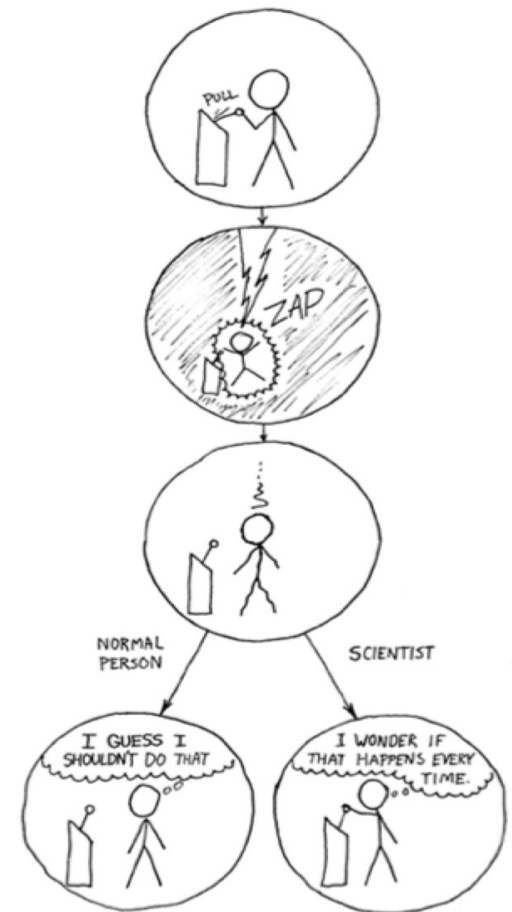


# The experimental process

Ivano Malavolta



# Question from the previous year

What exactly you want from the assignment



## Answer

- Show that you are getting familiar with the problem
- Give an indication about what you want to achieve with the experiment
- Show that you know how to structure the definition of an experiment according to the GQM
- Show that you are able to phrase quantifiable research questions according to measurable metrics
- Show that you did your homework in studying related literature
- See examples of Assignments on Canvas

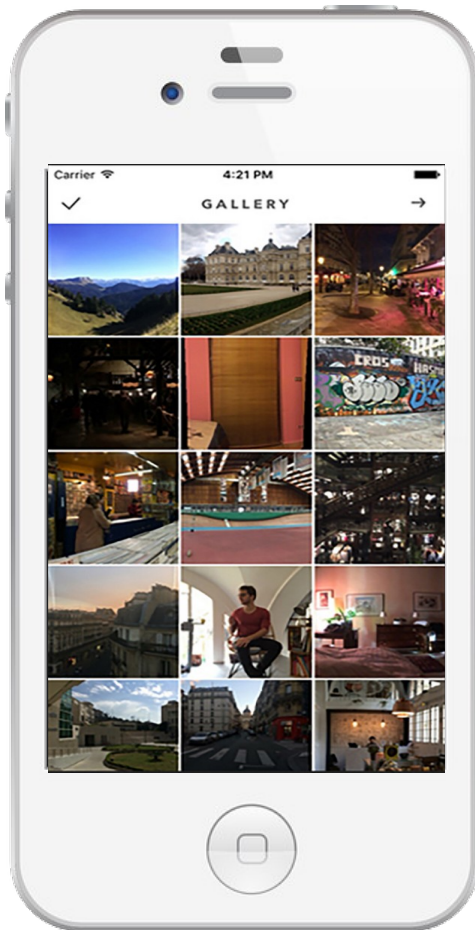
# Roadmap

Experiment principles

Terminology

The experimental process

# Running example



**Image encoding:** how do image encoding algorithms impact energy consumption?

- PNG
- JPEG
- ...


# Experiment principles

# from the previous lecture...

Intuition

It is an application of the scientific method

- ask yourself a
- background
- formulate an
- setup an
- observe
- perform on your results
- draw



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VU

## MAIN DRIVERS of experimentation:

- to be able to scientifically assess an idea
- generalize

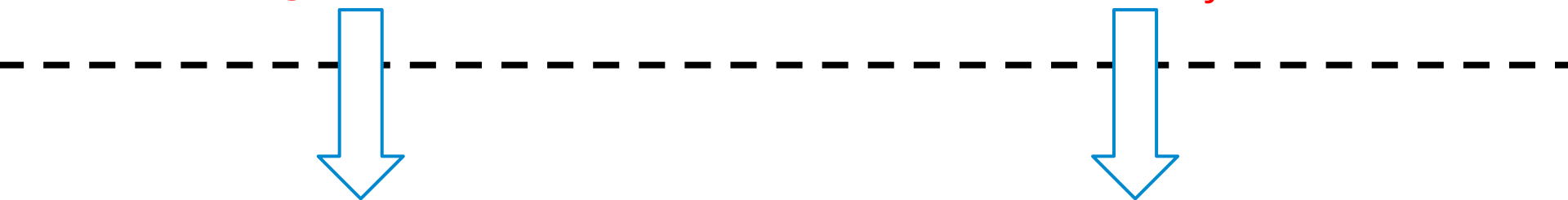
# Experiment principles

Theory



If I use different image encoding algorithms...

... different energy efficiency



JPEG, PNG

measured energy consumption per app

Observation

# Terminology



# Terminology

- **Independent variables**: quantities that we are able to manipulate/control (a.k.a. *input* variables)
  - e.g. encoding algorithm, size of image, operating system
- **Dependent variables**: quantities observed in the study (a.k.a. *response, output* variables)
  - e.g. energy consumption, gallery loading time

# Terminology

- **Factor**: an independent variable that we deliberately manipulate/control
  - e.g. image encoding algorithm
- **Treatment**: a specific value of a factor
  - JPEG, PNG for the image encoding algorithm
  - 1, 10, ..., 100 for the number of images in the gallery

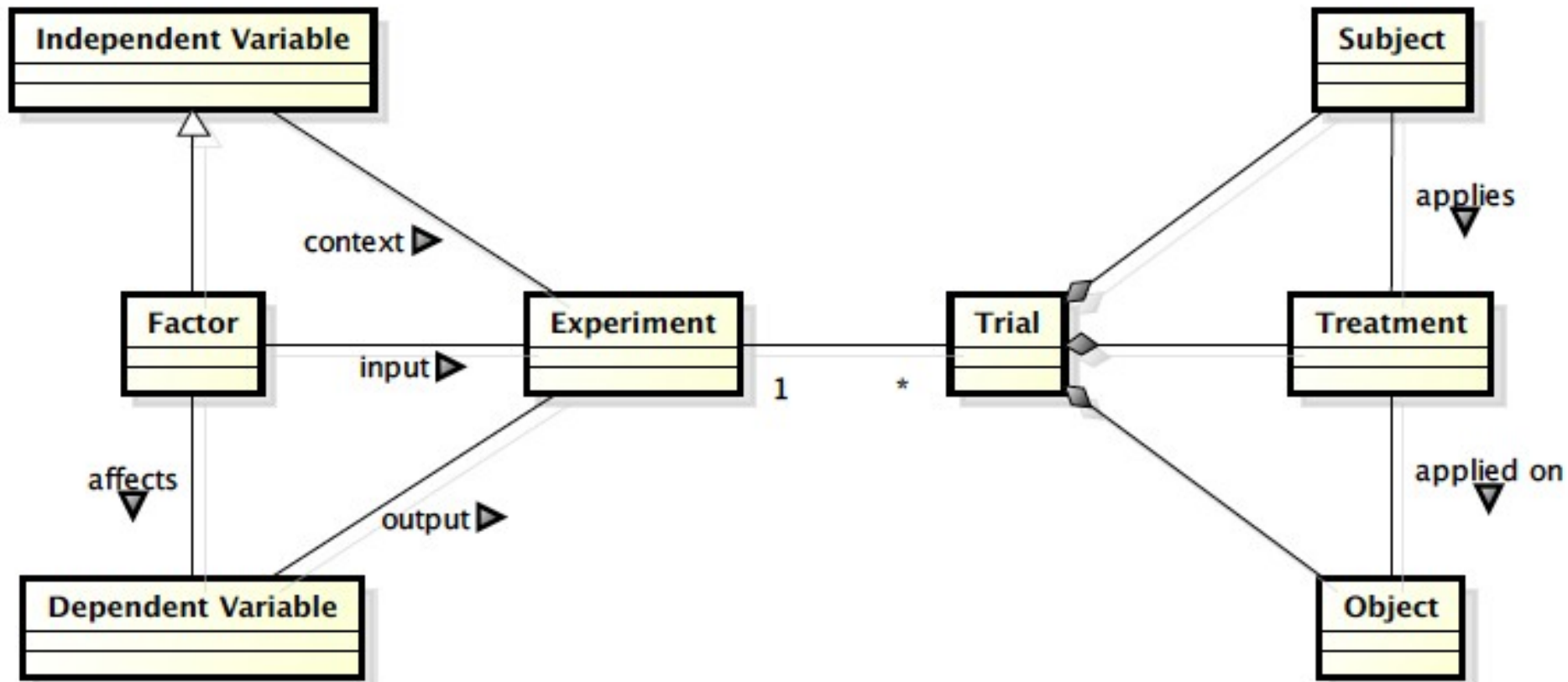
# Terminology

- **Subject**: who applies the treatment
  - e.g. software developer, software architect, user
- **Object**: the receiver of the treatment
  - e.g. image galleries of Android mobile apps

# Terminology

- **Trial**: combination of **subject**, **object** and **treatment**
  - e.g. **developer** John develops **app X** that encodes
- **Experiment**: a combination of several **trials** to observe the effects of the **treatments**
  - e.g. ???

# Let's put them all together...



Version 1.2  
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# The experimental process

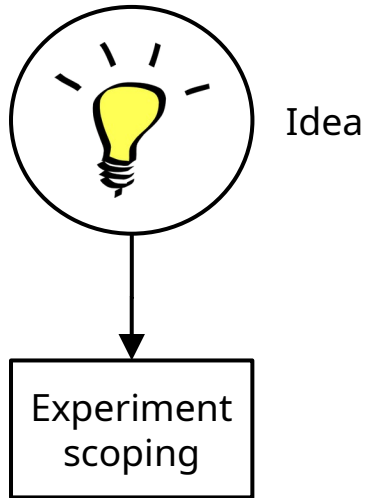
# 0 - It all starts with an idea



Idea

- Main idea behind the experiment
- The hypotheses must be stated clearly
  - Not formally, just clearly

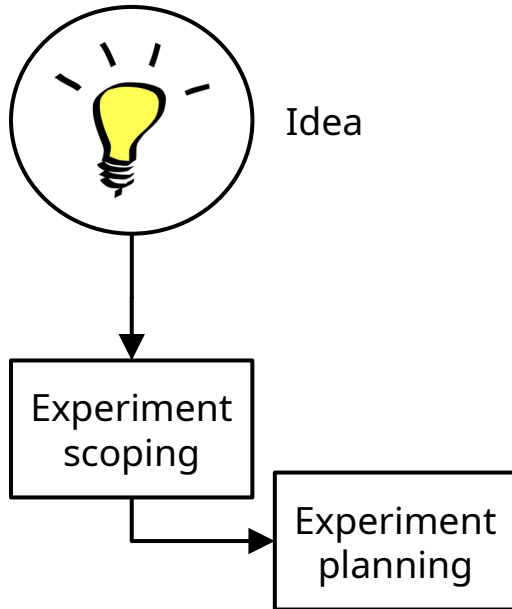
# 1 - Experiment scoping



- We scope the experiment by stating the problem, objectives, and goals
  
- We will use the Goal-Question-Metric (**GQM**) framework

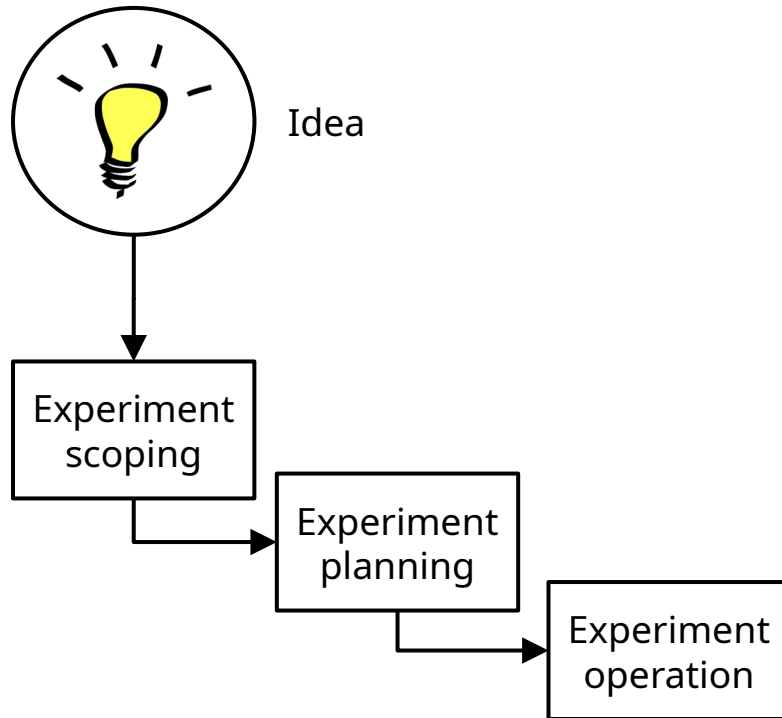


# 2 - Experiment planning



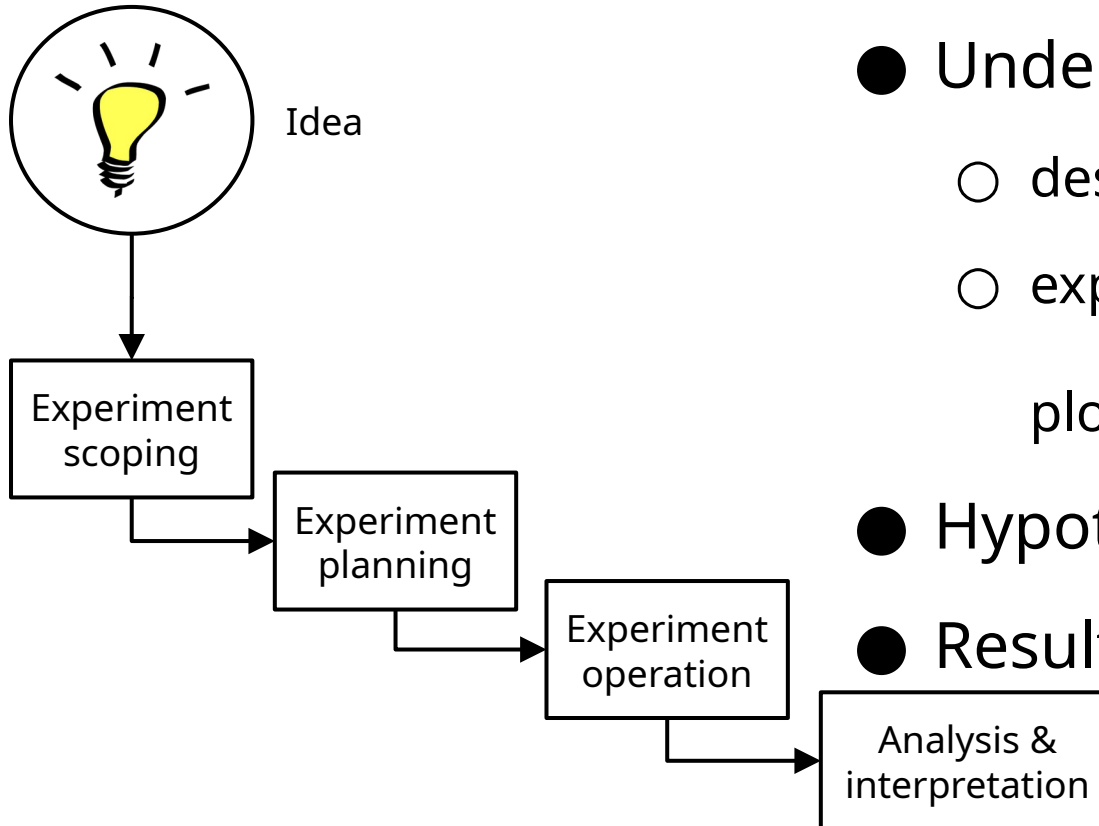
- Define context
- Formulate hypotheses
- Identify input and output variables
- Design the study
- Instrumentation
- Analyze validity threats

# 3 - Experiment operation



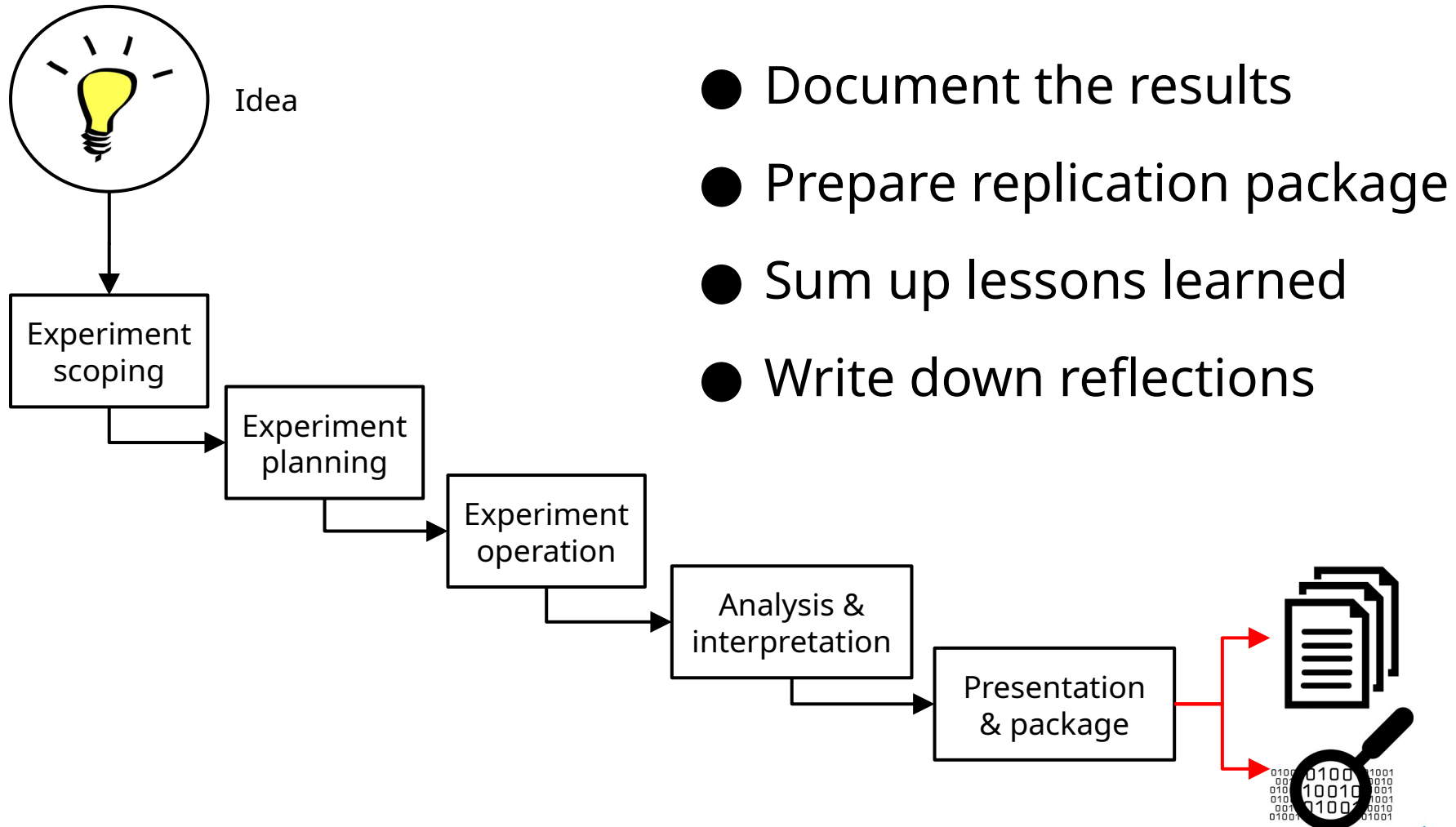
- Preparation
  - Guidelines, subjects training, code instrumentation, ...
- Execution
  - aka measurements collection
- Data Validation

# 4 - Analysis & interpretation



- Understanding the data
  - descriptive statistics
  - exploratory data analysis (e.g. box plots, scatter plots, ...)
- Hypothesis testing
- Results interpretation

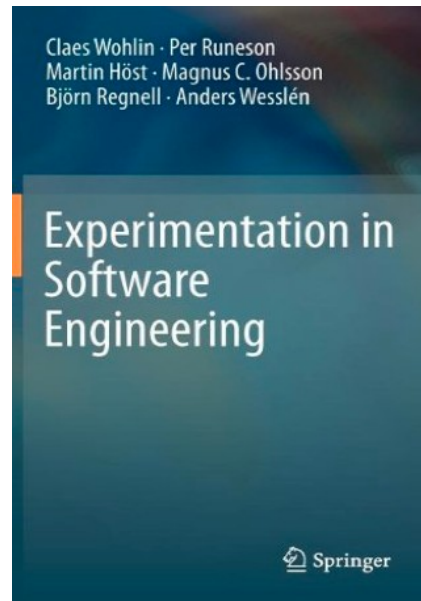
# 5 - Presentation & package



# What this lecture means to you?

- You have the basics on experimentation **principles** and **terminology**
  - Theory VS observation
  - Variables, treatments, factors, ...
- Overview of the experimental **process**
  - It is not a pure waterfall model
    - > But after operation you cannot come back!

# Readings



## Chapter 6