# 12. Project 2

## Sustainable Software Engineering
## CS4295

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1. Goal/assignment
2. Deliverables
3. Strategy
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, reddit? Tool website? Available in a package manager?)

# 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

- Different projects will have different expectations -> Make agreements with your coach.
  - Some projects are more technical and some projects more theoretical.
- Common requirements:
  - **Motivation**, formulation of the **problem** being addressed, etc.
  - Description of the **solution**.
  - **Validation** of the solution (if applicable -> discuss with coach)
  - **Discussion** of the solution. (Including limitations)

# Strategy

- No lectures
- Steering meetings from week 5 till week 8/9 (either online or in person).
  - 1 steering meeting per week. (**3 sprints + grace period**)
- Every week, you need to plan different tasks and assignments.
- Deadline **March 31**.
  - It should include a list of things that need to be done during the grace period.
  - **Grace period** till **April 14**. (⚠️ Holidays in the middle)

# Strategy

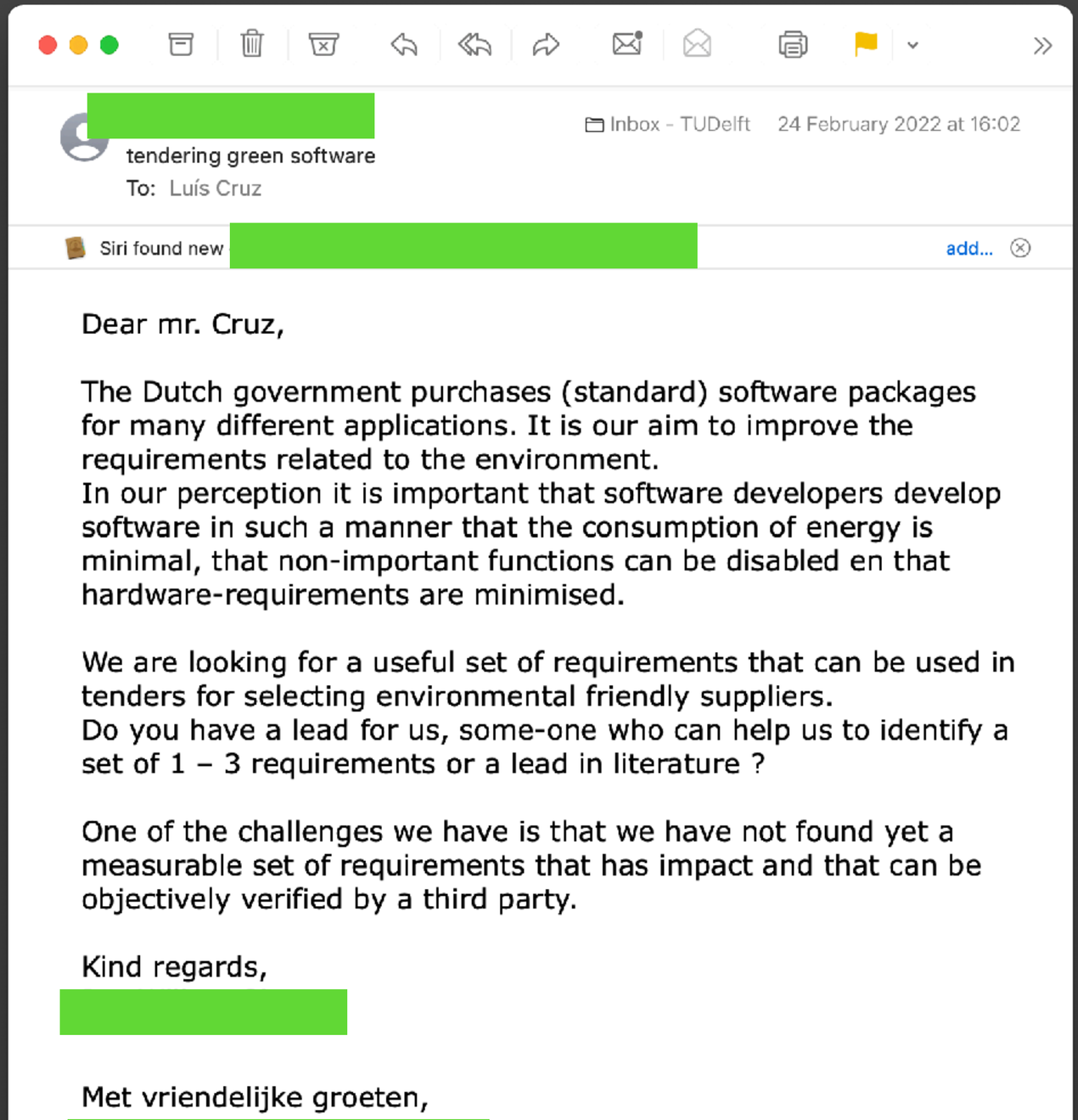
- Week 0 (today)
  - Decide project idea
  - Define and assign tasks for each week.
  - Define steering meeting schedule
- Week 1
  - Implement, implement
- Week 2
  - Implement, implement
- Week 3
  - Implement, Article, dissemination.

# Project ideas

- Green Procurement Requirements for Software Companies
- Static estimation of energy cost for sk-learn ML models
- Seamless measurements in sk-learn
- Energy patterns for Green AI
- Automate Approximate Computing
- Card deck/Game for Sustainable IT
- Web app for energy unit conversion/simplification
- Sustainability auditor for GitHub projects
- Energy Profiling of screen colour filter tools (or display settings)
- Energy Regression Testing
- Energy Profiling for IntelliJ (or other IDEs)
- … you can also propose yours! (Social and individual sustainability also possible)

# 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).



# 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.).

# Seamless measurements in sk-learn

- (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 with 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. (No need to analyse energy commits)
- Study existing efforts to improve energy efficiency in open source AI apps.
- Create an online catalog of common solutions to improve energy efficiency.

# Automate AxC

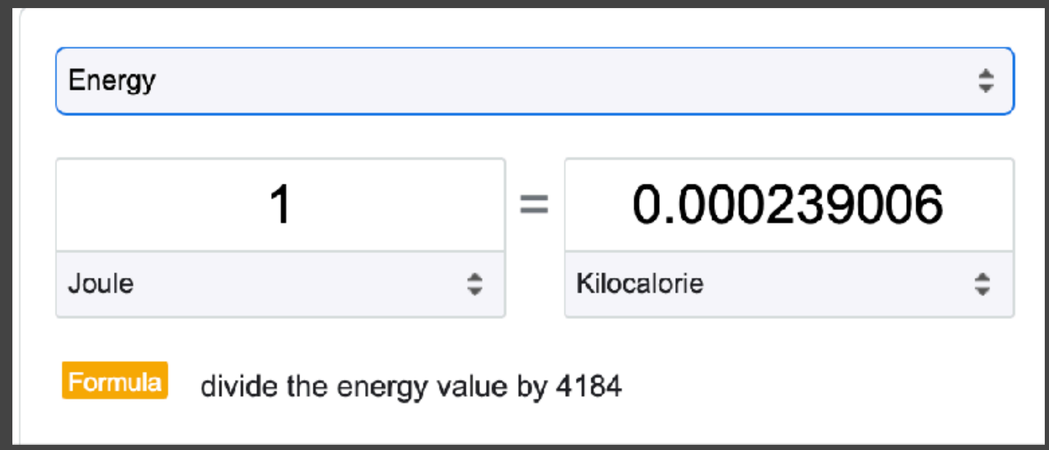
- Create a library to run Approximate Computing techniques
- Set of AxC techniques to define
- Tool to be made open source

# Card deck/Game for Sustainable IT

- Educational deck for Software Sustainability practices
- Purpose: use within software teams to discuss or learn about different sustainable IT practices: at the organisation level, software, etc.


# Web app for energy unit conversion/simplification

- Training ChatGPT emitted around 550 tonnes of CO2-eq. What's that?
- Watching a netflix video for 1hr spent 72kJ in my laptop. What's that?
- Be creative about conversions and the UI design.
- Explain conversions.



# Sustainability auditor for github projects

- Web tool that receives a GitHub link and reports a few checks on sustainability.
- E.g.:
  - Is there a code of conduct?
  - Language is inclusive
  - Any code changes mentioning energy efficiency?
  - Diversity of contributors
  - …

# Energy Profiling of screen colour filter tools (display seetings)

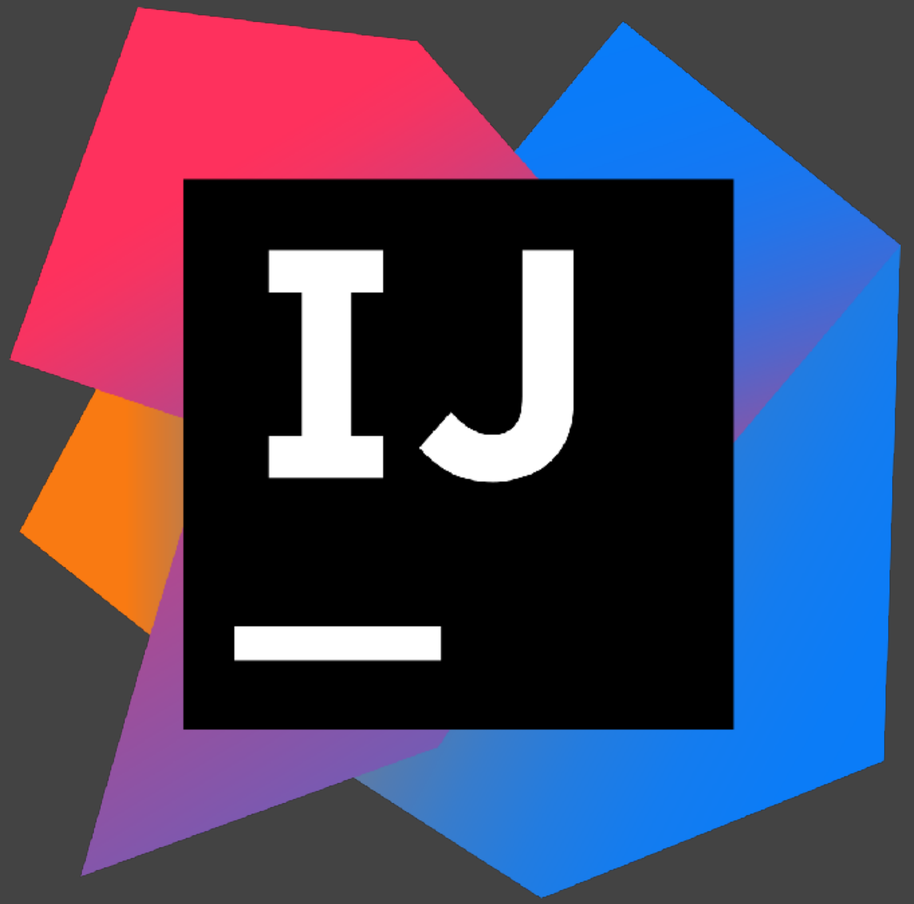
- Colour filters are used to have a better screen readability. There is a continuous adaptation of the colours according to the time.
- What about the energy efficiency of such settings? Is there a possible trade-off between readability and energy efficiency?
- The goal is to:
  - profile the energy consumption of such colour filters / display settings
  - Create a tool to make a trade-off with regard to energy consumption

# Energy Regression Testing

- Across different code changes, executing the same code will lead to different results. How can we detect a energy bug (a.k.a energy hotspot)?
- Create a tool that patches an existing testing framework (Junit) and does compares the energy of the same test across different versions -> significant increases should be reported.

# Energy Profiling for IntelliJ (or other IDEs)

- Intel RAPL for intelliJ?
- Other editors/IDEs also an option.
- (Already some projects out there but still far from ready to use)



# 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

- Select the **topic**: https://docs.google.com/spreadsheets/d/1Pyg077QGrvZFy5BIvEf-VYiP-w37xTO3CmaEmScPgxk/edit#gid=375532415
  - Ideally, **1 topic only has 1 group max**.
    - However, some topics can be **redefined** in distinct ways.
- Based on the topic, we will assign coaches (June or Luís)
  - Schedule a weekly meeting with your coach.

# Course Feedback Form

- https://forms.gle/rKapDGXMWNCp41bx5