Experiment Design for Computer Sciences

Week 2 – “The Role of Experimentation” Notes

Claus Aranha

http://conclave.cs.tsukuba.ac.jp/

Computer Science Department

Tsukuba, 2017

Lecture Overview

What did we learn today?

Main “take-aways” from this lecture:

- What is a scientific experiment;
- Three types of experiment;
- Fundamental Principles and Concepts of an experiment;

In real life...

Let me share two experiences

These concepts of experimentalism will follow you through your life as a researcher.

Let us discuss a few recent experiences;

In real life...

Follow your curiosity

Student A was using a fine-tuning tool to select a value for a parameter in one algorithm, before beginning the “true” experiment.

The tool suggested that the best value would be a very low value. **However** the theory behind the algorithm suggested that high values would be better. This is strange!

First the student checked for bugs in his code first, and then the bibliography. He also learned that a few papers also suggested the low value, but without justification.

Based on these findings, we decided to start a new experiment to understand the influence of this parameter on the data we were studying, and compare that with the usual benchmarks.

In real life...

Kill your babies

Student B developed a new algorithm to solve an optimization problem. He work very hard to find the set of parameters that would result in the best performance for his algorithm.

He compared his result with two older algorithms. He had source code access to those other algorithms, so he ran the programs without changing any parameters.

Unfortunately, one of the parameters that was adjusted was the computational effort of the algorithm. So the proposed algorithm was allowed to spend 100 times more computational effort than the other two algorithms.

You must always make sure that all comparisons in your experiment are fair. This is specially important when setting parameters.

Report 1 – Mini Experiment

Outline

Based on the discussions of *experimentation* in this lecture, I want you to think and execute a small experiment.

In this exercise:

- **I do not require** mathematical/statistical rigour, but
- **I do expect** some creativity and scientific honesty.

Example

Juliana and Claus disagree on whether bananas stay “good” longer inside or outside a fridge. They decide to settle the discussion with an experiment.

Report 1 – Mini Experiment

Example

Example

Do bananas stay “good” longer inside or outside a fridge?

What do they want to know?

- Appearance of the bananas: Color and consistency.
- Quality of the bananas: Taste and texture.

How do they do the experiment?

- Buy 6 bananas.
- Two of them are put whole in the fridge;
- Two of them are put whole on top of the fridge (covered)
- Two of them are cut in half, and one is on the fridge, one is on top;

How is the result evaluated?

- Visually inspect the bananas every day for dark spots
- Open the bananas after 7 days.
- If they are not moldy, eat them.

Report 1 – Mini Experiment

Ideas

The bananas example is not very rigorous, and could be improved in many ways, but it illustrate one way how experimentation thought (some times called *data-driven*) can be used in our lives)

Other ideas:

- Is it faster to use *memset* or *assign* in C++?
- Do you get wetter if you walk or run in the rain?
- Does the “Dry” option in the bathroom really works?
- Do you get more “likes” on facebook with cat pictures or with memes?
- Do students pick up trash from the street more than non-students?
- etc...

Report 1 - Mini Experiment

Report Outline

Think, execute and write a report on an experiment on any topic of your interest. The report structure must be (roughly) as follows:

- **The question**: What do you want to learn in your experiment? And why?
- **The alternatives**: What are the possible answers for your question that you can think *before you begin your experiment*?
- **The experiment**: What experiment did you try to do to answer your question? What data would you collect from your experiment?
- **The results**: What were the results of your experiment? What did you learn from it?

Report 1 - Mini Experiment

Terms and Conditions

- Deadline is May 8th (Monday after Golden Week).
- Submission is through Manaba (See assignments tab).
- Submission must be in PDF format, maximum 2 pages.
- This report is individual.
- This report will be graded on:
  - How interesting is the question;
  - How relevant is the experiment to the question;
  - How insightful was the analysis of the result;
  - How well written is the report
- This report will **not** be graded on:
  - The actual result of the experiment;
  - Statistical or mathematical rigour;
  - Relevance of the question;