Team project guide

Green Lab

Master of Computer Science

Aim

The team project will be carried out throughout the whole course by groups of **5 students**; the theoretical and practical aspects of each part of project will be presented during each week of the course, so that you will likely be on track within the course schedule. The result of the team project is about planning, designing, conducting, and reporting a successful experiment on energy efficiency in the context of software systems (e.g., mobile apps).

In this way, you will put into practice the skills and techniques that you have learned during the lectures and develop deeper insights about them by applying them on real software.

The experiment will be evaluated starting from a written report describing the main aspects of the experiment and according to a shared assessment rubric (reported at the end of this document). Within the team project, each of you will be responsible for a certain part of the project; as a team, you will report the responsibilities that each team member took in the project in the final report.

Project description

The goal of the team project is to plan, design, conduct, and report a scientific experiment in the context of energy efficiency of various types of software (e.g., mobile apps, Python libraries, microservices, etc.). Each team will work on a specific topic in the context of energy-efficient software; the instructor will provide a list of possible topics during the first week of the course, then each team can indicate their preferences about the topic they would like to work on during the course. In the following a set of examples of the potentially assignable topics is reported:

- What is the energy efficiency of AI-generated algorithms with respect to human-created algorithms?
- How do configuration settings of the Zipkin monitoring tool impact the energy consumption of the monitored system?
- How does WebGPU compare with respect to WebGL in terms of energy efficiency?

The topics will be assigned based on the preferences, technical skills, and knowledge indicated by each team after the first lecture of the course. Then, each team will be responsible to independently carry on the experiment on the assigned topic. When possible, the instructor can provide relevant datasets, scripts, and other material to the team in order to smooth the execution of their experiment.

Lectures and labs

Attendance of the lectures/labs is fundamental because it will be your chance for (i) assessing how the various parts of your final project deliverable are developed, (ii) asking questions to the instructor or teaching assistant in an interactive way and discuss potential doubts and unclear points in a timely manner, (iii) start reasoning on your project in a concrete manner, thus saving time. Said that, attendance in both lectures and labs is **mandatory for all team members**. The concepts, techniques, and tools discussed during the lectures and the labs will be at the core of your project, misinterpreting or not applying them will result in failing the course.

Contacting the teaching assistants or instructor

When having specific doubts and want to make questions either to the teaching assistants or instructor, you can ask questions directly in the Discussions section on Canvas (the instructor will be constantly available in there). When asking a question, please dedicate time in writing it in a clear manner, and in such a way that it can be easily understood and answered. If you do not word your question correctly, your question might not be answered.

If a team has a technical problem with a tool, they can directly contact the teaching assistant via a Canvas message, they will help you in solving the problem.

Labs schedule and deadlines

- Practical session 1:
  - Lab environment, tools, and devices (Android Runner, Experiment Runner)
- Practical session 2:
  - R in practice
- Practical session 3:
  - Statistical tests with R
- Practical session 4:
  - Data visualization in R

Assignment 1: Experiment description and GQM
Assignment 2: Experiment design
Assignment 3: Final report

Project submission

To be accepted, your project must be composed of two parts:

- **Written report** as a single PDF file. It must describe all the information related to the specific assignment. A Latex template for the team project deliverable is available in Overleaf[1]. Each deliverable must be written in English and must adhere to the formatting of the provided template. Also, the Latex source of the written report must be delivered for each assignment.
- [This applies only to the final report (assignment 3)] A link to a **GitHub repository** containing the complete replication package of your experiment including all the material for replicating your experiment and data analysis. The replication package must contain: source code of the scripts developed for running the experiment, source code of any

[1] https://www.overleaf.com/latex/templates/green-lab-report-template/cpchhrgcrnrr

software you developed for building the dataset, raw data resulting from the execution of the experiment, R scripts for data analysis, any other relevant material for replicating the experiment. The replication package must be a fork of the tool used for running the experiment and the structure of its folders can be customized according to your needs. The tools are:
    - **Android Runner**[2] for experiments involving smartphones/tablets
    - **Robot Runner**[3] for experiments involving robots
    - **Experiment Runner**[4] for all the other types of experiments
- [This applies only to the final report (assignment 3)] A link to a **YouTube video** where the team presents the main aspects of the experiment in a complete manner (from the motivation and context, design, execution, to the results, discussion, etc.)

The links to the GitHub repository and the YouTube video must be included at the end of the written report, which is the only file submitted via Canvas. The PDF file must have the following naming pattern: `<TeamName>-Assignment<Y>.pdf`, where `<TeamName>` is the name of your team and `<Y>` is the number of the assignment (i.e., either 1, 2, or 3).

IMPORTANT: The replication package must contain a readme file for allowing the instructor to replicate the experiment.

Intermediate assignments

As you may have noticed, we defined 3 assignments for your team project. Those assignments deal with specific increments of your team project work and their grading is cumulative. Each deliverable gets feedback on how to improve your experiment. More specifically:

- **Assignment 1**: you submit the project template with Sections 1, 2, and 3 completed. This part represents **20%** of the final grade of the team project.
- **Assignment 2**: by building on assignment 1, you will extend it with the detailed design of your experiment and experiment execution plan (Sections 4 and 5). This part represents **30%** of the final grade of the team project.
- **Assignment 3**: you complete your team project report by writing all the other sections of the provided Latex template. You provide also the experiment replication package. This part represents **50%** of the final grade of the team project.

Intermediate assignments are evaluated and will be part of the final assessment of the whole team project (assignment 3). Assignment 3 must be a coherent integration of the previous assignments. When working on assignments 2 and 3, the teams must address the feedback provided by the instructor in the preceding assignment. Hard copies of the assignments are not needed.

IMPORTANT: if you are working on assignments 2 or 3, mark in blue all the sections coming from the previous assignments that you changed for addressing instructor's feedback (you can use a Latex command for that). All the sections that have not been marked in blue will be considered as "unchanged".

[2] https://github.com/S2-group/android-runner
[3] https://github.com/S2-group/robot-runner
[4] https://github.com/S2-group/experiment-runner

Evaluation of the team project

In the following the grading rubrics used for evaluating the assignments are provided.

Assignment 1				
	Fail (< 5)	**Pass (~6-7)**	**Good (~7.5-8.5)**	**Excellent (>8.5)**
Introduction to the experiment	Description absent or very poor	Very basic description, no critical reasoning	Good description, with some additional elaboration.	Deep description and critical thinking, evaluation of alternatives, etc.
Related Work – Section 2 (description)	Description absent.	Very basic description.	Good description, the text flows well and the overall section is well structured.	Perfect description and flow of the text.
Related Work – Section 2 (quality)	Evident misjudgments of mentioned scientific articles	Fair (but not deep) reasoning on how the mentioned articles compare to the experiment being carried out.	Good reasoning on how the mentioned articles compare to the experiment being carried out.	Deep reasoning and critical thinking on how the mentioned articles compare to the experiment being carried out.
Related Work – Section 2 (completeness)	Partial, incomplete, clearly related papers are missing.	Few (e.g., 1-2) related papers are mentioned and described.	The main related papers are mentioned and described. Some notable related papers are missing.	The main related papers are mentioned and described. No notable related papers are missing.
Experiment definition – Section 2 (description)	Description absent.	Very basic description, no critical reasoning.	Good description, with some reasoning on the performed design decisions.	Deep description and critical thinking, evaluation of alternatives, etc.
Experiment definition – Section 2 (quality)	Evident errors, wrong usage of the GQM method.	Good usage of the GQM method, but it is very simple/basic, just enough for having a GQM model.	Good usage of the GQM method, no errors, fairly realistic reasoning.	Extremely precise GQM of the experiment, deep understanding and usage of the method.
Experiment definition – Section 2 (completeness)	Partial, incomplete GQM.	GQM usable for reasoning, but it clearly lacks some key elements of the experiment.	Complete GQM, represents everything needed for performing the experiment.	Perfectly complete GQM, surprisingly good in representing some specific aspects of the experiment.

Assignment 2				
	Fail (< 5)	**Pass (~6-7)**	**Good (~7.5-8.5)**	**Excellent (>8.5)**
Addressing feedback from assignment 1	Not done.	Very basic, just to pass to the next assignment.	Well addressed and well-reasoned updates.	Perfect.
Experiment planning – Section 3 (description)	Description absent.	Very basic description, no critical reasoning.	Good description, with some reasoning on the performed design decisions.	Deep description and critical thinking, evaluation of alternatives, etc.
Experiment planning – Section 3 (quality)	Evident errors, wrong definition of	Good contents, variables well defined,	Good usage of the discussed contents, no	Extremely precise experiment plan, deep

	variables, experiment design, statistical analysis plan.	and experiment design, but it is very simple/basic, just enough for completing the section.	errors, fairly realistic reasoning.	understanding and usage of the taught methods.
Experiment planning – Section 3 (completeness)	Partial, incomplete plan.	The experiment plan is usable for reasoning, but it clearly lacks some key elements of the experiment.	Complete plan, represents everything needed for performing the experiment.	Perfectly complete plan, surprisingly good in representing some specific aspects of the experiment.
Experiment execution – Section 4 (description)	Description absent.	Very basic description, no critical reasoning.	Good description, with some reasoning on the chosen tools and infrastructure.	Deep description and critical thinking, evaluation of alternatives, etc.
Experiment execution – Section 4 (quality)	Evident wrong choices, wrong setup of tools.	Simple setup, basic ideas about how to integrate the tools into the experiment execution infrastructure.	Good setup, nice ideas about how to integrate the tools into a working infrastructure.	Surprisingly good setup, very good ideas about how to integrate the tools into a working infrastructure.
Experiment execution – Section 4 (completeness)	Partial, incomplete setup.	Infrastructure usable, but there is something still missing.	Complete infrastructure, represents everything needed for performing the experiment.	Perfectly complete experimental infrastructure.

Final project (Deliverable 3)				
	Fail (< 5)	**Pass (~6-7)**	**Good (~7.5-8.5)**	**Excellent (>8.5)**
Addressing feedback from assignment 2	Not done.	Very basic, just to pass to the next assignment.	Well addressed and well-reasoned updates.	Perfect.
Results– Section 5 (description)	Description absent.	Very basic description, no critical reasoning.	Good description, with some reasoning on the performed decisions.	Deep description and critical thinking, etc.
Results– Section 5 (quality)	Evident errors, application of wrong statistical tests, etc..	Correct but very basic analysis.	Good analysis of results, well-done choices w.r.t. statistical tests.	Extremely good and elaborated analysis and presentation of results.
Results– Section 5 (completeness)	Partial, incomplete description of results (e.g., no normality checks, etc.).	Fairly complete, but something is still missing.	Complete and well done.	Surprisingly elaborate. Alternative statistical tests applied and compared.
Discussion – Section 6 (description)	Description absent.	Basic description, not really well-worded.	Good description.	Surprisingly well written.
Discussion – Section 6 (quality)	Wrong conclusions.	Very basic discussion, no critical reasoning.	Good discussion, with some reasoning on the obtained results	Very deep discussion and critical thinking.
Discussion – Section 6 (completeness)	Partial, incomplete discussion.	Ok, the main points are touched, but something is missing.	Complete discussion.	Well-elaborated discussion. Discussed also some points which were not discussed during

				the course.
Threats to validity – Section 7 (description)	Description absent. Not following the template by Cook and Campbell.	Very basic description, no critical reasoning.	Good description, with some reasoning on the chosen tools and infrastructure.	Deep description and critical thinking, evaluation of alternatives, etc.
Threats to validity – Section 7 (quality)	Evident wrong analysis of threats. Not following the template by Cook and Campbell.	Basic elaboration, but not really connected to the experiment.	Nice discussion of threats to validity.	Surprisingly good discussion of threats to validity.
Threats to validity – Section 7 (completeness)	Important threats are missing. Not following the template by Cook and Campbell.	Only the obvious threats to validity are discussed.	Complete discussion of threats to validity.	Surprisingly deep and well-thought discussion.
Replication package	Absent.	Partial, something is still missing.	Complete and well organized. Replicable experiment.	Surprisingly elaborate, smart solutions, experiment fully replicable.
YouTube video	**Pass** if the student presents a part of the experiment for at least 3 minutes in the YouTube video, **fail** otherwise. This part is mandatory, i.e., failing this part means failing the whole assignment.			

Fraud

Information exchange and collaboration are fully allowed within each single team, cases of plagiarism or inter-team collaboration and deliverable contents exchange will be reported to and managed by the official fraud committee. In case of fraud, the consequences of those acts may potentially lead to: formal warning, inclusion of the formal warning in your VU student file, suspension from giving exams for a given period, expulsion from the VU.