

Problem Statement and Goals

Software Engineering

Team 6, EcoOptimizers

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Table 1: Revision History

Date	Developer(s)	Change
Date1	Name(s)	Description of changes
Date2	Name(s)	Description of changes
...

1 Problem Statement

[You should check your problem statement with the problem statement checklist. —SS]

[You can change the section headings, as long as you include the required information. —SS]

1.1 Problem

1.2 Inputs and Outputs

[Characterize the problem in terms of “high level” inputs and outputs. Use abstraction so that you can avoid details. —SS]

Inputs: Source code that requires refactoring for energy efficiency. **Outputs:** Refactored code with reduced energy consumption, along with performance and energy consumption reports.

1.3 Stakeholders

Direct Stakeholders

[**Software Developers**]: They will be the primary users of the refactoring library as they will be the ones to integrate the library into their code for better refactoring.

[**Dr. Istvan David (Supervisor)**]: Dr. David has a vested interest in the development of the system. He will play a crucial role in guiding and mentoring our team throughout the project. As the project supervisor, he will be the key advisor, offering feedback on technical aspects, project management, and research methodologies.

[**Business Sustainability Teams**]: These teams are responsible for considering how a company's practices affect the environment. They will especially be interested in viewing the metrics provided by the library on how it improves the energy efficiency of software over time, therefore decreasing the burden on hardware and minimizing the company's environmental footprint.

Indirect Stakeholders

[**Business Leaders**]: They focus on reducing operational costs associated with energy consumption, especially in large-scale or cloud-hosted applications. Use of the library in their products allows them to better achieve those goals.

[**End Users**]: While not directly affected by this refactoring library, end users of technology that use the library will benefit from more responsive and efficient software that consumes less power, especially in mobile, embedded, or battery-dependent applications.

[**Regulatory Bodies**]: They enforce energy consumption and sustainability standards, and ensure that software adheres to environmental regulations and may certify tools that meet efficiency requirements. Their oversight promotes the adoption of energy-efficient software practices.

1.4 Environment

Programming Language: Python will be the main language for developing refactoring tools and performing energy optimization. **Reinforcement Learning Library:** Stable Baselines will be the library to implement reinforcement learning techniques. **Development Frameworks and Tools:**

1. Github will be used for version control and for CI/CD integration to automate refactoring processes.
2. Visual Studio Code will be the IDE used.

Database: MySQL will be the database used to store and retrieve data about refactoring and energy consumption metrics.

[\[Hardware and software environment —SS\]](#)

2 Goals

3 Stretch Goals

4 Challenge Level and Extras

The expected challenge level of our project is general. This is due to the relatively straightforward technical knowledge required for its completion. The project primarily involves applying known software optimization and refactoring techniques, which are well-documented and accessible. Additionally, the required programming knowledge is in Python which is known by all of the team members and was taught in our undergraduate courses. Although the project does involve substantial development and research components, we anticipate the overall scope and depth of work to be manageable within the given timeframe.

To further enhance the project and address any potential gaps in the challenge level, we propose two additional activities: User Documentation and Usability Testing. These extras will allow us to provide support for future users of the tool and ensure that the tool meets user expectations and accessibility standards.

Approval of the challenge level and extras will be discussed with the instructor, and adjustments may be made as needed throughout the term.

Appendix — Reflection

[Not required for CAS 741 —SS]

The purpose of reflection questions is to give you a chance to assess your own learning and that of your group as a whole, and to find ways to improve in the future. Reflection is an important part of the learning process. Reflection is also an essential component of a successful software development process.

Reflections are most interesting and useful when they're honest, even if the stories they tell are imperfect. You will be marked based on your depth of thought and analysis, and not based on the content of the reflections themselves. Thus, for full marks we encourage you to answer openly and honestly and to avoid simply writing "what you think the evaluator wants to hear."

Please answer the following questions. Some questions can be answered on the team level, but where appropriate, each team member should write their own response:

Ayushi Amin Reflection

1. *What went well while writing this deliverable?*

Writing the deliverable went quite well overall. The project itself was well defined and we were able to meet with the industry supervisor which helped clarify most of the details. Our team worked well together which helped each member to clarify any concerns particularly about the database we decided to use. Our team had some good discussions regarding making decisions on what languages and tools to use in the project such as our decision to use MySQL for our database.

2. *What pain points did you experience during this deliverable, and how did you resolve them?*

Not all the information was clarified or given by the supervisor at an early stage so writing this document took some time which caused us to delay working on this for a couple days. The team and I decided to consistently check in with the supervisor to encourage him to provide the required documents and information we needed as soon as possible. We used email as well as discord to directly reach out to the supervisor in which we finally ended up getting the information 2 days before the deadline and then crammed to finish the milestone documents.

Sevhena Walker Reflection

1. *What went well while writing this deliverable?*

Right off the bat, I want to say that this deliverable was characterized by a great sense of *discovery*. I learnt more about my team members and what their goals are. I learnt more about the project we had chosen and our supervisor's reasoning behind proposing it. I learnt new information on topics that were novel to me. This deliverable has filled me with a sense

of excitement and a budding confidence that I hope will only continue to grow.

There is much to learn about the project my team has chosen. Being able to go through the process of breaking it down and identifying what technologies will be used, and what features our system will have makes our project more concrete. Compared to the start of the project when things seem more vague and daunting, there remains a sense that we will achieve what we have set out to do.

2. *What pain points did you experience during this deliverable, and how did you resolve them?*

Of course, not everything is just sunshine and roses. Having to deconstruct a project with concepts that you are only vaguely familiar with can be an overwhelming task. While we were able to seek guidance from our supervisor, the onus was still on us to slowly unravel this new mass of information and piece it together in a coherent and structured manner. Our supervisor has been out of country and in a different time zone which has led to a gap in discourse. There were times when our team was left scratching our heads trying to figure out what the best way or, at the very least, what would be a *suitable* way to plan out our project.

Full Name Reflection

1. *What went well while writing this deliverable?*
2. *What pain points did you experience during this deliverable, and how did you resolve them?*
3. *How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?*

Group Answers Reflection

1. *How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?*

We carefully adjusted our project scope by focusing on the most important goals and prioritizing features that mattered most, while also setting clear milestones to keep us on track. The feedback we got from our supervisor helped us refine our goals, making sure we were ambitious but also realistic about what we could achieve.