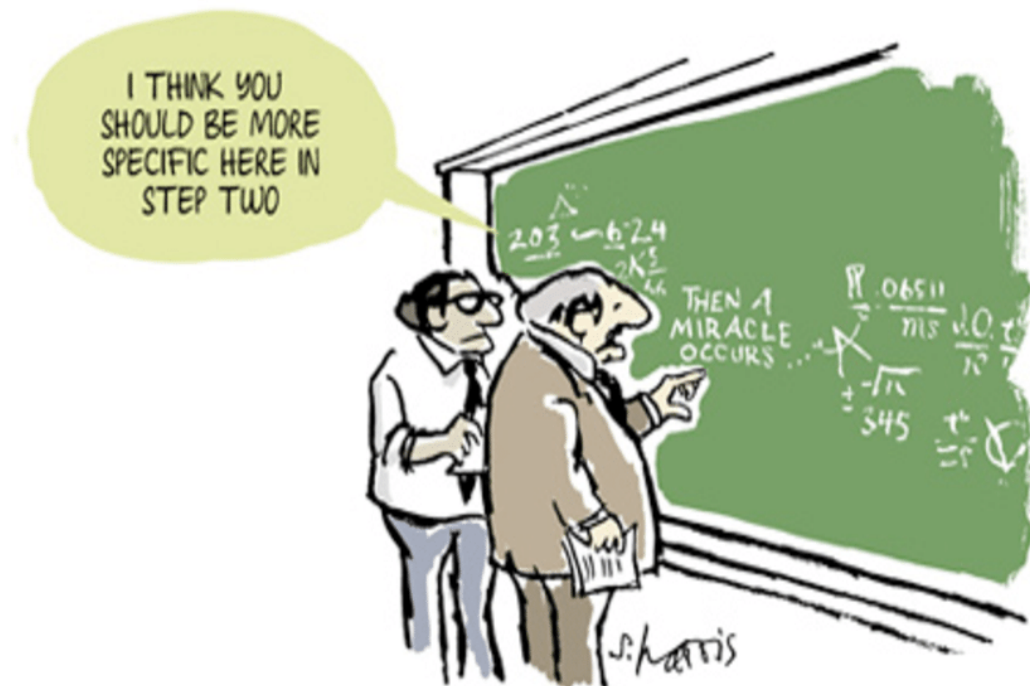


Figure 1.1:

One of the largest stumbling block in studying mathematics is perhaps learning how to prove theorems. In this post, I would share with you 3 of the most commonly used technique with at least one step by step example.

**1. Direct proof**

Perhaps the most intuitive and straightforward way to write proofs. It goes by "If  $A$ , then  $B$ " or " $A$  implies  $B$ " or mathematically  $A \Rightarrow B$ .

**Example 1 :** *The sum of two even numbers is also even.*

*Proof.* Let  $x$  and  $y$  be even numbers. Since they are even, by definition they can be rewritten as  $2n$  and  $2m$  respectively. Thus, the sum  $x+y = 2n+2m = 2(n+m)$ , which is even number by definition.  $\square$

**Example 2 :** *Third Binomial Formula*

$$\begin{aligned} (a-b) \cdot (a+b) &= a \cdot a + a \cdot b - b \cdot a - b \cdot b \\ \text{Proof.} \quad &= a^2 + a \cdot b - b \cdot a - b^2 \\ &= a^2 - b^2 \end{aligned} \quad \square$$

**Example 3 :** *Square of odd number is also odd*

**2. Indirect proof or proof by contradiction**

**Example 4 :** *Square root of two is irrational*



# Bibliography

- [1] M. Artin, *Algebra*. Pearson, 2010.