11. Project 2

Sustainable Software Engineering
CS4295

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1. Goal/assignment
2. Deliverables
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4. Ideas

Assignment

- **Goal:** Solve a Sustainable Software Engineering problem.
  - **Identify 1 problem** that should be fixed to help enabling sustainability in the software engineering industry/community.
  - **Propose a solution**. A tool, framework, guidlelines, etc.
  - **Implementation**.
  - **Validation**. (Depending on the idea) (side note: the cancelled class was all about this)
  - **Dissemination**/social impact. (Solution should be open source, welcome contributors, post on twitter, hacker news, reddit? Tool website?)

Deliverables

- Paper-like **article**. (Min 4 pages, max 10)
- Online **git repo** with open source codebase and/or replication package.
- **Presentation**: 7 min + 5min Q&A

Article

- If the project is more focused on **implementing a tool**, only a description of the motivating problem and the tool is sufficient (maybe a few screenshots, etc)
- If the project is more focused on **studying** a context and existing solutions (low implementation), the article will be the **main selling point** and needs more detail.
- (This will become clear once we discuss the project ideas)

Strategy

- No lectures
- Steering meetings from week 5 till week 8/9 (either online or in person).
  - At least one steering meeting 1 per week. (Min **3 sprints**)
- Every week, you need to plan different tasks and assignments.
- Deadline **April 5**.
  - **Grace period** till end of week (April 8).

Strategy

- Week 0 (today)
  - Decide project idea
  - Define and assign tasks for each week.
  - Define steering meeting schedule
- Week 1
  - Implement, implement
- Week 2
  - Implement, implement
- Week 3
  - Implement, Article, presentation, dissemination.

Project ideas

- Simple energy consumption tool for multiple environments (hardware, OS?)
- Green Procurement Requirements for Software Companies
- Static estimation of energy cost for sklearn ML models
- Add FLOPs to sklearn (or other cpu-/gpu-intensive libraries).
- Energy patterns for Green AI
- Carbon-aware job scheduler for *nix systems
- Carbon intensity plugin for browsers
- … you can also propose yours! (Social and individual sustainability also possible)

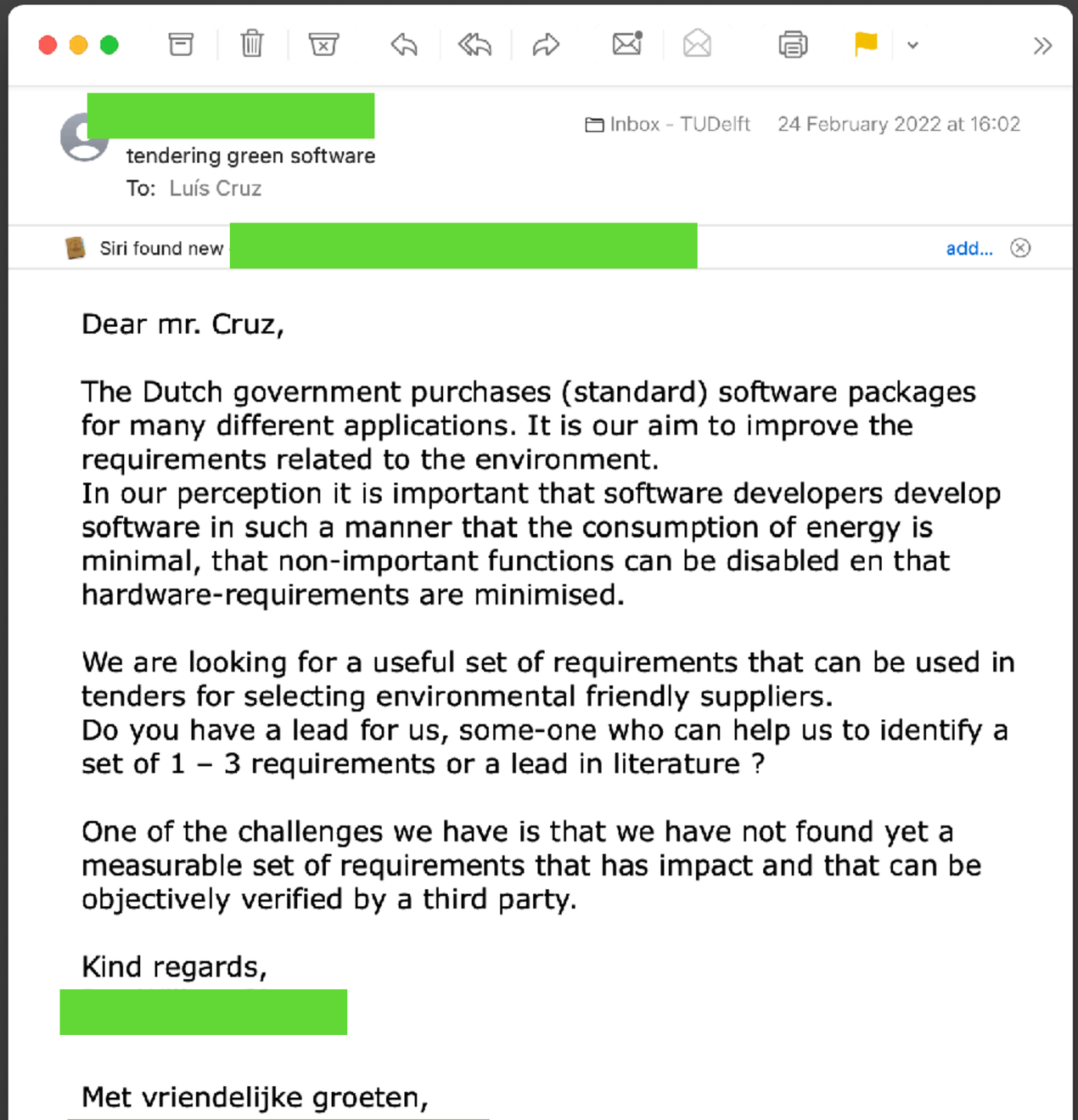
Simple energy consumption tool for multiple environments

- Bare minimum:
  --cmd flag
  --energy #returns energy consumption
  --power #returns average power
  --time #returns execution time
  --csv #returns a csv file with all power measurements and timestamps

- Work indentically across different environments.
  E.g.: 1) Linux, Windows, Mac, or 2) Intel, AMD, M1, or 3) only M1.

Green Procurement Requirements for Software Companies

- Create a framework that can be used to assess the degree of sustainability of software company and/or a software project.
- Focuses on organisational-level requirements (nut not only).
- What must be done at the organisational level to assure green software development?
  - And what can we ask **today** and what should we ask in the **future**? (One cannot require today's companies to perform energy tests in a market where no one does it).



[redacted]

Inbox - TUDelft 24 February 2022 at 16:02

tendering green software

To: Luís Cruz

Siri found new [redacted] add...

Dear mr. Cruz,

The Dutch government purchases (standard) software packages for many different applications. It is our aim to improve the requirements related to the environment.
In our perception it is important that software developers develop software in such a manner that the consumption of energy is minimal, that non-important functions can be disabled en that hardware-requirements are minimised.

We are looking for a useful set of requirements that can be used in tenders for selecting environmental friendly suppliers.
Do you have a lead for us, some-one who can help us to identify a set of 1 – 3 requirements or a lead in literature ?

One of the challenges we have is that we have not found yet a measurable set of requirements that has impact and that can be objectively verified by a third party.

Kind regards,

[redacted]

Met vriendelijke groeten,

Static estimation of energy cost for sklearn ML models

- (Or other software artefacts?.)
- Collect all sort of metrics from many ML models
- Study which metrics can be a proxy for energy consumption.
- Propose a model and define its boundaries (e.g., only works for a specific algorithm, or problem domain — NLP, computer vision, etc.).

Add FLOPs to sklearn

- (or other cpu-/gpu-intensive libraries)
- Study the most seamless way to report FLOPs in model training and maybe model inference?
- E.g., when training a model, you call the **fit** method. Perhaps FLOPS could automatically be stored.
- Apply it in existing ML projects as a use case.
- Check how to extract FLOPs wit python here: http://www.bnikolic.co.uk/blog/python/flops/2019/09/27/python-counting-events.html

Energy patterns for Green AI

- Replicate energy patterns for mobile apps
- Study existing efforts to improve energy efficiency in open source AI apps.
- Create an online catalog of common solutions to improve energy efficiency.

Carbon-aware job scheduler for *nix systems

- Simple CLI tool that takes into account carbon intensity.
- **1st iteration**
  - It receives as input a task, the expected time to execute and the maximum it takes to execute. The tool schedules the task to optimise carbon emissions.
  - Should retrieve data from electricity map (or other source).
  - Could also work offline?

Carbon intensity plugin

- Widget/Browser plug-in that shows an icon with details about the carbon intensity at each particular time.
- **2nd iteration**
  - Show s few “energy smells” in the web page (e.g., non-clean energy source, large/non-optimised images, etc.

Propose your idea

- Be quick! It should not take you longer than today.
- Feel free to propose something for social or individual sustainability.

Next first steps

- Schedule your recurrent **steering meeting**: https://calendly.com/luismcruz/sustainables

- Select the **topic**: https://docs.google.com/spreadsheets/d/16v4XoeUyc48wmvAbNcXazyJDm580BalirglCoAVsZ3Y/edit#gid=375532415
- (Links Shared on Mattermost)